A Game of Urban Resilience:

Playing the Social-Ecological System of a Rapidly Developing Caledon, Ontario, Canada

by
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presented to the University of Waterloo
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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis including any required final revisions as accepted by my examiners.

I understand that this thesis may be made electronically available to the public.

Abstract

Considerable land in the Town of Caledon, located in Ontario, Canada, is protected by the Greenbelt including sections of the Niagara Escarpment and the Oak Ridges Moraine. Caledon is also subject to an expected rapid population increase, which is at the expense of cultural landscapes and ecosystem functions. As a rural town with agricultural industries and conservation authorities, provincial urban development pressures present Caledon as a case study for engaging with complex and interconnected social, ecological, and planning problems. Through the design of a serious game as a tool for community education and engagement in urban planning, this thesis investigates the relationship between sprawling urban form, ecological illiteracy, and the growing acceptance of environmental degradation.

A board game modelled on Caledon's social-ecological systems, titled *Paving Paradise*, has been developed to generate dialogue and address the central conflict of urban sprawl, and positions social-ecological urbanism (SEU) frameworks as a solution. SEU is a method of urbanization that applies concepts of systems resilience against urban design, where social-ecological systems are maintained and supported through social institutions and built environments to enhance a city's resiliency. *Paving Paradise* functions as a speculative planning model, where urban form is influenced by top-down policy, but transformed by community resilience, adaptation, and ecological stewardship. Designed for community members, the game assigns players distinct roles and asks them to balance individual objectives with collective success to build a socially and ecologically resilient Caledon. Through play, participants engage in dialogue that fosters empathy and encourages new perspectives on the many dimensions of resilient urban growth.

Games can serve as a medium to communicate and link complex ideas in accessible ways, giving agency to individuals not specifically trained in various aspects that impact their community. The designed game leverages the educational and engaging properties of game mechanics, acting as a method to communicate social-ecological systems while simultaneously fostering discussion, negotiation, and collaboration. Within this research, mapping is used to synthesize and extract Caledon's existing social-ecological conditions, and SEU design proposals are illustrated and applied to a neighbourhood in Caledon to show improved human-nature connections, ultimately forming the narrative and logistical foundation of the game. The game's core mechanics are adapted from an existing tile-laying board game centered on territorial expansion, but they are further informed by game theory and refined through multiple rounds of playtesting and participant interviews. *Paving Paradise* creates conditions for players to imagine and collaborate on a shared landscape, becoming an effective tool for collective learning and social mobilization.

Paving Paradise does not aim to provide solutions or design guidelines. Rather, it simplifies complex and interlinked ideas of policy, urban form, and social-ecological systems to offer a platform for engaging willing participants, in and out of Caledon, on creating and nurturing a resilient urban environment.

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Introduction

Start Game!

Built-up area

Greenbelt

Niagara Escarpment

Oak Ridges Moraine

Figure 0.1

Built-up areas and the Greenbelt in Caledon.

0.0 Start Game!

As the world continues to change and evolve at the hand of human innovation and development, pressures on the land increase while cities take shape, revealing the interconnected relationship between social and ecological services. Social-ecological services are the benefits produced through the interactions within social-ecological systems, which include ecological functions that sustain life as well as the social and institutional processes that govern how these benefits are generated, distributed, and maintained.[1] There are many avenues for exploring the interdependent relationship between social-ecological systems and their services in the built environment. Using the Town of Caledon, Ontario, Canada as a case study, this thesis explores declining environmental memory and ecological literacy as a reason for the growing acceptance of environmental degradation and proposes the use of serious games in urban planning for community participation and learning as a solution. A board game is developed based on Caledon's social-ecological systems and is intended for general audiences to generate discourse on urban development within their community.

The game, named *Paving Paradise*, is a competitive game that follows a tile-laying structure in which players must collaboratively construct the physical board, resulting in a unique landscape with each round of play. Players take on distinct roles and must navigate between individual objectives and collective social-ecological resilience in order to win. *Paving Paradise* realizes itself as a speculative urban form where the design of cities is not influenced solely by top-down actors, but is gradually formed through shared community knowledge, purpose, culture, and environmental justice. The central research questions are:

- How has policy influenced urban sustainability and pro-conservation behaviour in Caledon?
- What urban design strategies can strengthen human-nature connection and Caledon's social-ecological resilience?
- Can the adaptation of an existing game centered on territorial expansion serve as an effective tool for public engagement with resilient urban growth within a shared landscape?

1 Elinor Ostrom, "A General Framework for Analyzing Sustainability of Social-Ecological Systems," *Science* 325, no. 5939 (2009): 419, https://doi.org/10.1126/science.1172133; Carl Folke et al., "Adaptive Governance of Social-Ecological Systems," *Annual Review of Environment and Resources* 30, no. Volume 30, 2005 (2005): 443, https://doi.org/10.1146/annurev.energy.30.050504.144511.



Figure 0.2

Water and rock formation in Forks of the Credit Provincial Park.

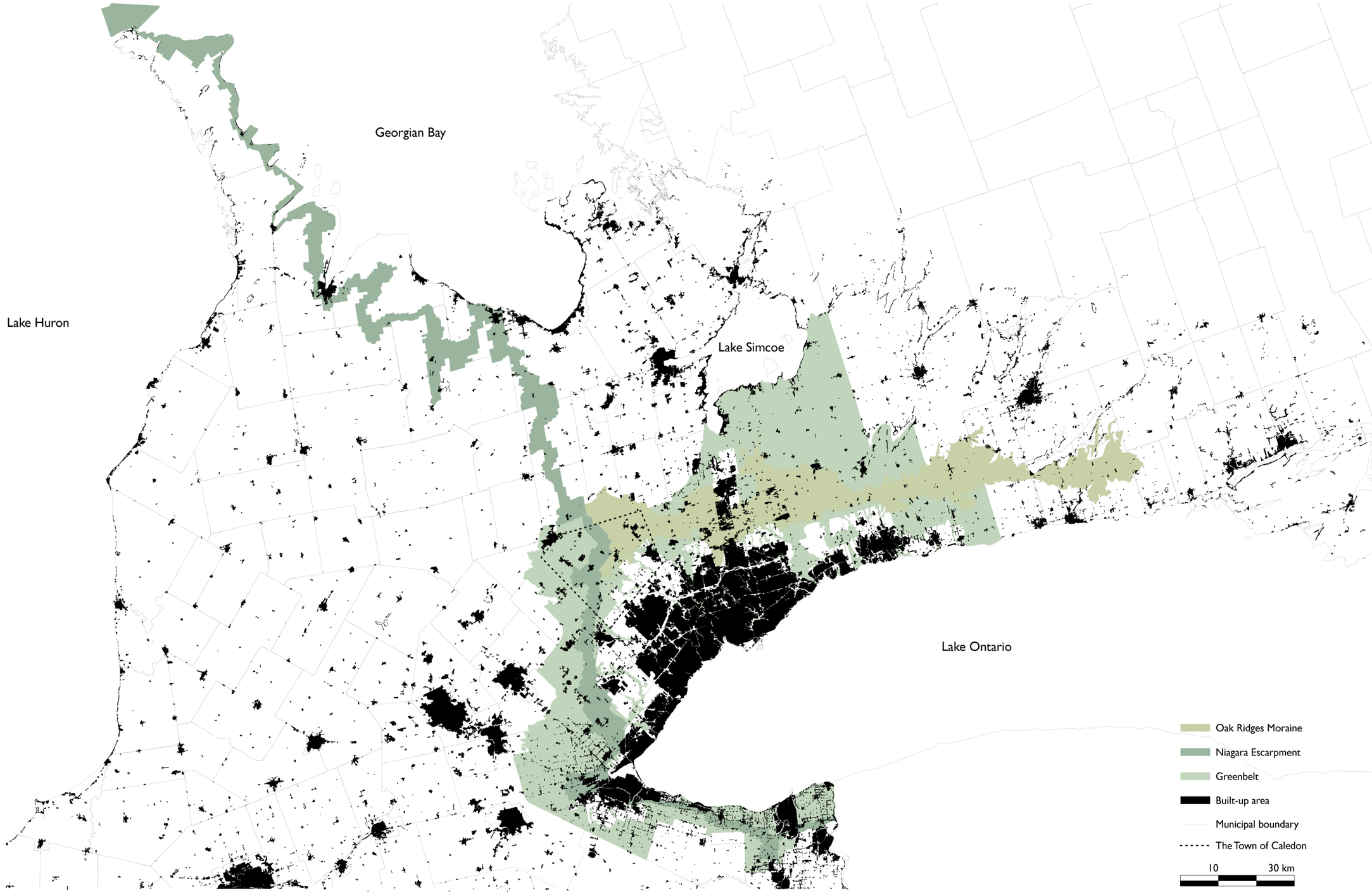


Figure 0.3

Context map of the Greenbelt in Ontario.

While cities are integral to creating social networks, growing and applying knowledge, and forming foundational structures of society, cities are often built on, and at the expense of, biodiverse and cultural landscapes.[2] To illustrate, a community's economic reliance on aggregate mining may lead to the conversion of critical ecosystems into quarries (social), resulting in polluted watersheds and biodiversity loss (ecological). A method of urbanization that respects local ecosystems must be developed to minimize negative ecological change. Functioning ecosystems are not only vital to the health of the environment, but also those who inhabit the land, and the development initiatives that ensure the production of energy crops and raw materials necessary for industry and manufacturing.[3] Understanding the importance of sustainable urbanization in protecting ecosystems, researchers have begun exploring the application of system resilience against interlinked social and ecological systems and urban development, in other words, social-ecological urbanism (SEU).[4] The following introduction sections will provide a high-level overview of social-ecological urbanism, define games and their functions within this thesis, and contextualize Caledon as an ideal speculative site for applications of social-ecological urbanism research. Furthermore, the specific interest in developing a board game to address the thesis questions will be discussed. Finally, the research methodologies and objectives are outlined, followed by a summary of the remaining chapters of this thesis.

2 Stephan Barthel et al., "History and Local Management of a Biodiversity-Rich, Urban Cultural Landscape," *Ecology and Society* 10, no. 2 (2005): 16, https://www.jstor.org/stable/26267721.

3 Stephan Barthel et al., "Principles of Social-Ecological Urbanism - Case Study: Albano Campus, Stockholm," *ResearchGate*, 11, accessed March 17, 2025, https://www.researchgate.net/publication/261031967_Principles_of_Social-Ecological_Urbanism_-_Case_Study_Albano_Campus_Stockholm.

4 Johan Colding et al., "Frontiers in Social–Ecological Urbanism," *Land* 11, no. 6 (2022): 3, https://doi.org/10.3390/land11060929.

0.1 Intersection of Social-Ecological Urbanism, the Town of Caledon, and Serious Games

The term "environmental generational amnesia" was used by Peter Kahn to describe how environmental perceptions are formed by childhood experiences rather than factual standards.[5] As a result of the world urbanizing further with each generation, people's understanding of the "normal" state of the environment become increasingly degraded as the climate continues to change. Unaware of the full extent of environmental destruction, mental and physical health suffers as people lose positive personal affiliations with nature and accept pollution, flooding, and drought as a normal environmental standard.[6] With fewer opportunities for meaningful experiences with healthy environments in dense cities, generations become increasingly ecologically illiterate and less pro-conservation oriented.[7] This creates a negative feedback loop where limited access to natural spaces weakens human-nature connection, normalizes environmental degradation, perpetuates urban density and material extraction, which further reduces access to nature [Figure 0.4]. However, exposure to nature alone does not guarantee pro-conservation behaviour, a combination of

5 Peter H. Kahn Jr., "Children's Affiliations with Nature: Structure, Development, and the Problem of Environmental Generational Amnesia," in *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (MIT Press, 2002), 113.

6 Kahn Jr., "Children's Affiliations with Nature," 113.

7 Colding et al., "Frontiers in Social–Ecological Urbanism," 13.

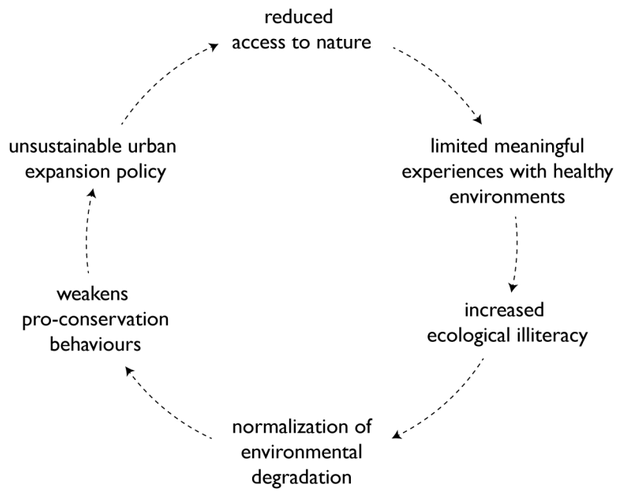


Figure 0.4

Environmental generational amnesia negative feedback loop.

both emotional connection and knowledge about nature is necessary to motivate action and make environmental issues personally meaningful.[8]

SEU has gained momentum in scholarly discourse as an approach to urban development that recognizes ecosystems as cultural landscapes that must be supported and maintained by social institutions and the physical built form.[9] The concept first entered scholarly discourse with the publication of *Principles for Social Ecological Urbanism* by Stephan Barthel et al. in 2013, and was further developed by scholars including Johan Colding and Lars Marcus, who positioned it at the intersection of urban ecology and urban design, emphasizing the resilience of interlinked social and ecological urban systems.[10] The Town of Caledon is the selected site for social-ecological analysis and the designed game due to its ecological significance and anticipated rapid population increase. Caledon is a municipality within the Region of Peel in Southern Ontario that overlaps sections of the provincially protected Greenbelt, Oak Ridges Moraine, and Niagara Escarpment. As a result, the municipality has remained considerably rural compared to its regional neighbours. However in July 2024, Caledon became responsible for implementing the *Region of Peel Official Plan* which includes residential and employment growth plans over the next 30 years.[11] Caledon's interpretation of the regional plan will convert over 4000 hectares of prime agricultural land into new urban areas along the new provincial Highway 413.[12] As Caledon's urban form is being shaped by a wide variety of conflicting interests and stakeholder agendas with minimal regard for local cultures and ecologies, emphasis must be placed on the future resiliency of the municipality. Caledon is at risk of sprawl-oriented urban development that will harm the natural environment and overwhelm its social services. Driven by top-down forces, a degree of separation is forming between the city and its residents, as development plans do not align with the municipality's cultural heritage and ecological significance.

8 Tanja M. Straka et al., "From Nature Experience to Pro-Conservation Action: How Generational Amnesia and Declining Nature-Relatedness Shape Behaviour Intentions of Adolescents and Adults," *Ambio* 54, no. 7 (2025): 1166, https://doi.org/10.1007/s13280-025-02135-7.

9 Barthel et al., "Principles of Social-Ecological Urbanism - Case Study," 13.

10 Meta Berghauser Pont et al., "Editorial: Social-Ecological Urbanism: Developing Discourse, Institutions and Urban Form for the Design of Resilient Social-Ecological Systems in Cities," *Frontiers in Built Environment* 8 (August 2022): 1, https://doi.org/10.3389/fbuil.2022.982681.

11 "Official Plan," Town of Caledon, March 20, 2025, https://www.caledon.ca/en/town-services/official-plan.aspx.

12 "Future Caledon: Our Official Plan," Town of Caledon Have Your Say, accessed September 26, 2025, https://haveyoursaycaledon.ca/official-plan-review.

In participatory planning, a method to engage and educate the community includes serious games, which are defined as games designed with a purpose beyond fun and pure entertainment. While still enjoyable to play, serious games employ conventional game mechanics to communicate complex interdisciplinary knowledge and facilitate "serious" objectives such as research, teaching, or training in an accessible manner for players to engage with. Games can simulate alternate realities by translating real-world challenges, like climate change, into what-if scenarios to generate discussions and new ways of thinking.[13] Social-ecological resilience requires a systemic understanding of spatial interconnections, cross-generational ecological stewardship, and most critical to this thesis, a balance between top-down and bottom-up actors, as healthy social-ecological relationships depend on local community involvement.[14] However, restructuring governance to combine top-down and bottom-up actors is beyond the scope of this research. Instead, a serious game is developed for this thesis to engage and educate players on Caledon's social-ecological systems, create a platform for participation, open dialogue on environmentally sustainable urban landscapes, and encourage pro-conservation behaviours.

The designed game, named *Paving Paradise*, aims to address recent urban development policies that will further environmental degradation and methods to protect social-ecological services and human-nature connection in the Town of Caledon. The game frames sprawling development as the primary threat to the city's resilience, and street networks as opportunities for nature experiences and urban greening as the main objectives. While the game is grounded in real-world possibilities, it does not simulate reality perfectly, rather, it highlights how individual efforts are often constrained by power structures. *Paving Paradise* seeks to reveal both the consequences of unchecked sprawl and the importance of collective resilience in shaping healthier communities.

13 Ekim Tan, "Play the City: Dungeons and Dragons for Cities," in *Architectonics of Game Spaces* (2019), 268, https://doi.org/10.1515/9783839448021-018.

14 Lars Marcus et al., "Cognitive Affordances in Sustainable Urbanism: Contributions of Space Syntax and Spatial Cognition," *Journal of Urban Design* 21, no. 4 (2016): 440, https://doi.org/10.1080/13574809.2016.1184565.

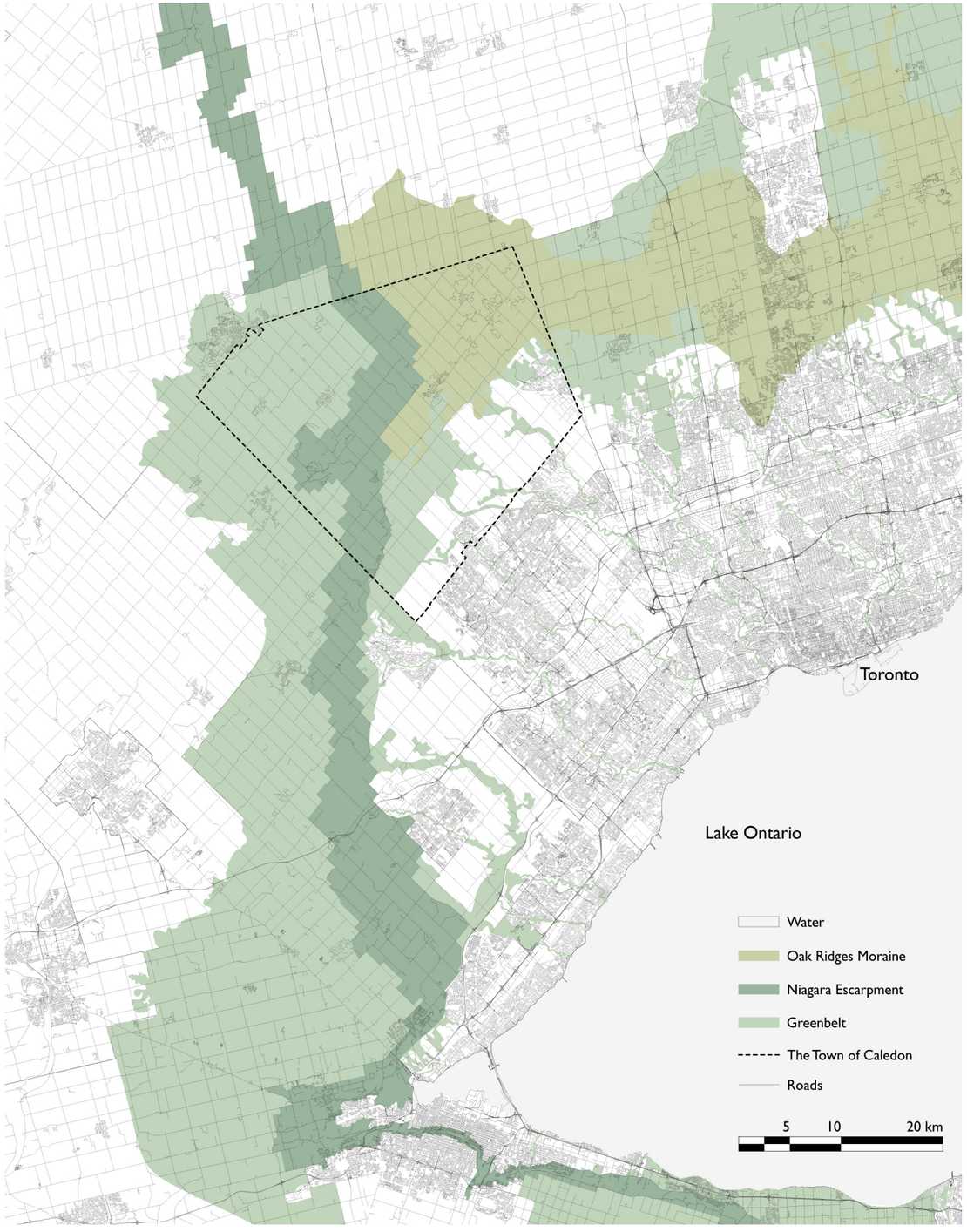


Figure 0.5
(on facing page)

Context map of Caledon in the Greater Toronto Area.

0.2 Methodology

The methodological approaches adopted to answer the questions within this research include mapping, urban design proposals, game theory analysis, game design, playtesting, and interviews.

As a broad use of the term, mapping within this research encompasses the processes by which data, analyses, and social-ecological conditions of Caledon are synthesized to determine and extract information for the design of the game. The mapped information is primarily gathered from open data sources, official planning documents provided by the municipality, literature, and articles concerning Caledon's social-ecological aspects, as well as literature describing contemporary SEU frameworks or recommendations. Visually throughout this thesis, mapping is represented in different formats to best serve the information presented, including multi-scalar maps of geographical area depicting land use, adjacencies, and contexts; a graphic chronological timeline highlighting historical events and future trajectory; visualizations of existing SEU frameworks implemented as speculative design proposals within Caledon; and charts and diagrams mapping key actors, attributes, typologies, stakeholders, and their relationships, in the context of Caledon's urbanization. The results of the mapping analyses become the thematic and logistical mechanics of the designed game.

Following the collection of foundational research for the game's narrative through mapping and design proposals, four iterations of the game are created. *Paving Paradise* uses the tile-laying format from the board game *Carcassonne*, where players must expand and develop their territory, and reinterprets the game mechanic as a method to translate urban growth and resilience. Game mechanics from *Monopoly*, *Ticket to Ride*, and *Pandemic* are also analysed and incorporated to further support the design of the game and its central themes. Additionally, the designed game is derived from and compared to literature concerning game design theory, specifically participatory planning, serious games, and popular household games, for their engaging, educational, and entertaining qualities. Changes to each iteration are informed by an analysis of the successes and failures of the previous iteration. Successes and failures are determined through rigorous playtesting to ensure the game is playable and meets playtesting objectives outlined in the Playtest Guide on page 197 of the Appendix. The documentation and analysis of the playtests are exclusively used for the thematic and mechanical operations of designing the game. With the fourth and final iteration of *Paving Paradise*, participants play through the game and form a focus group to discuss their experience while playing. The focus group's responses are described and analyzed in Section 3.3 of Chapter Three and the conclusion of the thesis.



Figure 0.6

Section of the Caledon Trailway in Inglewood.

0.3 Thesis Structure

This book is organized into three distinct parts: Chapter One: *Growing Threats*, Chapter Two: *Ways of Winning*, and Chapter Three: *Playing the Game*.

Chapter One: *Growing Threats*

The first chapter defines the problem of urban sprawl threatening Caledon's unique social and ecological landscape, positioning the town as a prime case study for the implementation of SEU frameworks. Through mapping as the primary methodology, a comprehensive analysis of the existing site conditions and the forces driving development is outlined. This chapter establishes the foundation for the game's external threat, highlighting key concepts that the physical game board and rounds of play must respond to.

Chapter Two: *Ways of Winning*

The second chapter explores street network and urban greening design strategies to enhance Caledon's social-ecological resiliency. Through applying existing SEU research and frameworks into urban design proposals, an analysis of social-ecological relationships on a neighbourhood scale will be visualized. The proposals will be used to illustrate how ecologically resilient design interventions can be integrated to improve human-nature connection, promote community well-being, and increase local biodiversity. The research conducted in this chapter aims to minimize the environmental impacts of urbanization. It establishes the main objectives within the game and outlines the thematic concepts and game mechanics necessary to support the thesis topic.

Chapter Three: *Playing the Game*

The third and final chapter begins with an analysis of existing game design literature, followed by the process of designing the physical board game. Building on the research conducted in Chapters One and Two, the narrative and logistical aspects of *Paving Paradise* are developed and iterated upon. This chapter further describes the translation and abstraction of SEU research into game mechanics, as well as how proposed SEU frameworks are integrated into the game's structure. The iterations will evolve based on four rounds of playtesting with participants, culminating with documentation of the final iteration, participant focus group interview questions and answers, and a final analysis and discussion of the game design in relation to the research questions. This chapter concludes by proposing *Paving Paradise* as a serious game to encourage public engagement and collective learning about sustainable urban landscapes, particularly in terms of how policy influences urban resilience and how design strategies can strengthen human-nature connections.

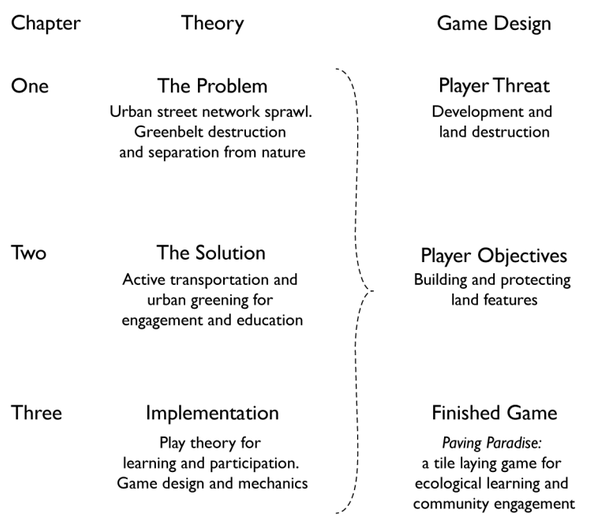


Figure 0.7

Overall thesis chapter organization.



Chapter One

Growing Threats

Roads

Figure 1.1

Road networks in Caledon.

1.0 Growing Threats

The Town of Caledon is situated on land part of the Treaty Lands and Territory of the Mississaugas of the Credit First Nation, the Huron-Wendat, Haudenosaunee Peoples, and the Anishnabek of the Williams Treaties. The Town was home to Indigenous peoples for millennia until 1818, when the Ajetance Purchase agreement, or Treaty 19, surrendered the area to the British Crown, and was divided into the townships of Albion, Caledon, and Chinguacousy. Agricultural practices dominated and influenced the development of mill towns along watercourses, including the Credit River and Humber River watersheds. Following the construction of three railways in the late 1800s, the towns began to grow. Caledon was later incorporated as a city in 1974 with the amalgamation of Bolton Village, Caledon East Village, Albion Township, Caledon Township, and the north half of Chinguacousy.

In the present day, almost 80% of Caledon is comprised of the Greenbelt and sections of the Niagara Escarpment and Oak Ridges Moraine. Spanning over 2 million acres, Ontario's Greenbelt is the largest in the world and was established in 2005 to protect farmland and natural heritage, limit urban sprawl, and safeguard vital resources that enhance quality of life. Within the Greenbelt, the Niagara Escarpment and Oak Ridges Moraine are among the most biologically rich landscapes in the country, replenishing groundwater, providing habitats for species at risk, and containing the highest quality agricultural soils. The Greenbelt Act has reduced development initiatives, thereby maintaining Caledon's identity as a region of vast natural forests, rivers, and lakes. However, recent changes to provincial growth policies, amendments to conservation acts, and accelerated environmental assessments pose a threat to these biodiverse and rural landscapes. With land largely comprising ecologically significant areas, provincial urban development plans place Caledon in an extreme and complex challenge.

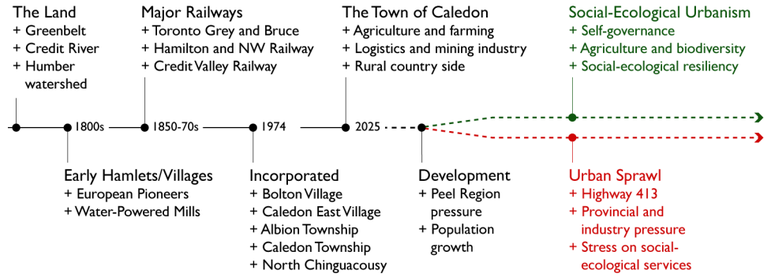


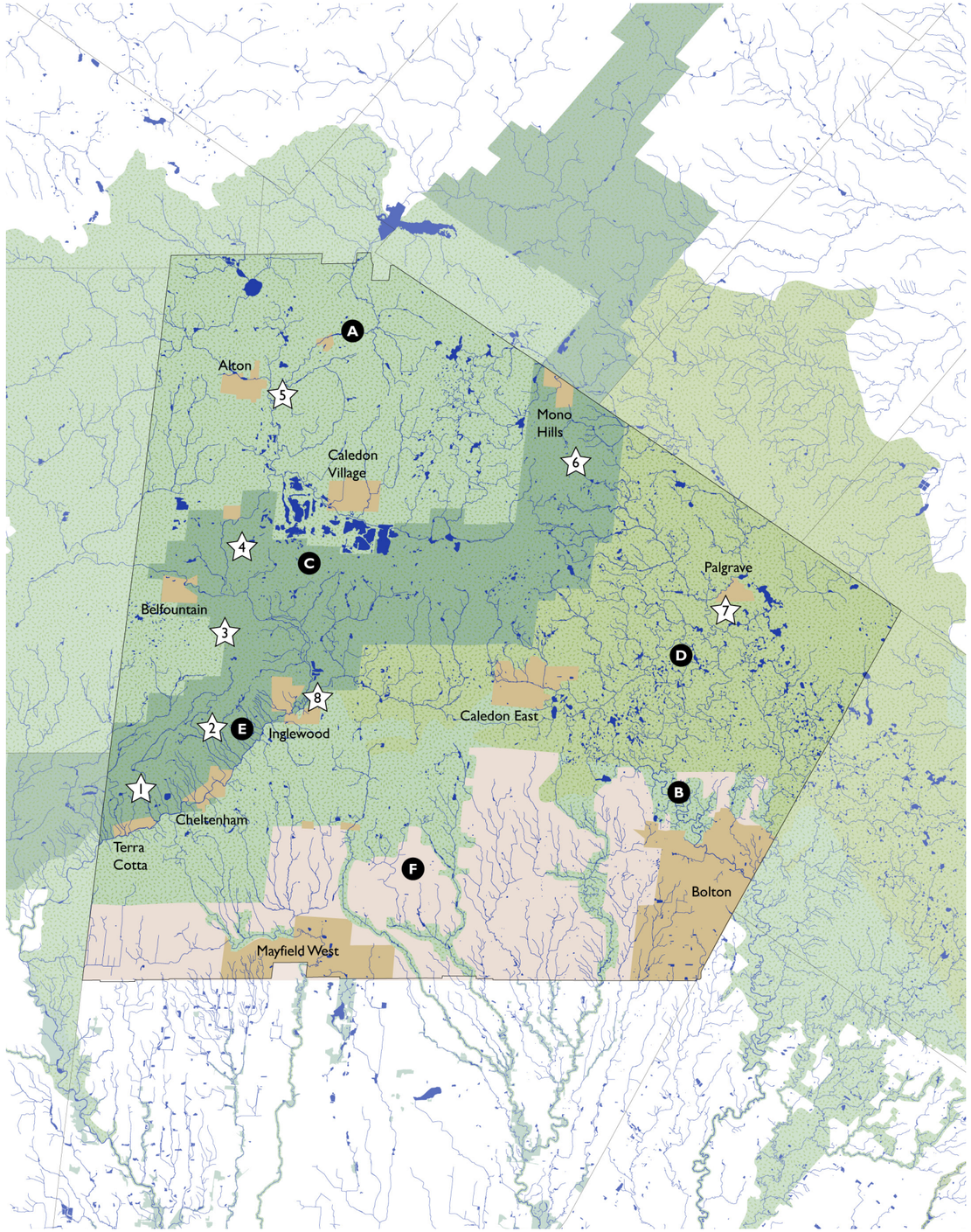
Figure 1.2

Development of the Town of Caledon timeline.



Figure 1.3

Section of the Credit River in Inglewood.



1 Terra Cotta Conservation Area

2 Cheltenham Badlands

3 Belfountain Conservation Area

4 Forks of the Credit Provincial Park

5 Upper Credit Conservation Area

6 Glen Haffy Conservation Area

7 Albion Hills Conservation Area

8 Ken Whillans Conservation Area

A Credit River

B Humber Watershed

C Limestone & Dolomite

D Critical Wetlands

E Queenston Shale

F Soil Class 1-3
Canadian Land Inventory soil classification as high potential for crop production

Greenbelt

Niagara Escarpment

Oak Ridges Moraine

Water

Prime Agricultural Land

Village / Hamlet / Rural

Municipal Boundary

2.5 5 10 km

Figure 1.4

Caledon land designations and significant ecological areas and features.

Caledon's future resiliency depends on planning policies that protect natural systems and strengthen environmental awareness. In an increasingly urbanized world, Peter Kahn's theory of environmental generational amnesia posits that each new generation will accept progressively degraded natural environments as the norm.[15] If urban expansion continues at the expense of natural landscapes, diminishing opportunities for human-nature interaction will contribute to a growing disconnect from nature and perpetuate a trend of ecological illiteracy.[16] Communities like Caledon, where residents have enjoyed close proximity to nature, demonstrate that sustained exposure fosters stronger environmental awareness and a greater willingness to protect it.[17] The direct access to ecological services from farming, abundant wildlife, and vast natural forests shape the environmental memory of the residents. For example, their collective memory is highlighted by the residents and The Forks of the Credit Preservation group, who have, and continue to, protest environmental issues on the destruction of the protected Greenbelt and farmland from Highway 413 and urban sprawl. Caledon's heritage is rooted in a strong relationship between people and the natural environment, from early operations that employed local clay for brickmaking and stone from the escarpment for construction to water powered mills and fertile soils for farming.[18] Through its industries relying on natural ecologies, Caledon has and continues to nurture a long-standing connection between the land and its inhabitants, emphasizing the importance of preserving biodiversity and protecting human–nature connections.

As Caledon faces development pressures that risk compromising environmental conservation, a self-reinforcing cycle is initiated: reduced conservation policies in favour of development result in diminished access to nature, lowered ecological literacy and public support for sustainable planning, and thereby permitting further development-focused policies. Addressing this cycle requires a cross-generational approach to conservation that protects and enhances ecological assets, integrates nature into urban life, and encourages community-based learning and civic engagement. Yet, within top-down planning structures, those with lived experience of environmental loss often lack agency over land-use decisions. Through diagramming the interlinked social and ecological consequences of rapid and unsustainable urbanization, this chapter aims to describe and visualize the relationships between policy, ecosystems, and human well-being.

15 Kahn Jr., "Children's Affiliations with Nature," 113.

16 Straka et al., "From Nature Experience to Pro-Conservation Action," 1166.

17 Straka et al., "From Nature Experience to Pro-Conservation Action," 1166.

18 "The Cheltenham Brick Works (Abandoned)," *Inside Caledon, Ontario*, May 1, 2011, https://www.insidecaledon.com/caledon/20110511174-the-cheltenham-brick-works-abandoned/; Nicola Ross, "Pit by Pit," *In The Hills*, September 20, 2022, https://www.inthehills.ca/2022/09/pit-by-pit/; Kelvin Browne, "Stone Houses of Shaw's Creek," *In The Hills*, June 16, 2010, https://www.inthehills.ca/2010/06/stone-houses-of-shaws-creek/.



Figure 1.5

"Stop the 413" sign posted along the Caledon Trailway.



Figure 1.6

Signs protesting the "mega-quarry" and Highway 413 posted in Belfountain.



Figure 1.7

Signs protesting the "mega-quarry" and Highway 413 posted in Alton.

1.1 Urban Sprawl and the Proposed Highway 413

Figure 1.8
(on facing page)

Extents of the proposed Highway 413 on Google Earth, dated 1/1/2021.

In November of 2024, Bill 212, or *Reducing Gridlock, Saving You Time Act*, received Royal Assent. Included within the bill was the *Highway 413 Act* intended to accelerate the highway's construction by exempting it from the provincial *Environmental Assessment Act*. The exemption will permit 24-hour construction in designated areas, circumvent public and indigenous consultation, and limit landowner resistance.[19] In June of 2025, Bill 5, or *Protect Ontario by Unleashing our Economy Act*, passed, weakening environmental protection acts and rewriting the Endangered Species Act where the provincial government can deem land as a "special economic zone" to bypass regulations and consultations with Indigenous groups.[20]

Both Bill 212 and Bill 5 prioritize accelerated urban development and rapid infrastructure expansion with minimal public consultation. They prioritize car-dependent planning over ecological concerns, Indigenous rights, and the long-term consequences of environmental degradation. While the Ontario government argues the highway will reduce travel time, global studies on traffic and economics prove that highways lead to induced demand and do not relieve congestion.[21] In reality, the construction of this project will overlap sections of the Greenbelt and agricultural land for 59 km of new infrastructure and expedite development adjacent to the proposed 11 interchanges connecting to Caledon's municipal roads.[22] Caledon residents are concerned by its car-dependent planning, paving of natural green space, and impacts on critical farmland.[23] The case of Highway 413 reflects the trend toward rapid development and car dependency at the expense of environmental conservation. Continuing this trajectory will contribute to reshaping the landscape and the next generation's perception of what is "normal" for the state of natural environments. A report on the environmental impact of Highway 413, conducted by Environmental Defence in 2021, provided evidence on how the construction of the highway will exacerbate climate change and further encourage the development of car-oriented suburban sprawl, posing a direct threat to the health of people, communities, and ecosystems. These legislative changes reflect a broader shift toward prioritizing economic development over environmental protection, raising serious concerns about the long-term sustainability and well-being of the community in Caledon.

In the 2021 report, Environmental Defence along with a transportation modelling team calculated that with the mixture of vehicle types currently on the roads, Highway 413 will produce approximately 17.4 million tonnes of CO_2 by 2050, or the equivalent to the energy use from 81 000 homes over a year.[24] However, pollution caused by the highway will take effect prior to completion. Bill 212 permits early work construction of sections, such as bridges over waterways, that will destroy and pollute green space and at-risk species habitat before any environmental assessments are conducted. The construction of the highway will cross and disturb the Humber River and Credit River watersheds, which are home to both vital and endangered species. This will contribute to poorer

19 "Bill 212, Reducing Gridlock, Saving You Time Act, 2024 - Legislative Assembly of Ontario," accessed September 26, 2025, https://www.ola.org/en/legislative-business/bills/parliament-43/session-1/bill-212. Schedule 3

20 "Bill 5, Protect Ontario by Unleashing Our Economy Act, 2025 - Legislative Assembly of Ontario," accessed September 26, 2025, https://www.ola.org/en/legislative-business/bills/parliament-44/session-1/bill-5. Schedule 2

21 Emma McIntosh, "More Highways Likely Won't Clear Ontario's Traffic. What Will?," Explainer, *The Narwhal*, February 16, 2023, https://thenarwhal.ca/ontario-highways-induced-demand-explainer/.

22 "Highway 413," Highway 413, accessed March 24, 2025, https://highway413.ca/en/.

23 Sabrina Almeida, "Caledon Group Tells Provincial Election Candidates to Cancel Proposed Highway 413," Caledon Enterprise, February 22, 2025, https://www.caledonenterprise.com/politics/provincial-elections/caledon-group-tells-provincial-election-candidates-to-cancel-proposed-highway-413/article_abcd9231-6e41-5ff9-8499-36c29d59690a.html.

24 "Paving Paradise: The Impact of Highway 413 on Greenhouse Gas Emissions, Air Pollution & Suburban Sprawl," Environmental Defence, 2021, 5.



water quality by increasing salt levels from runoff, adding stress to dependent ecosystems and their functions. Ecosystems and ecological functionality must be assessed at a larger scale considering the natural movement of wildlife, such as the endangered Redside Dace with over 65% of its remaining habitat located in the Credit and Humber River watersheds.[25] In addition to sensitive aquatic species, the rivers function in a system connected to riverbanks, wetlands, and forests that create critical habitat connectivity essential for the biodiversity in the area. Across the highway's proposed footprint in Caledon, twenty-nine federally protected species at risk will be impacted, including the Redside Dace, Western Chorus Frog, Red-headed Woodpecker, and Bank Swallow.[26] Federal protections for these species have helped delay the project by denying permits that would harm habitats of species at risk.

In addition to wildlife, overall human and community well-being will also be impacted by habitat destruction and environmental degradation resulting from Highway 413. The increased pollution will worsen air and water quality, and the interference with critical waterways and wetlands will likely worsen the existing flooding problems experienced in the Peel Region.[27] As natural systems collapse and ecosystems degrade, people living farther from or near damaged natural areas tend to have fewer interactions with nature, worsening the human-nature disconnect.[28] The resulting separation perpetuates generational environmental amnesia and extinction of experience, reflecting a decline in a level of ecological literacy necessary for pro-conservation action toward biodiversity loss.[29] As each generation experiences a degraded environment as their norm, this already lowered baseline risks pushing ecosystems toward irreversible collapse and complete environmental devastation.

Intended to expedite the construction of large development and infrastructure projects like Highway 413, Bill 212 and Bill 5 have significant implications for environmental conservation and Indigenous groups' Treaty Rights within Ontario. While currently undetermined if the Ontario government's efforts will successfully accelerate its construction as the proposed highway cuts through various sections of federally listed endangered species habitat, it highlights trends in recent legislature that prioritize economic gain over the health of communities and the environment.[30] As policy continues to corrode human-nature connectivity, the shifting baseline for the environmental norm will lead to fewer meaningful experiences in natural settings and a decline in pro-conservation attitudes and ecological literacy among younger generations.

25 Anushka Yadav, "'Ecological Breakdown': Environmental Devastation from Highway 413 Becoming Clearer; Brampton & Mississauga at Significant Risk," The Pointer, 2024, https://thepointer.com/article/2024-10-05/ecological-breakdown-environmental-devastation-from-highway-413-becoming-clearer-brampton-mississauga-at-significant-risk.

26 Yadav, "'Ecological Breakdown.'"

27 "Paving Paradise: The Impact of Highway 413," 5.

28 Masashi Soga and Kevin J Gaston, "Extinction of Experience: The Loss of Human — Nature Interactions," *Frontiers in Ecology and the Environment* 14, no. 2 (2016): 96.

29 Straka et al., "From Nature Experience to Pro-Conservation Action," 1173.

30 Rebecca Gao, "Construction Starting on Highway 413: What You Need to Know," In-Depth, *The Narwhal*, June 17, 2025, https://thenarwhal.ca/ontario-highway-413-bill-5/.

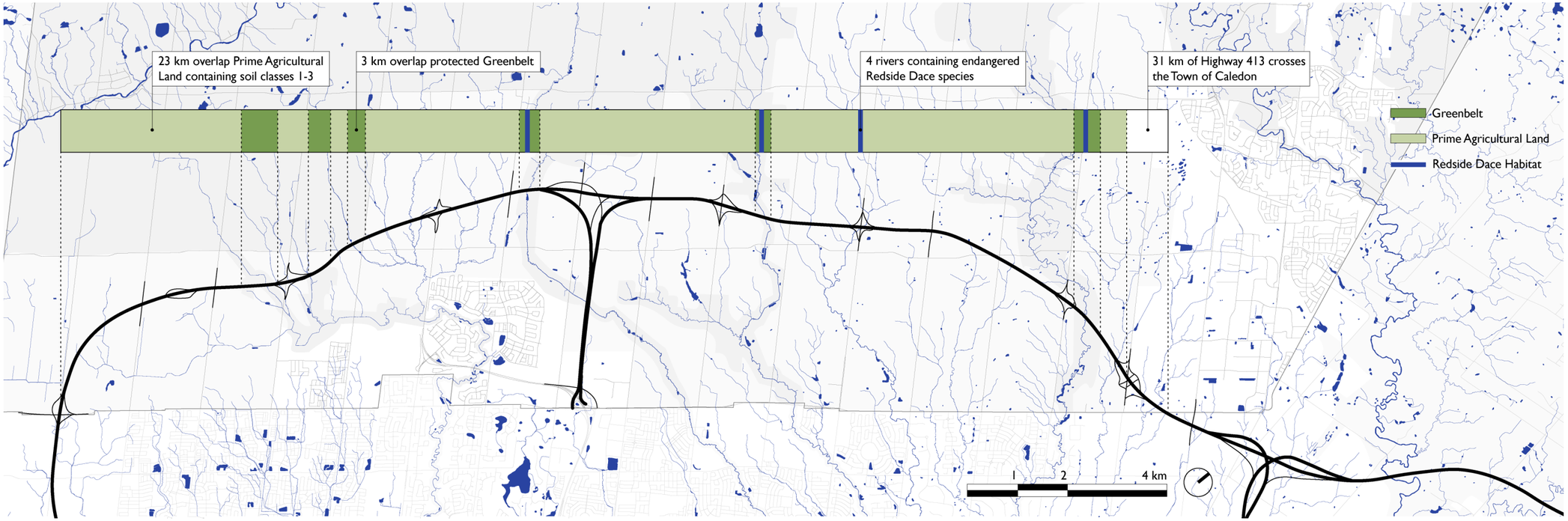


Figure 1.9

Significant ecologies that will be impacted by the construction of the proposed Highway 413.

1.2 Developing the Greenbelt

The Town of Caledon's *Official Plan*, or *Future Caledon – Our Official Plan* (*Future Caledon*), was adopted by Council in March of 2024 as a guide to shaping Caledon over the next 30 years in accordance with the *Region of Peel Official Plan*. This document outlines the planned growth and management to guide decision-making until 2051, which includes over 4000 hectares of new development for community and employment purposes. Over the course of three phases and review, *Future Caledon* will replace the existing *Official Plan*, which dates back to 1978. In Part B: *Managing Growth and Change*, a population forecast of 300 000 in 2051, compared to a population of 81 000 in 2021, acts as a planning framework for development in the designated Urban System.[31] *Future Caledon* structures the municipality into three systems: Rural System, Natural Environmental System, and Urban System.[32] Comparing the land designations and town structure mappings from the existing *Official Plan* and *Future Caledon*, the Urban System has expanded and replaced previously designated Prime Agricultural Area within the Rural System as the 4000 hectares of New Urban Area [Figure 1.12]. The New Urban Area also surrounds the Greenbelt and the proposed Highway 413, which has been incorporated into the plans. While an aggregate resource management plan has yet to be developed for *Future Caledon*, a 2024 amendment to the 1978 *Official Plan* remains in effect and continues to designate and identify land within the Greenbelt as Caledon High Potential Mineral Aggregate Resource Areas (CHPMARA).[33] The land rezonings permitting development on rural and environmentally sensitive areas dismisses community input regarding the negative impacts on local communities, natural ecosystem functions, endangered species, and the distinctive landscape features that define Caledon.[34] The implementation of *Future Caledon* prioritizes developer-led planning over environmental and heritage conservation, weakening social-ecological resilience and reducing residents' access to healthy green space, further cementing ecological illiteracy.

31 "Future Caledon Official Plan," Town of Caledon, 2024, B-5.

32 "Future Caledon Official Plan," B-3.

33 "Future Caledon Official Plan," A-16.

34 Rachel Morgan, "Residents Fear Caledon's New Council Approved Official Plan Could Pave Paradise," The Pointer, 2024, https://thepointer.com/article/2024-03-26/residents-fear-caledon-s-new-council-approved-official-plan-could-pave-paradise.



Figure 1.10

Downey's Farm entrance.

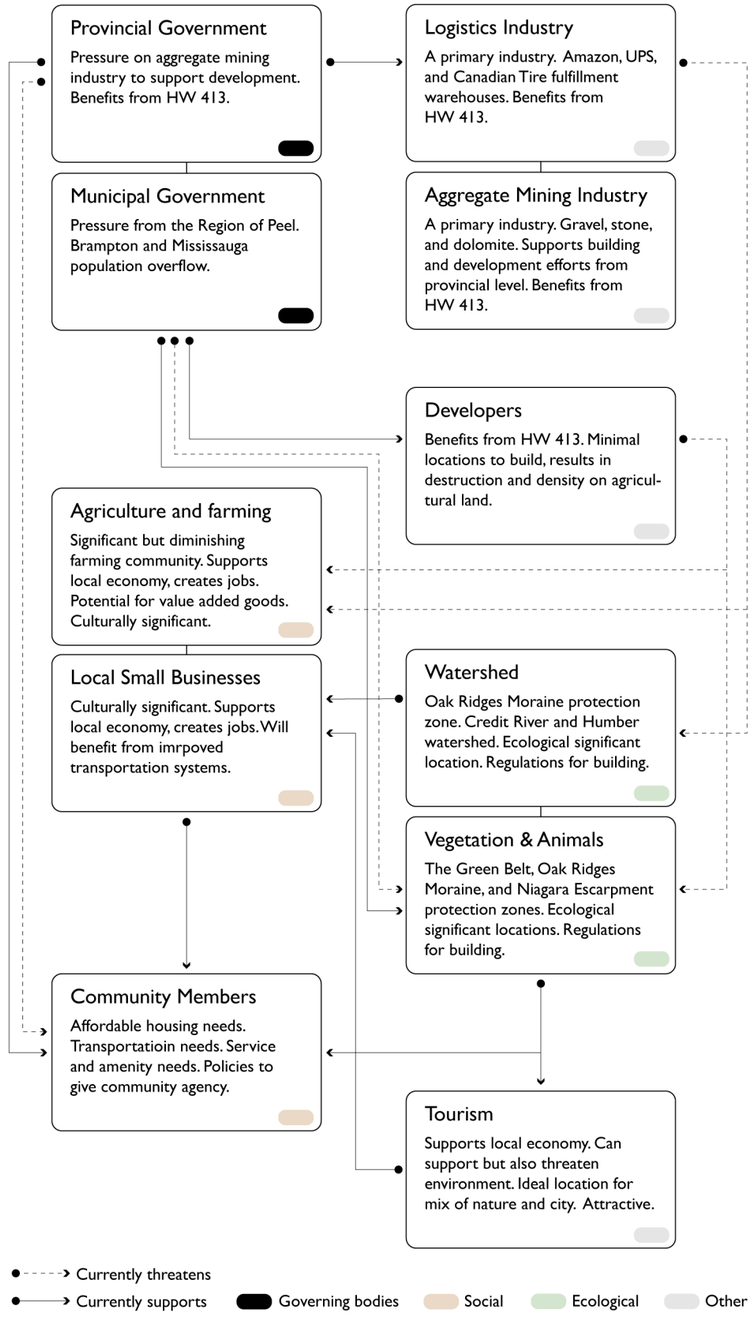
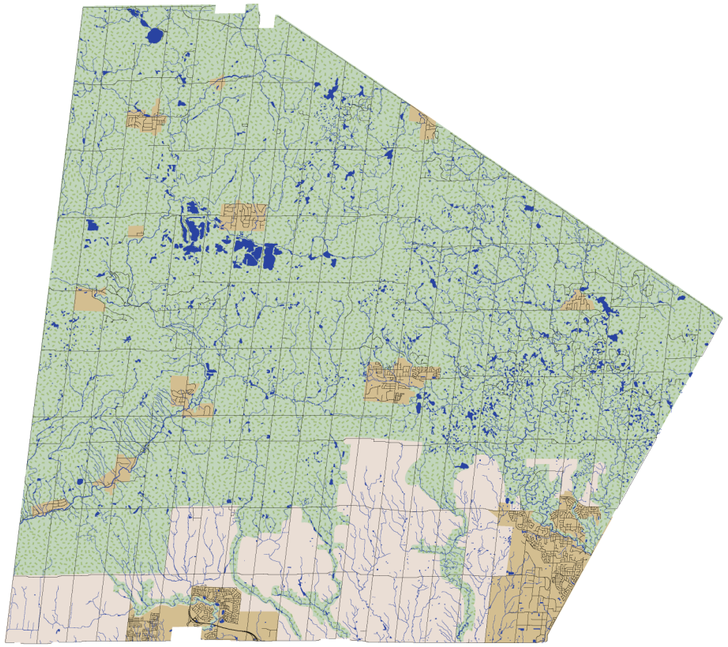


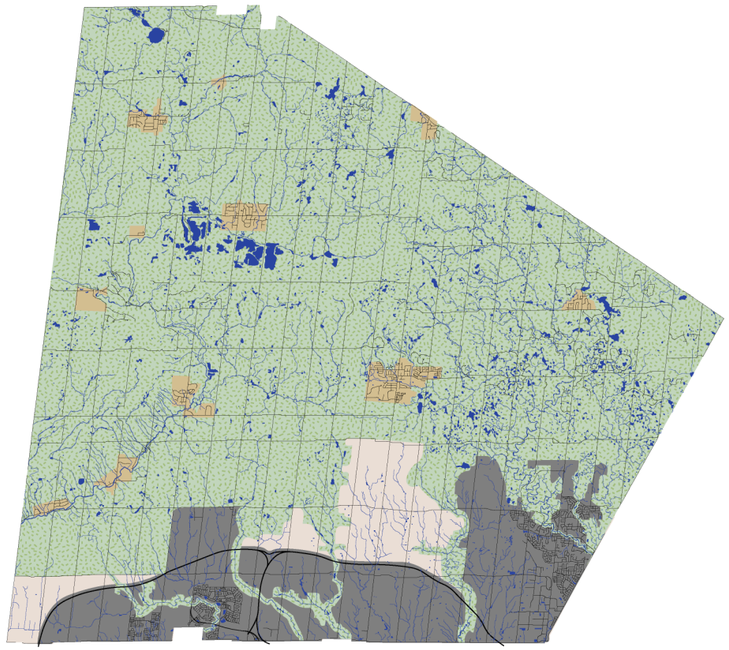
Figure 1.11

Caledon's stakeholders, actors, and relationships.



1978 Town of Caledon Official Plan
Amended 2024.

- Greenbelt
- Water
- Agricultural Land
- Village / Hamlet / Rural
- Roads
- Highway 413



2024 Draft Future Caledon Official Plan
To be implemented in three phases and replace the existing plan.

- 2051 Urban Area

2.5 5 10 km

Figure 1.12

Land designation and town structure comparison between the amended 1978 *Town of Caledon Official Plan*, and the 2024 Draft *Future Caledon Official Plan* adopted in 2024.

Caledon has remained considerably rural in contrast to Brampton and Mississauga. The existing pockets of urbanization within Caledon are primarily found in the southern portion outside of the Greenbelt, with the Village of Bolton being the most populated community, and Mayfield West the most rapidly developing. Many smaller villages and hamlets are scattered throughout the Greenbelt, delineating the early farming and industrial settlements and communities established around natural resources, such as fertile soils, geological formations, and the Credit and Humber Rivers [Figure 1.14].

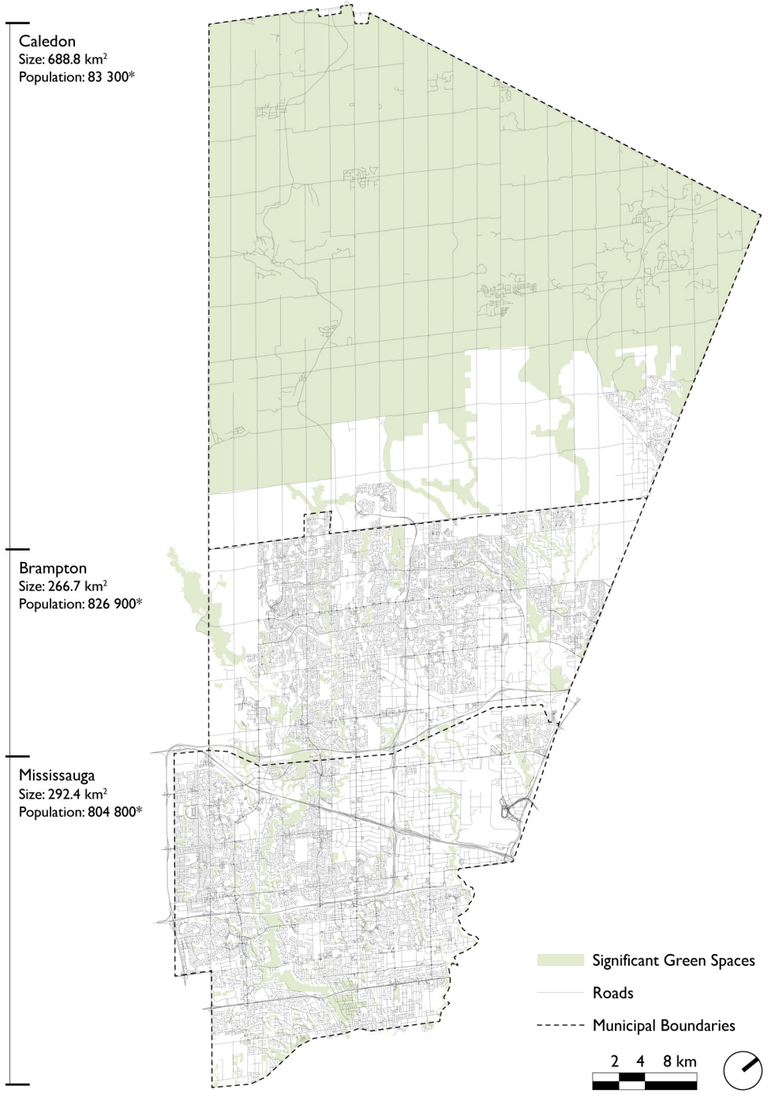


Figure 1.13

Population comparisons between the municipalities in the Region of Peel. Contains data from World Population Review accessed in January 2025.

In *Future Caledon*, the Urban System previously isolated to Bolton and Mayfield West now span the width of the southern portion of Caledon. This expansion almost entirely replaces the provincially designated Whitebelt, defined as a buffer for the Greenbelt, and Prime Agricultural Land, or land considered optimal for farming due to its high potential for crop production. This large-scale rezoning will both drastically alter the landscape of the south and remove the protective buffer, threatening adjacent ecosystems within the Greenbelt. *Future Caledon* has also made it easier to build within the Greenbelt with Section D, *Natural Environment System*, adopting a landscape features approach where if avoiding development is not possible, the city must attempt impact mitigation, feature restoration, or feature enhancement.[35] If none of those options are possible, the approach will be system compensation or replication.[36] However, this approach does not consider the entire ecosystem natural features operate within. Similar to ecological offsetting, the removal, alteration, or replacement of a feature will have an impact on the whole system, recreating a natural feature may not provide the same ecological results, especially for critical ecosystems located in the Niagara Escarpment and Oak Ridges Moraine.[37] The weakening of environmental conservation and protection policies further endangers at-risk species native to Caledon's woodlots and wetlands as ecosystem boundaries diminish to make way for new development.

35 "Future Caledon Official Plan," D-7-8.

36 "Future Caledon Official Plan," D-7-8.

37 Mattia C. Mancini et al., "Biodiversity Offsets Perform Poorly for Both People and Nature, but Better Approaches Are Available," *One Earth* 7, no. 12 (2024): 2169, https://doi.org/10.1016/j.oneear.2024.10.002.

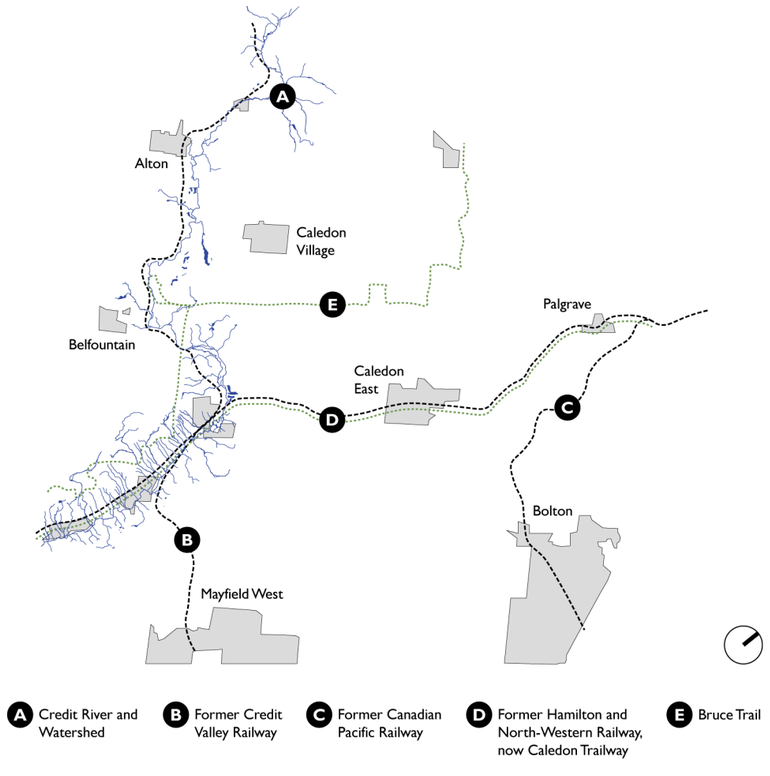


Figure 1.14

Pockets of development along the Credit River and railways through Caledon.

Removal of Caledon's Whitebelt and relaxation of natural green space protection have consequences for human well-being in addition to the wildlife in the area. Over the course of 30 years, after the construction of Highway 407, the surrounding green space and farms were paved into residential and commercial sprawl.[38] The rezoning of farmland to urban area in Caledon will likely result in sprawling and car-oriented development led by Highway 413, creating longer commute times, pollution, and loss of farmland. From the Peel Region's 2021 data, 31% of the land is used for commercial agriculture and Caledon is home to over 80% of the farmland in the region.[39] According to the Ontario Federation of Agriculture, farmland contributes billions of dollars and thousands of jobs as one of the most important economic sectors in the Greater Golden Horseshoe Region.[40] The complete loss of prime agricultural land in *Future Caledon*'s Urban System strategy becomes both an economic loss and a loss in opportunity to form meaningful human connections with nature in Caledon's urban fabric.

38 "Paving Paradise: The Impact of Highway 413," 16.

39 "Agriculture: Peel's Agriculture Industry in 2021," Peel Region, 2021, https://census-regionofpeel.hub.arcgis.com/pages/agriculture-2021.

40 "Paving Paradise: The Impact of Highway 413," 15; "Farmland at Risk Report - Greater Golden Horseshoe," *Ontario Federation of Agriculture*, 2018, https://ofa.on.ca/resources/farmland-at-risk-report/.



Figure 1.15

Greenfield development in Mayfield West.



Figure 1.16

Screenshots from Google Earth showing the development of Mayfield West, Highway 410, and surrounding areas between 2005-2025. Showing imagery from (top down):
Google, Maxar Technologies, dated older - 11/20/2005
Google, Maxar Technologies, dated older - 3/29/2013
Google, CNES / Airbus, dated older - 6/28/2019
Google, Airbus, dated 6/15/2025 - 8/4/2025

The practice and cultural heritage of farming provide direct experiences with nature, fostering a deeper and more educational human-nature relationship. Global studies show a positive correlation between engaging in meaningful nature experiences, rather than just exposure to nature, and pro-conservation behaviours as increased knowledge about nature motivated individual's conservation efforts.[41] The destruction of Caledon's agricultural heritage and green landscapes disconnecting residents from nature experiences also limits the physiological benefits received from time spent in natural settings.[42] The collective effects of environmental devastation contributes to the cycle of an overall decline in ecological literacy and future pro-conservation action.[43] Cross generational urban strategies and policies that prioritize healthy ecosystem functions and environmental education must be adopted to reset the baseline for environmental norms ensuring social and ecological resilience for all subsequent generations.

Future Caledon represents a significant shift in land use policy that prioritizes rapid urban growth over long-term environmental conservation, heritage, and community well-being. The plan weakens existing protections around the Greenbelt, Niagara Escarpment, and Oak Ridges Moraine by overlooking the linkages of ecosystems and natural features, risking irreversible ecological degradation. The large-scale rezoning paves the way for sprawling, car-dependent development and diminishes opportunities for meaningful human-nature connections, which are central to ecological literacy and pro-conservation values. Without policies that actively protect natural systems and foster environmental education, Caledon risks deepening generational environmental amnesia and weakening social-ecological resilience. Future planning must balance growth with preservation through community engagement and knowledge sharing to sustain Caledon's distinct ecological and cultural form.

41 Masashi Soga and Kevin J. Gaston, "Nature Benefit Hypothesis: Direct Experiences of Nature Predict Self-Reported pro-Biodiversity Behaviors," *Conservation Letters* 16, no. 3 (2023): 4, https://doi.org/10.1111/conl.12945.

42 MaryCarol R. Hunter et al., "Urban Nature Experiences Reduce Stress in the Context of Daily Life Based on Salivary Biomarkers," *Frontiers in Psychology* 10 (April 2019): 13, https://doi.org/10.3389/fpsyg.2019.00722.

43 Straka et al., "From Nature Experience to Pro-Conservation Action," 1173.

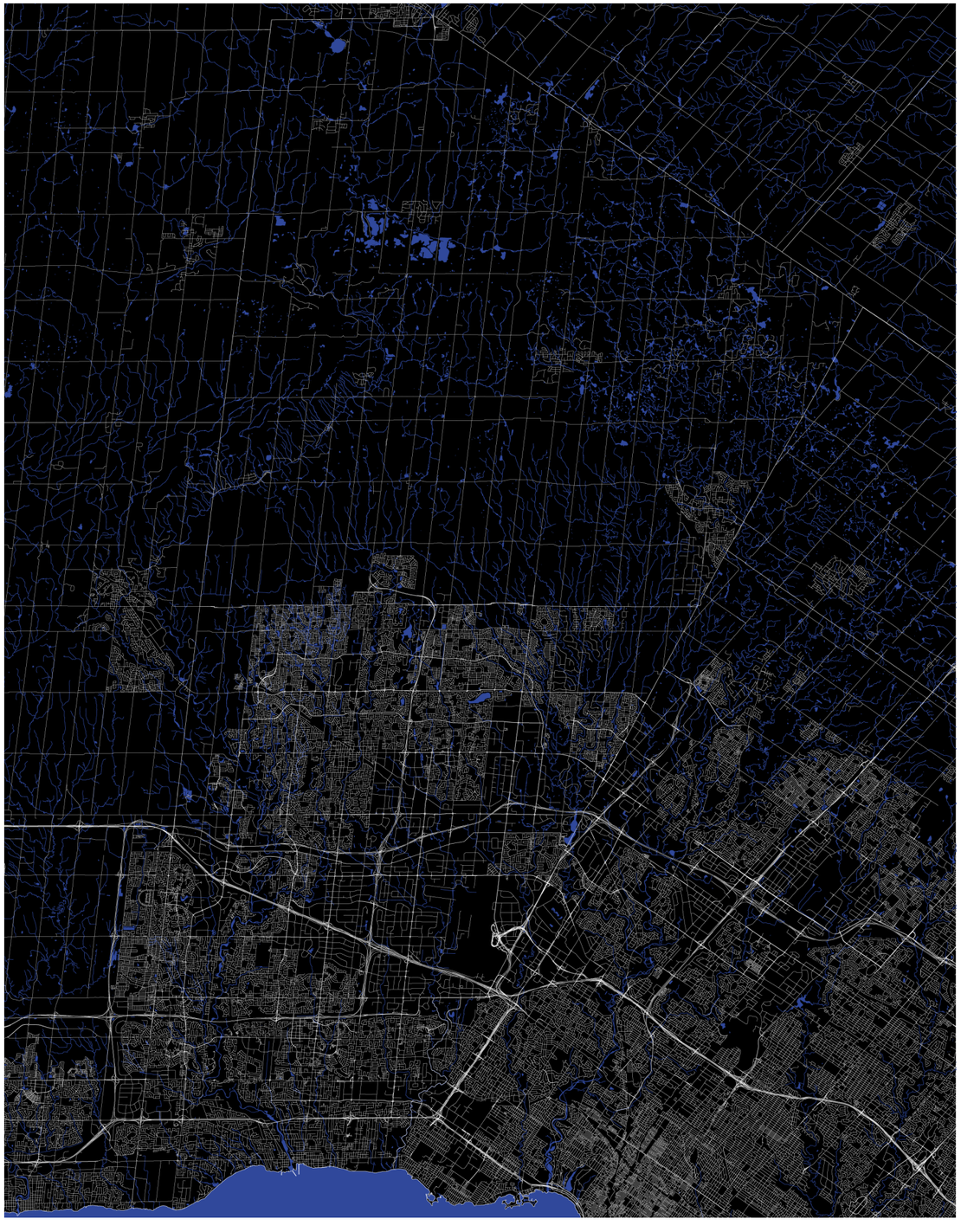


Figure 1.17
(on facing page)

Road networks and waterbodies in the Region of Peel.

1.3 Conclusion

Caledon is currently at a critical moment where planning decisions will have lasting implications for the environmental awareness and well-being of future generations. The influence of development in shaping policies, such as Highway 413 and the adoption of *Future Caledon*, poses significant threats to the city's natural systems, erodes human-nature connections, and reinforces cycles of generational environmental amnesia. As legislative priorities increasingly sideline conservation efforts and community input, Caledon's biodiversity and cultural heritage face escalating risk. Ensuring a resilient and sustainable future requires a balance between development and ecological stewardship, as well as aligning policy with ecosystem functions. Urban design must allow opportunities for environmental engagement and literacy through incorporating community consultation, active engagement, and involvement of individuals with firsthand experience and knowledge about the land.

A bottom-up approach is essential for shaping policies that promote community well-being and the systems that support it. Although theoretical, applying socially and ecologically resilient strategies to Caledon's existing urban dynamics enables an evaluation of its adaptive capacity and offers a testbed for resilient urbanization frameworks. Prioritizing ecosystem functions and resilience thinking within the design process can generate innovative solutions for sustainable development and offer a blueprint for other communities facing similar pressures of rapid urbanization. Unchecked sprawling development threatens Caledon's resilience and the resulting decline in ecological literacy; confronting and dismantling this trajectory is the central conflict addressed in this thesis.

Chapter	Theory	Game Design
One	**The Problem** Development of Highway 413 over sections of the Greenbelt. Planned urban expansion within the whitebelt and agriculturally prime soil.	**Player Threat** While playing against the risk of sprawling development and ecological devastation. Players must assume roles to protect Caledon's social-ecological services as the city urbanizes
Two	The Solution	Player Objectives
Three	Implementation	Finished Game

Figure 1.18

Chapter One theory and game design organization.

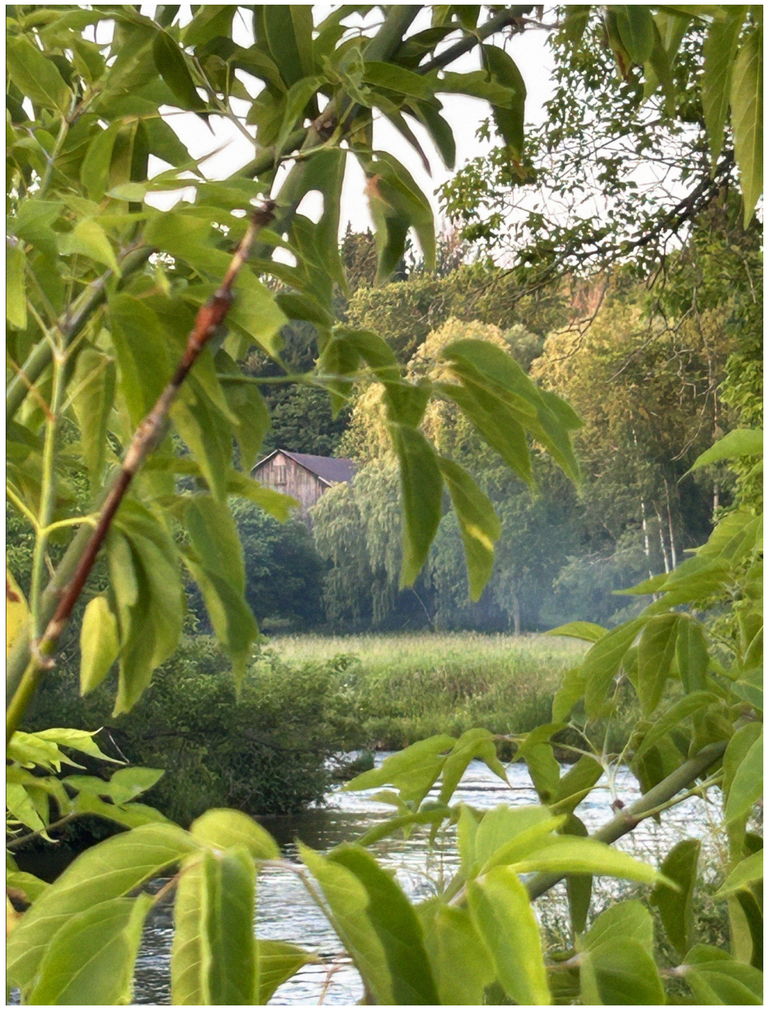


Figure 1.19

Scene from a hiking trail in Caledon.

Paving Paradise Rulebook

In this document, pages with a black tab marked "Paving Paradise Rulebook" contain information on the game's mechanics extracted from the rulebook that align with the research content. The complete rulebook can be found on page 164.

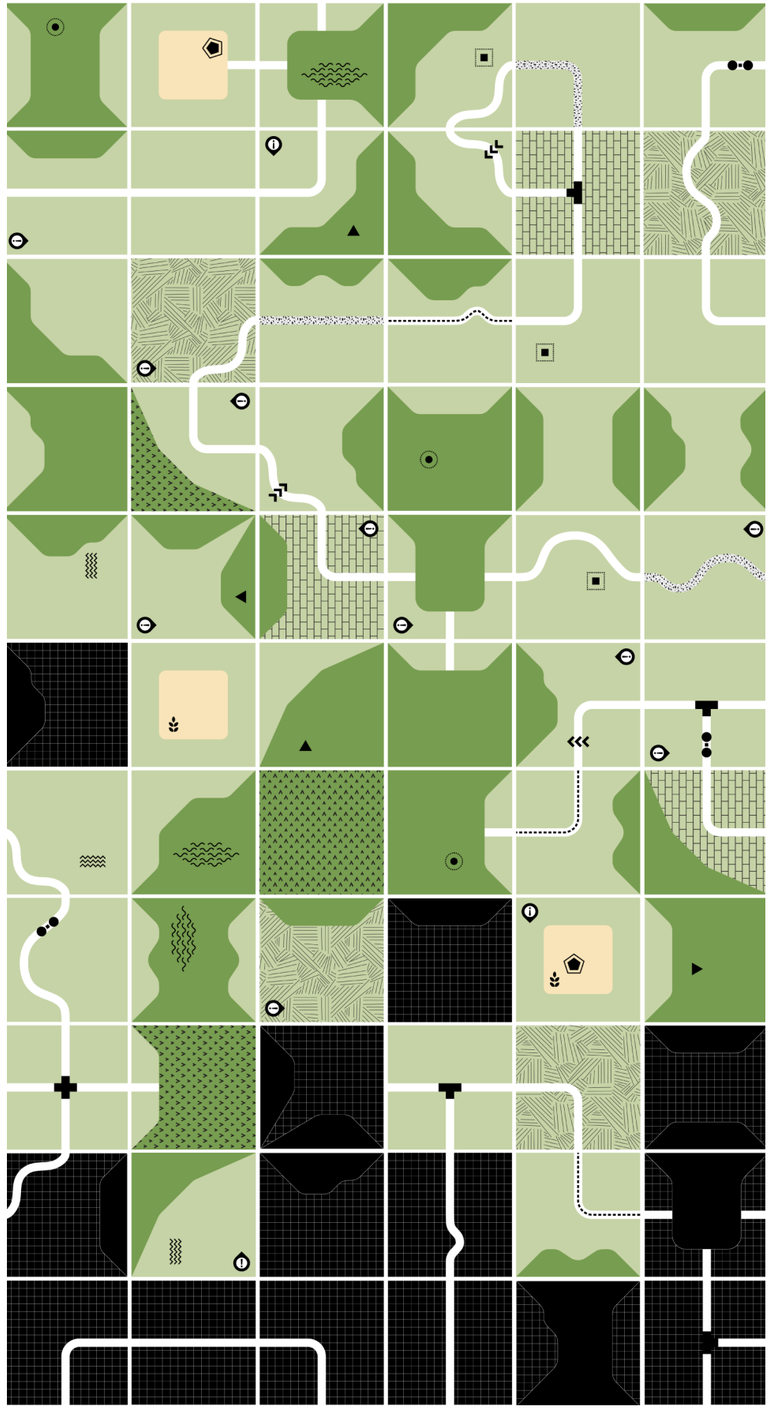


Figure 1.20

Paving Paradise Rulebook cover page.

Paving Paradise

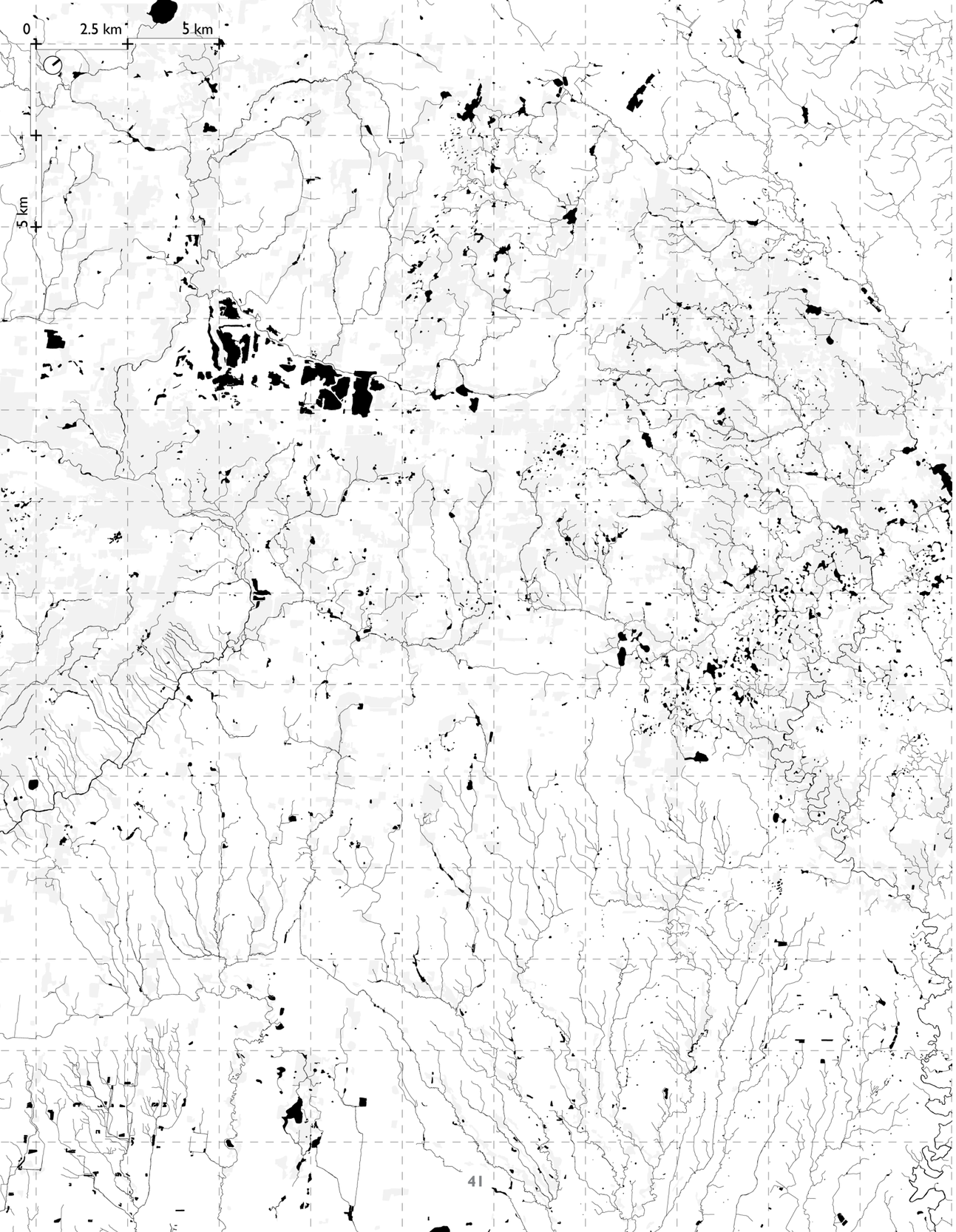
A tile laying game for 2 to 4 players.
Inspired by *Carcassonne*, designed by Klaus-Jürgen Wrede, with rulebook by Christof Tisch. © Hans im Glück Verlag and Z-Man Games, Inc.

Introduction

The design of *Paving Paradise* is influenced by the realities of urban sprawl within the Town of Caledon and aims to raise awareness and create dialogue on protecting its cultural and ecological significance. The Town of Caledon is a Canadian city known for its natural landscape, countryside charm, and pockets of historic villages. The city today is urbanizing to welcome more residents but is at risk of sprawl-oriented development and ecological devastation. In this game, players must develop Caledon with sustainability in mind to ensure the well-being of its residents through the protection and enhancement of social-ecological services. Players will place their Community Members onto Roads, Parklands, Farms, and Community Hubs. Only the most judicious placements will gain the points required to stop urban sprawl and win the game.

Game Overview

At the beginning of the game, each player draws Objective cards. On their turn, players place one tile at a time to create Roads, Parklands, Farms, and Community Hubs. However, this is also how Roads, Parklands, Farms, and Community Hubs can be paved over. To score points, players must negotiate, collaborate, and place Community Members on these tiles. Points are scored during and at the end of the game. After the final scoring, the player who scored the most points will have contributed the most towards Caledon's social-ecological resilience and sustainable urban landscape.



Chapter Two

Ways of Winning

Water

Forested areas

Figure 2.1

Waterbodies and forested areas in Caledon.

2.0 Ways of Winning

The concept of resiliency stems from the ability of systems to resist and recover from disturbances and change. In 1973, C.S. Holling described a resilience framework not as one that expects future events, but as one that recognizes that future events are unexpected and is capable of adapting to whatever form it may be.[44] C.S. Holling showed how dynamic natural ecosystems can maintain stability in a variety of states, that nature is less in balance than it is a collection of constantly changing variables, and over time, may entirely shift in character and function as the dominating variables and their relationships reorganize.[45] The resilience concept describes how systems can maintain stability in differing and alternative states through their ability to endure and reconfigure in response to disturbances. Humans are increasingly becoming the dominant actors in cultural and natural landscapes and as a result, they must learn to operate within the breaking points of stable natural states. In planning, to better integrate living ecosystems and built-up cityscapes, urbanization can be managed as a system with social and ecological resilient potential.

Resiliency gradually found its way into scholarly discourse and soon after into policy during the early 21st century. With the publication of *Principles for Social-Ecological Urbanism* by Stephan Barthel et al. in 2013, the concept advanced as a principal framework for creating resilient urban designs. Social-ecological urbanism (SEU) research considers social and ecological factors as an interlinked system to understand how institutions, processes of governance, and physical forms can promote self-organising urban systems with humans as co-creators of nature.[46] Contemporary research on the topic attempts to highlight a clear approach and mobilize resiliency thinking within planning practices for the built environment to improve community well-being and ecological literacy.[47] A necessary condition for a more sustainable future is the joint effort between design and ecology to build urban forms that support meaningful human-nature connections to reverse generational environmental amnesia.

44 C. S. Holling, "Resilience and Stability of Ecological Systems," *Annual Review of Ecology and Systematics* 4 (1973): 21.

45 Barthel et al., "Principles of Social-Ecological Urbanism - Case Study," 21.

46 Meta Berghauser Pont et al., "Social-Ecological Urbanism: Developing Discourse, Institutions and Urban Form for the Design of Resilient Social-Ecological Systems in Cities," *Frontiers in Built Environment* 8 (August 2022): 1, https://doi.org/10.3389/fbuil.2022.982681.

47 Karl Samuelsson, "The Topodiverse City: Urban Form for Subjective Well-Being," *Frontiers in Built Environment* 7 (December 2021): 7, https://doi.org/10.3389/fbuil.2021.735221; Colding et al., "Frontiers in Social–Ecological Urbanism," 3.



Figure 2.2

Waterfall located in the Forks of the Credit Provincial Park.

As urbanization continues at a rapid pace and people live deeper into cities, humans become further removed from a truly natural world. Modern urban environments are often planned with strict boundaries and land designations, without consideration of the biophysical realities of the land, which limits human interaction with natural landscapes and the ecological systems that support human life. A strict division between humans and nature has been embedded into the physical structure of cities. As a result, this separation has become ingrained in daily routines, making it harder to build emotional and cognitive connections to develop pro-conservation behaviour.[48] Integrating more accessible and ecologically significant spaces into the design of everyday urban areas can encourage cognitive resilience building, which is especially crucial during childhood as environmentally conscious habits tend to translate into adulthood.[49] Additionally, within the social dimension, smaller and local green environments can be perceived as more valuable for human-nature connections through recreational value and personal affiliation compared to larger nature reserves.[50] This chapter focuses on suburban design interventions that strengthen social relationships with nature on a neighbourhood scale to combat the effects of car-oriented sprawling development and biodiversity loss. Speculative design frameworks are illustrated and applied to the Town of Caledon to diagram how ecologically resilient interventions can be integrated into neighbourhoods, and their potential to build pro-environmental human behaviour and ecological literacy.

While modern urban planning often imposes top-down design, Karl Samuelsson's concept of topodiversity emphasizes aligning with natural and bottom-up dynamics of city development to create a "topodiverse city," an alternative to both dense and sprawling cities. Topodiversity recognizes that different spaces contribute to well-being in distinct ways depending on their role within a broader spatial system, and that the goal is to design cities that preserve or enhance this diversity while minimizing environmental impact.[51] A topodiverse city is designed to be neither too spread out nor too crowded, creating many small, urban activity centres connected to larger natural and rural networks [Figure 2.3].[52] This balance gives people local and diverse areas that are easier to travel between, offering more pathways to support their overall well-being.[53]

48 Marcus et al., "Cognitive Affordances in Sustainable Urbanism," 445.

49 Colding et al., "Frontiers in Social–Ecological Urbanism," 7.

50 Marcus et al., "Cognitive Affordances in Sustainable Urbanism," 445.

51 Samuelsson, "The Topodiverse City," 4.

52 Samuelsson, "The Topodiverse City," 6.

53 Samuelsson, "The Topodiverse City," 6.

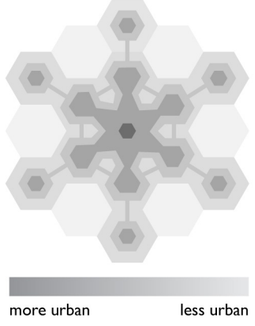


Figure 2.3

Reproduction of Samuelsson's topodiverse spatial system diagram. The darker shades are more urban areas within a larger rural area shown in a lighter shade.

Samuelsson, "The Topodiverse City." © 2021 Samuelsson.

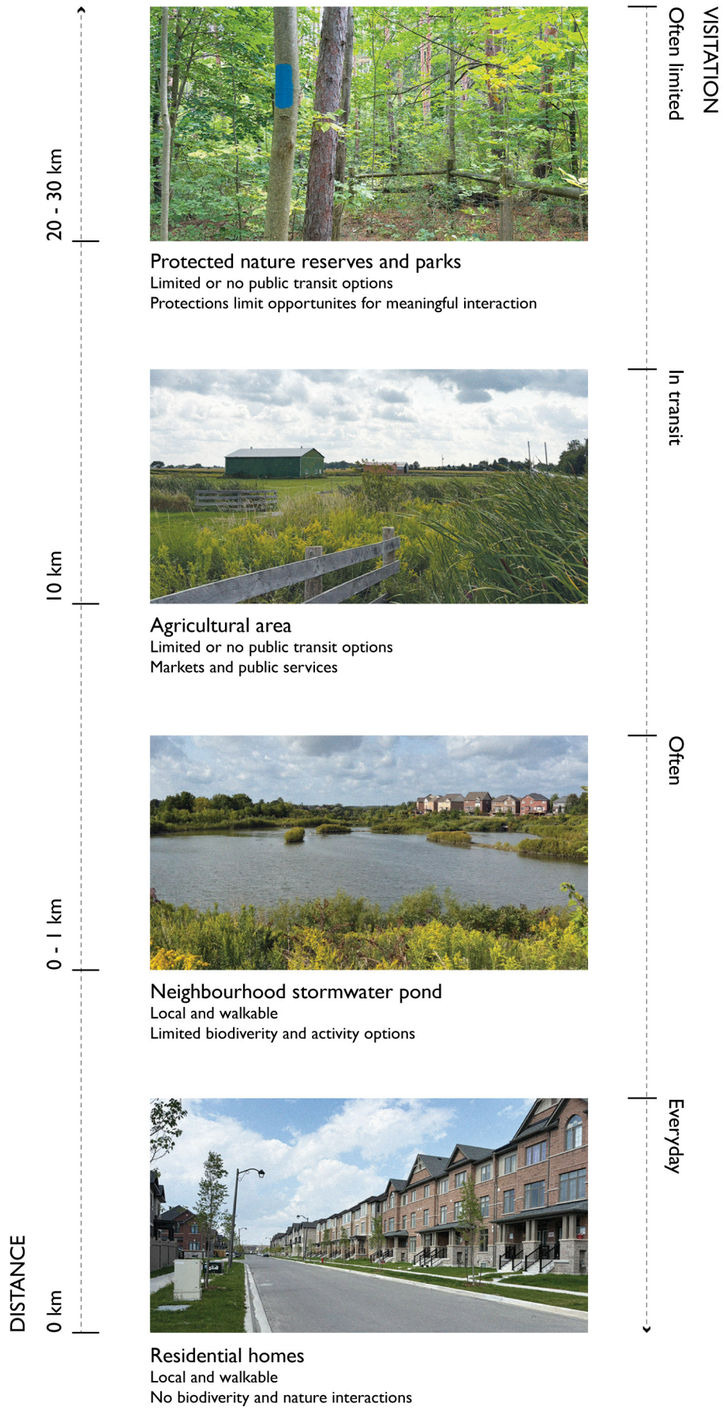


Figure 2.4

Accessibility, visitation, and influence of natural areas in Caledon's neighbourhoods.

The purposed suburban design frameworks for Caledon focus on street networks as a dimension for active movement and interaction, and opportunities for green infrastructure and human-nature connection in the city's residential areas. Following a topodiverse framework, the design proposals aim to create a network of adaptable, diverse neighbourhoods connected to the broader urban fabric, supporting a range of activities, enhancing human well-being, and fostering cognitive resilience. While many of the design interventions may be challenging to execute due to the governance structure Caledon currently operates within, the main objective of the proposals is to raise awareness and spark discussion on the possibilities of ecologically focused design initiatives within local communities. Mayfield West is selected as the case study site for applying and analyzing design interventions in Chapter 2. This neighbourhood was chosen because it is currently under development as part of Mayfield West Phase Two in *Future Caledon*, is adjacent to the proposed Highway 413, overlaps with sections of the Greenbelt, and has the potential to serve as a prototype for surrounding Whitebelt lands designated for urban development by 2051.

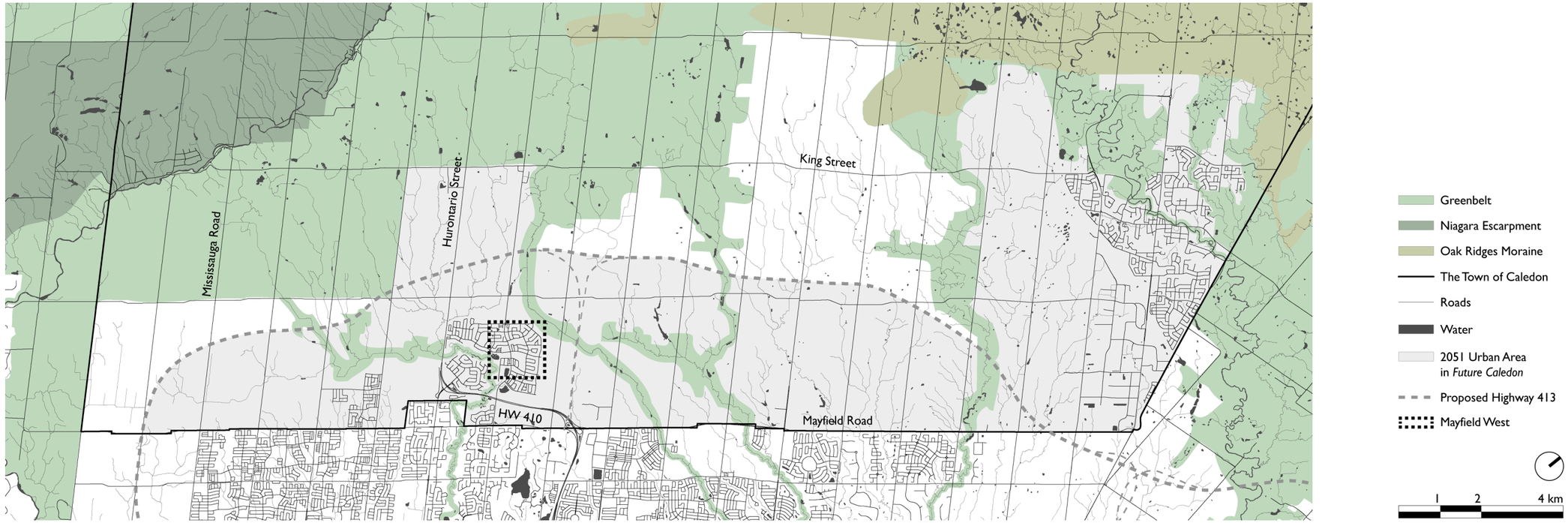
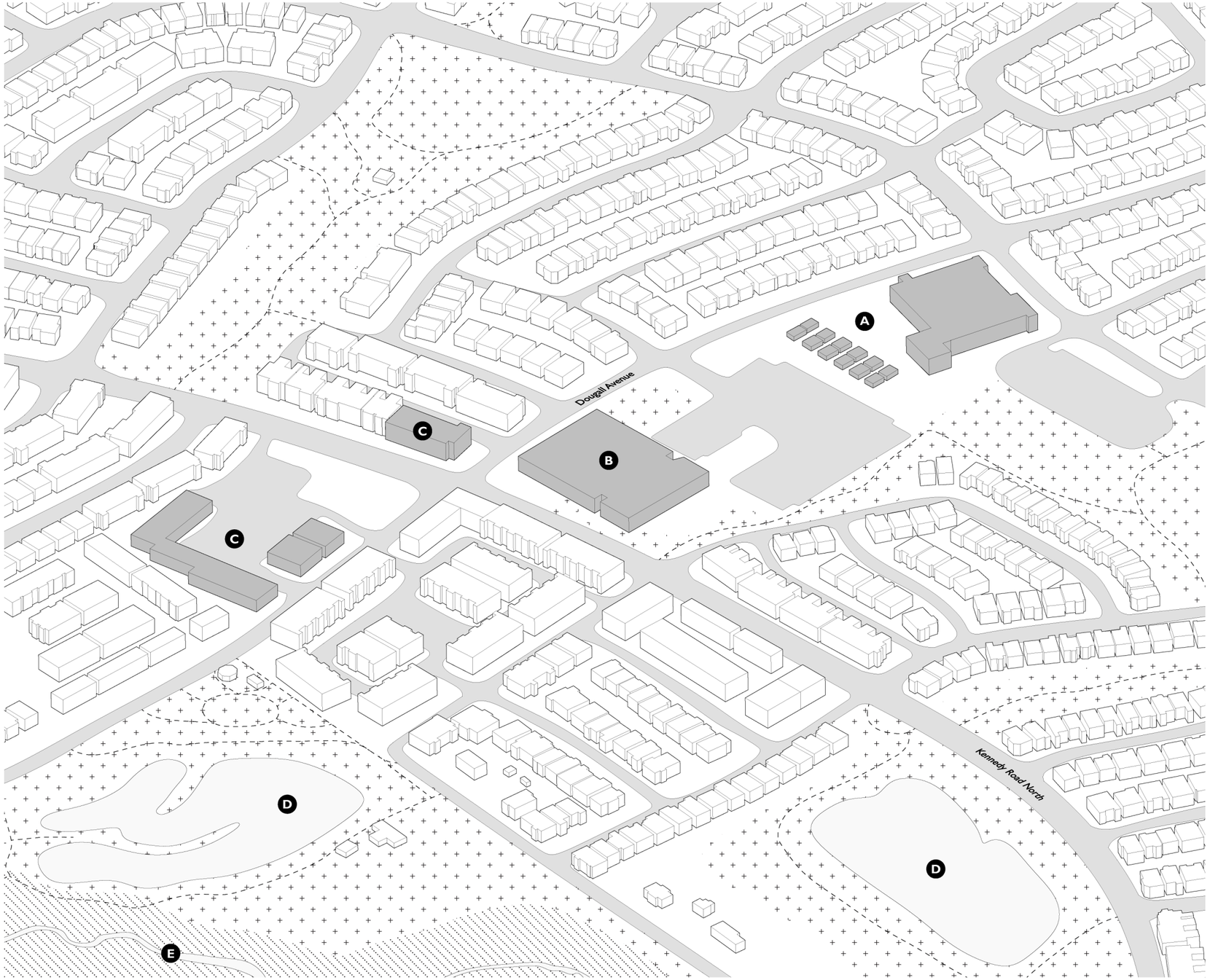


Figure 2.5

Context map of Mayfield West and study site.

Private property
Non-residential
Roads
Walking paths
Public parks
Protected Greenbelt
Water

A School
B Community Centre
C Commercial
D Stormwater Pond
E Etobicoke Creek



ACTORS ON URBAN FORM
"Land feature"

"Road"
Infrastructure leading from one destination to another.

Roads
Walking paths

"Parkland"
Public spaces containing protected ecologically significant areas, existing natural features or constructed green spaces.

Public parks
Protected Greenbelt
Water

"Farm"
Refers to infrastructure for providing any form of goods and services.

Private property
Non-residential

A B C

"Community Hub"
Refers to public spaces for community use.

Non-residential
Roads
Walking paths
Public parks
Protected Greenbelt

B D E

STAKEHOLDERS
"Community Member"

Human	Pedestrians/cyclists Residents Business owners etc.
Non-human	Plants Animals Water

Figure 2.6

Spatialisation of the existing conditions in Mayfield West (left), and diagram of how the site has been abstracted and simplified in the game (right).

2.1 Street Networks as a Dimension for Interaction

With the proposal of Highway 413 as a prime example, urbanized municipalities within the Greater Toronto Area are designed for cars as the dominant mode of transportation at the expense of natural landscapes. Car dominance is further emphasized by the vast and sprawling street networks characteristic of single-family residential zones throughout the area. While Caledon currently has relatively few sprawling neighbourhoods because of existing environmental protections, the mass rezoning of Prime Agricultural Land into an Urban System described in *Future Caledon* opens Caledon up to developers and continues car-oriented, sprawling street networks. This section will examine street networks and public green spaces within Mayfield West as urban actors and their potential to support social-ecological systems and influence human-nature connections.

Chapter	Theory	Game Design
One	The Problem	Player Threat
Two Section 2.1	The Solution Improve active transportation networks on a neighbourhood scale. Increase urban greening through strategic planted paths and nature interventions along everyday routes.	Player Objectives Players receive Objective cards they must achieve and complete throughout the duration of the game. Objectives align with design proposals and act as educational tools to engage with topics on urban sustainability.
Three	Implementation	Finished Game

Figure 2.7

Chapter Two Section One theory and game design organization.



Figure 2.8

Backpacking crossing sign in Caledon.



Figure 2.9

Caledon Trailway path.



Figure 2.10

Trans Canada Trail street sign in Caledon.

Improve Active Transportation Infrastructure

Research shows street networks have the most influence on generating activity; therefore, by considering streets as their own formal dimension, street layouts and the location of destinations have the potential to work together and dictate street life and transportation choices.[54] In Mayfield West, several car-dominated streets have been identified for conversion into bike and pedestrian-friendly routes [Figure 2.13]. Priority is given to streets that intersect with the highest number of community programs, including commercial areas, public spaces, and green spaces, to ensure that these high traffic routes better support and promote active transportation throughout the neighbourhood. Increasing walk ways and bike lane connectivity to a greater distribution of destinations can amplify the activity and accessibility level of a given area, like the case in Denmark where decreasing motor traffic connectivity while increasing bike networks resulted in increased bike trips.[55] Similarly, the Arbutus Greenway in Vancouver, British Columbia, exemplifies how repurposing 9 km of an old railway corridor into a green landscape for active and sustainable transportation can successfully attract thousands of daily users and support ongoing enhancements to the path [Figure 2.14 and 2.15].[56]

Integrate Nature Along Frequently Travelled Routes

Observations of human movement throughout cities have also shown a preference towards routes that are as straight and direct as possible and a tendency for people to minimize the overall change in angular direction throughout their trip, for example favouring more turns with larger angles over fewer turns at sharper angles.[57] However, movement along rigid, paved routes from one point to another restricts opportunities for environmental observation and learning, whereas navigating natural spaces, such as hiking, requires direct negotiation with the terrain and surroundings.[58] The frequently travelled streets in Mayfield West make them ideal candidates for active transportation and urban greening to introduce moments of nature engagement as part of people's daily movement throughout the neighbourhood. Street networks prioritizing bike or foot traffic can be treated as hiking trails connecting rural and urban landscapes and designed as such to enhance local biodiversity.[59] Considering route preferences, urban active transportation spaces can be planned to optimize human-nature interaction occurrences by locating key areas for ecological intervention on frequented paths.

54 B Hillier et al., "Natural Movement: Or, Configuration and Attraction in Urban Pedestrian Movement," *Environment and Planning B: Planning and Design* 20, no. 1 (1993): 32, https://doi.org/10.1068/b200029.

55 Christopher Barrington-Leigh and Adam Millard-Ball, "Global Trends toward Urban Street-Network Sprawl," *Proceedings of the National Academy of Sciences* 117, no. 4 (2020): 1944, https://doi.org/10.1073/pnas.1905232116.

56 "Arbutus Greenway," City of Vancouver, accessed September 27, 2025, https://vancouver.ca/streets-transportation/arbutus-greenway.aspx.

57 Samuelsson, "The Topodiverse City," 2.

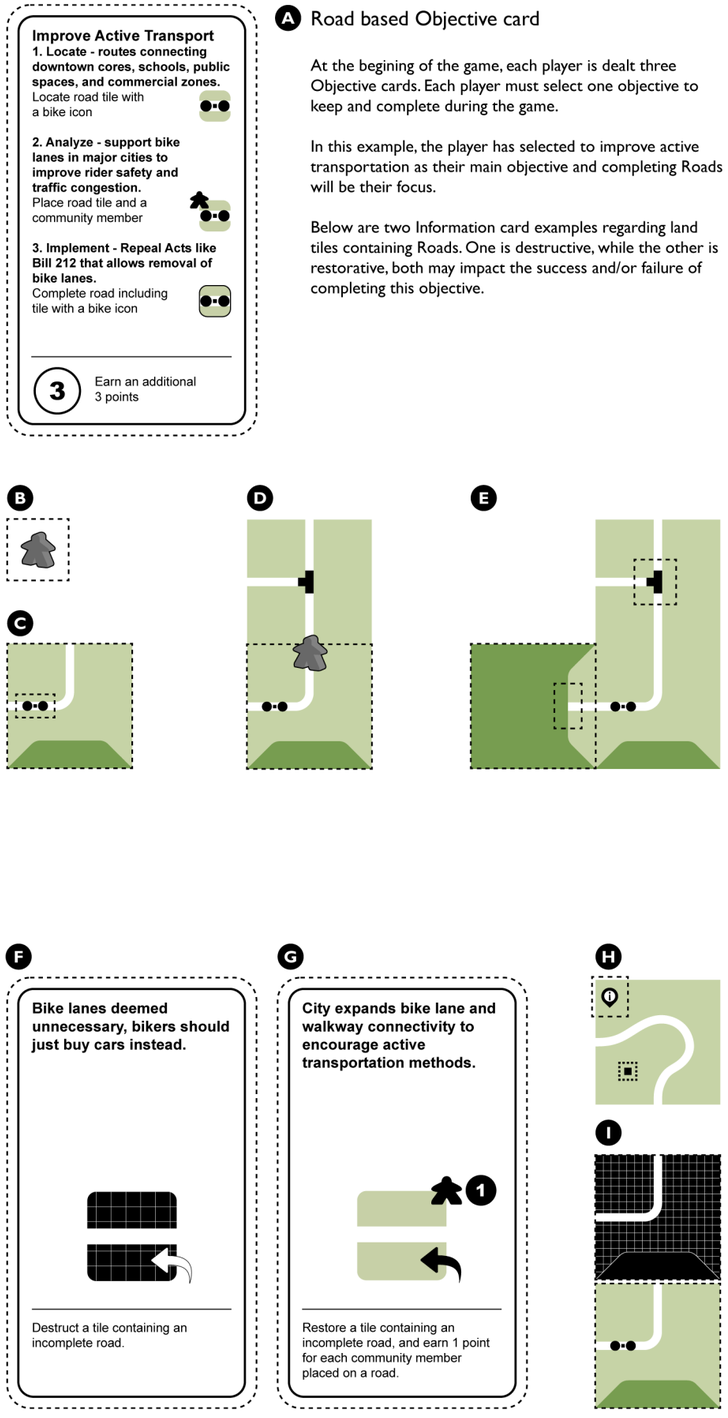
58 Michael U. Hensel, "Rural Urban Dialogue as Experience: Urban Hiking Trails and Architecture and Landscape Architecture Hybrid Typologies," in *Urban-Rural Dialogue in Green City Design: Advancing Urban Social-Ecological Systems*, ed. Alessandra Battisti et al. (Springer Nature Switzerland, 2025), 13–14, https://doi.org/10.1007/978-3-031-88318-7_2.

59 Hensel, "Rural Urban Dialogue as Experience," 21.

Chapter	Theory	Game Design
Two	The Solution	Player Objectives
Section 2.1.1	Improve active transportation networks and planted paths within neighbourhoods.	Informs the content on player Objective cards within the game. For example, the "Improve Active Transport" card.

Figure 2.11

Chapter Two Section One Part One theory and game design organization.



A Road based Objective card

At the begining of the game, each player is dealt three Objective cards. Each player must select one objective to keep and complete during the game.

In this example, the player has selected to improve active transportation as their main objective and completing Roads will be their focus.

Below are two Information card examples regarding land tiles containing Roads. One is destructive, while the other is restorative, both may impact the success and/or failure of completing this objective.

Paving Paradise Rulebook

Mechanics

A Player selected Objective card

B Unplaced Community Member

C Gain possession of a tile containing a bike icon on a Road

D Place the tile containing a bike icon by ensuring at least one side of the tile connects with another tile that has already been placed, and place a Community Member

E Complete the Road containing a bike icon by ensuring both ends of the road meet an intersection. The completed Road is scored immediately, and the Community Member can be removed

F Example of an Information card where a tile containing a section of an incomplete Road must be flipped over. Any points associated with this tile will not be scored

G Example of an Information card where a tile containing a section of an incomplete Road that has previously been flipped over, can now be resotred. Any associated points can be scored

H Example of a tile containing an Information card symbol. When this tile is placed, an Information card must be drawn by the player that placed the tile

I Example of the back side (flipped over and destructed), and top side of a tile

Figure 2.12

How to complete Road-based Objective and Information cards in *Paving Paradise*.

Private property

Non-residential

Roads

Walking paths

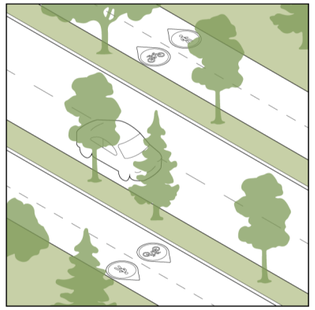
Public parks

Protected Greenbelt

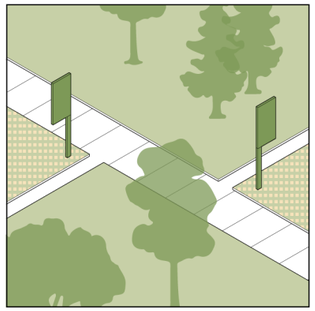
Water

Active transportation priority paths

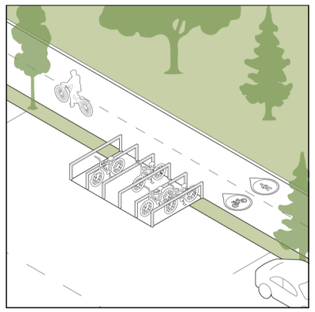
Urban greening



Walking and bike paths



A Proposed wayfinding locations



B Proposed bike parking locations

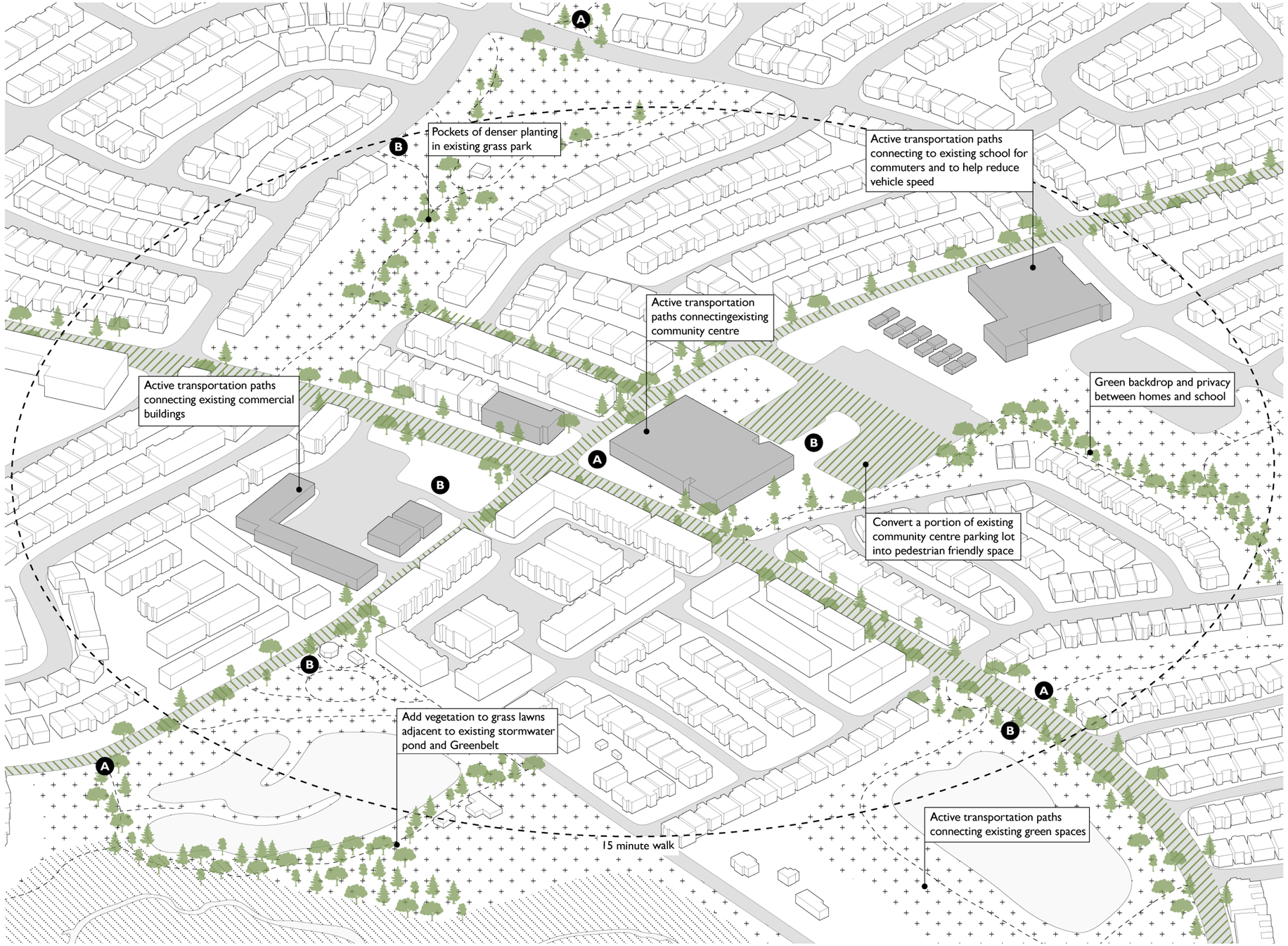


Figure 2.13

Spatialisation of proposed street network interventions in Mayfield West.



Figure 2.14

The Arbutus Greenway in Vancouver, British Columbia.



Figure 2.15

Ariel view of the community gardens along the Arbutus Greenway. Screenshot from Google Earth, showing imagery © Google, and © Vexcel Imaging US, Inc., dated 6/12/2024.

Locate Green Interventions in Central Locations

By facilitating activity, the street network dimension functions as a physical space for interaction with other people and the natural environment. Studies of human behaviour in cities show that people do not move randomly but travel between a small set of key destinations that structure their daily routines.[60] The location of destinations and their vicinity to each other play a crucial role in street network movement patterns. Central locations, where different places within a city are easily accessible from multiple directions, are attractive for business or transportation hubs as they're highly trafficked.[61] Along the active transportation corridors, central destinations in Mayfield West can be further retrofitted to facilitate social and ecological interaction by integrating recreational green spaces [Figure 2.18]. A straight-line distance of about 2.5-3 kilometres is found to be the transition between a local neighbourhood scale and the broader city scale beyond.[62] This suggests that placing most daily destinations within this range can encourage active transportation and increase activity and connection within a neighbourhood. While movement across the city is still essential for economic growth, the neighbourhood street network can guide the placement of ecological interventions to optimize human-nature interactions.[63] Introducing natural environments along everyday routes, such as the walk from school, can create meaningful connections with the surrounding landscape and help reduce ecological illiteracy.

60 Marta C. González et al., "Understanding Individual Human Mobility Patterns," *Nature* 453, no. 7196 (2008): 781, https://doi.org/10.1038/nature06958.

61 Samuelsson, "The Topodiverse City," 5.

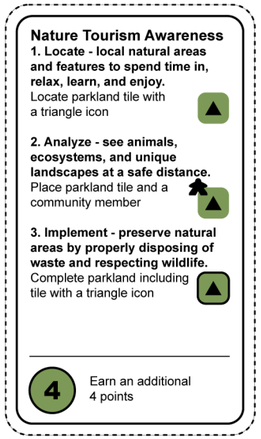
62 Samuelsson, "The Topodiverse City," 5.

63 Samuelsson, "The Topodiverse City," 7.

Chapter	Theory	Game Design
Two Section 2.1.2	The Solution Increase urban greening through strategic nature interventions along everyday routes to improve accessibility and visitation.	Player Objectives Informs the content on player Objective cards within the game. For example, the "Nature Tourism Awareness" card.

Figure 2.16

Chapter Two Section One Part Two theory and game design organization.

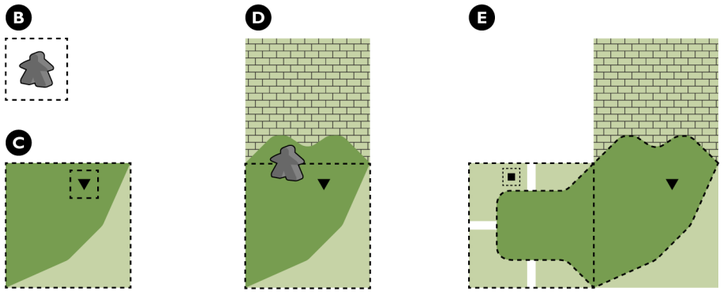


A Parkland based Objective card

At the begining of the game, each player is dealt three Objective cards. Each player must select one objective to keep and complete during the game.

In this example, the player has selected to raise nature tourism awareness as their main objective and completing Parklands will be their focus.

Below are two Information card examples regarding land tiles containing Parklands. One is destructive, while the other is restorative, both may impact the success and/or failure of completing this objective.



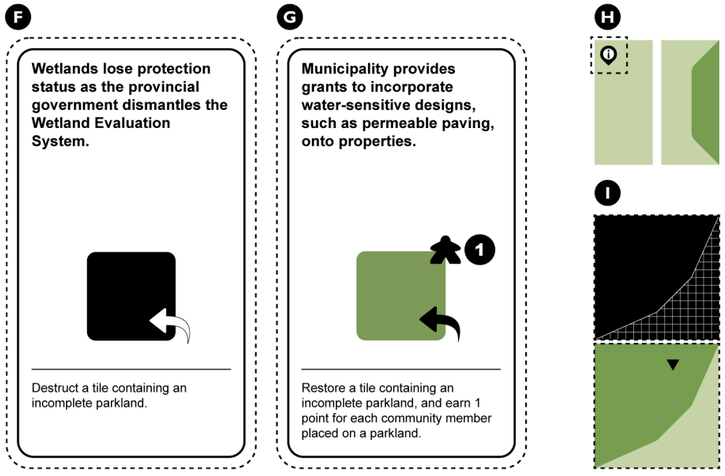


Figure 2.17

How to complete Parkland-based Objective and Information cards in *Paving Paradise*.

Paving Paradise Rulebook

Mechanics

A Player selected Objective card

B Unplaced Community Member

C Gain possession of a tile containing a triangle icon on a Parkland

D Place the tile containing a triangle icon by ensuring at least one side of the tile connects with another tile that has already been placed, and place a Community Member

E Complete the Parkland containing a triangle icon by ensuring all borders of the Parkland connect. The completed Parkland is scored immediately, and the Community Member can be removed

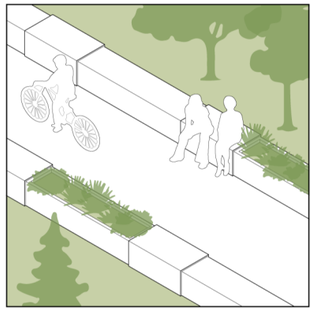
F Example of an Information card where a tile containing a section of an incomplete Parkland must be flipped over. Any points associated with this tile will not be scored

G Example of an Information card where a tile containing a section of an incomplete Parkland that has previously been flipped over, can now be resotred. Any associated points can be scored

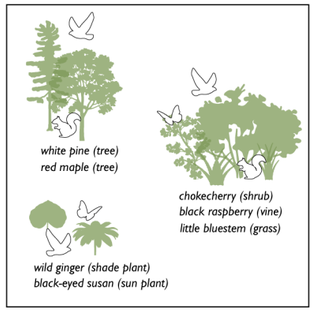
H Example of a tile containing an Information card symbol. When this tile is placed, an Information card must be drawn by the player that placed the tile

I Example of the back side (flipped over and destructed), and top side of a tile.

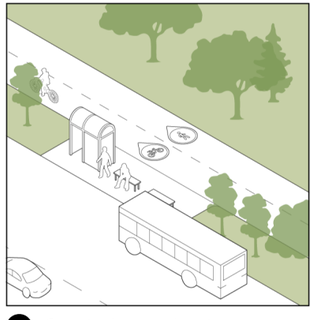
- Private property
- Non-residential
- Roads
- Walking paths
- Public parks
- Protected Greenbelt
- Water
- Active transportation priority paths
- Urban greening
- Nature recreation



Increase park benches



Native, water-efficient, wildlife supporting plant examples



A Greening bus stop locations

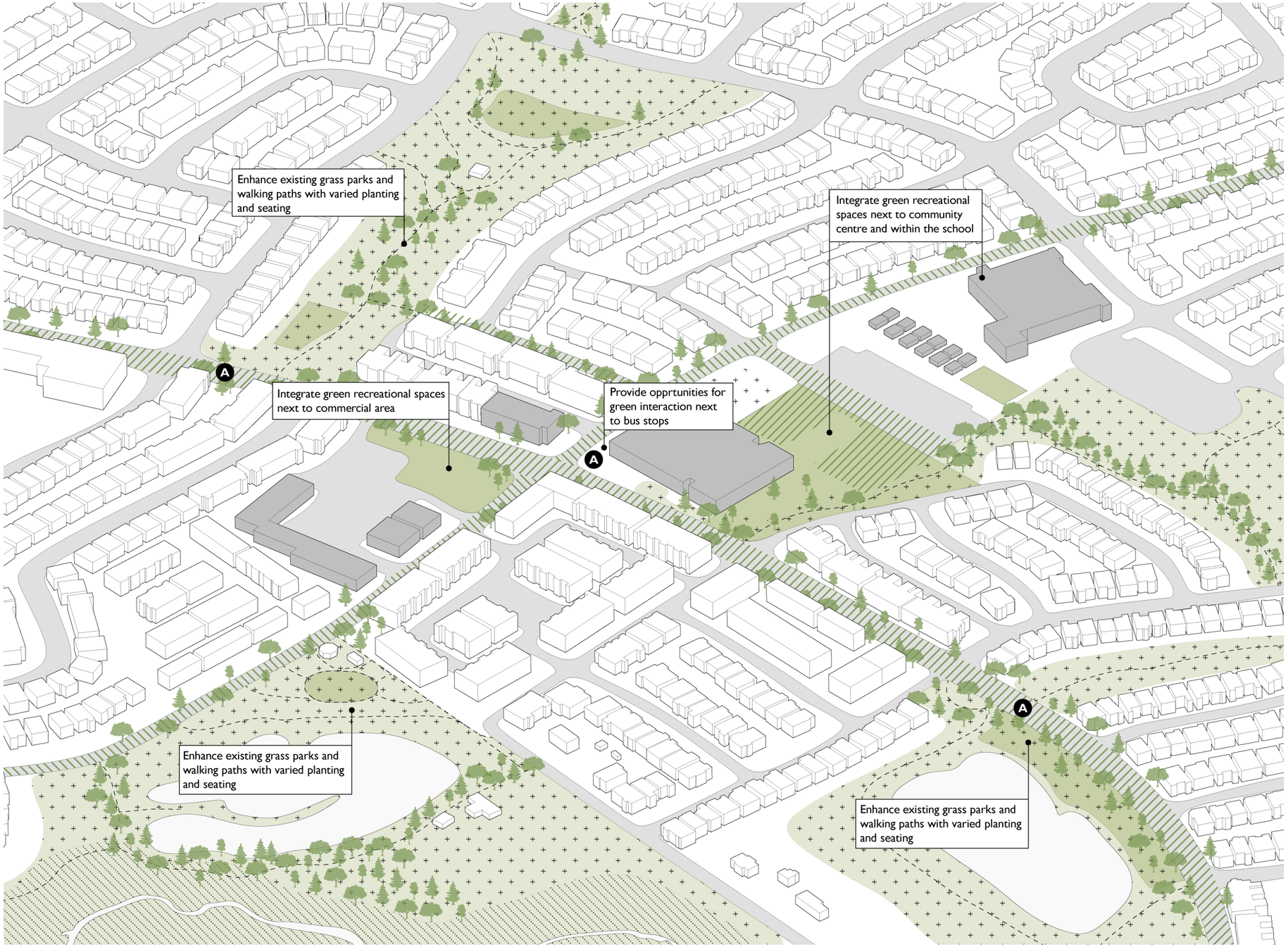


Figure 2.18

Spatialisation of proposed public space interventions in Mayfield West.

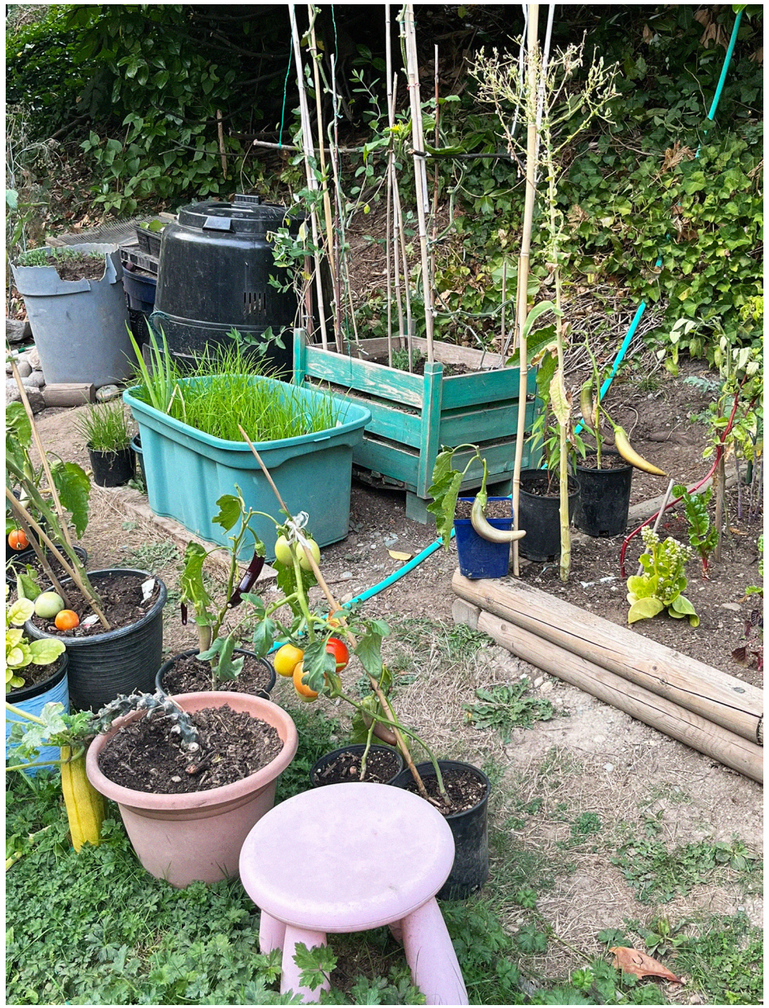


Figure 2.19

Community vegetable garden in Caledon.

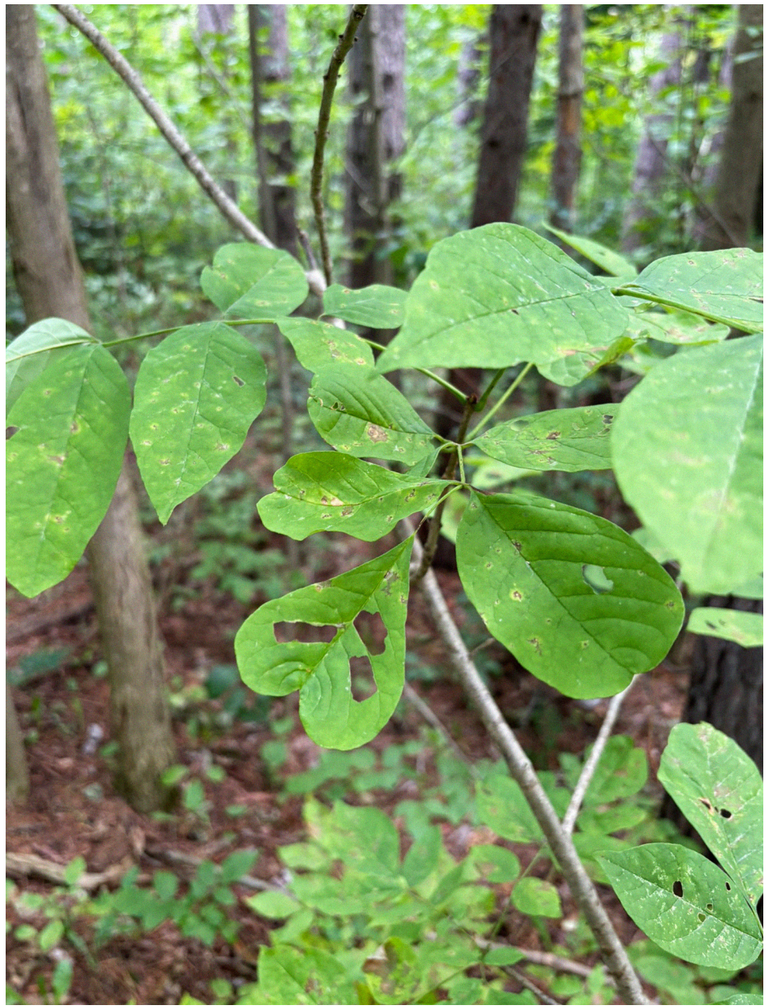


Figure 2.20

Heart shaped leaf found on a trail in Alton.

As Caledon faces car-dependent planning patterns, there is an opportunity to reimagine its future through the lens of social-ecological resilience. The configuration of street networks shapes individual activity spaces by influencing transportation choices, travel routes, and the location of social and economic activity. Strategically planning ecological interventions along active transportation paths can support local biodiversity and community well-being. Rather than expanding sprawling street networks that prioritize automobiles or creating dense concrete jungles, the integration of active and green transportation infrastructure offers a more sustainable alternative.[64] When thoughtfully designed, Caledon can leverage its street networks as a social dimension to facilitate meaningful human-nature connections and environmental education.

64 Samuelsson, "The Topodiverse City," 7.



Figure 2.21

Over grown abandoned railway in Caledon.

2.2 Green Infrastructure for Building Pro-Conservation Behaviours

Time in natural environments is proven to reduce stress and improve well-being, contributing to a growing interest in urban greening and biophilic design.[65] The integration of nature into cityscapes can improve ecological literacy and pro-conservation behaviour by providing access to nature in people's immediate surroundings.[66] Successfully integrating ecologically conscious design in cities requires treating social and ecological systems as equally essential and interconnected, for example, reconsidering property rights and species habitats.[67] Resilient communities require collaboration between developers, policy makers, scientists, and communities to create green infrastructure and multifunctional land to offer ecological, cultural, and economic benefits.[68] Urbanization with a focus on social-ecological services can bring urban residents closer to nature and raise awareness to human dependency on natural ecosystems. This section explores social services and public spaces in Mayfield West as urban actors, highlighting their role in supporting social-ecological systems and generating human-nature interactions.

65 Samuelsson, "The Topodiverse City," 3.

66 Colding et al., "Frontiers in Social–Ecological Urbanism," 7.

67 Colding et al., "Frontiers in Social–Ecological Urbanism," 8.

68 Ahmed Abouaiana, "Constructed Wetlands as Green Infrastructure to Improve Quality of Life," in *Urban-Rural Dialogue in Green City Design: Advancing Urban Social-Ecological Systems*, ed. Alessandra Battisti et al. (Springer Nature Switzerland, 2025), 182, https://doi.org/10.1007/978-3-031-88318-7_11.

Chapter	Theory	Game Design
One	The Problem	Player Threat
Two Section 2.2	The Solution Community gardens to support ecological education and moral affiliations to nature. Urban green retrofits and infrastructure for improved animal and water movement through cities.	Player Objectives Players receive Objective cards they must achieve and complete throughout the duration of the game. Objectives align with design proposals and act as educational tools to engage with topics on urban sustainability.
Three	Implementation	Finished Game

Figure 2.22

Chapter Two Section Two theory and game design organization.



Figure 2.23

Water body beside the Alton Mill.



Figure 2.24

Water dam at the Alton Mill.



Figure 2.25

"Check your shoes" sign for invasive species at the Caledon Trailway trail head in Inglewood.



Figure 2.26

Survey site for invasive spotted lanternfly on the Caledon Trailway in Inglewood.

Support Urban Agriculture and Community Gardens

Resilient urban ecosystems comprise complex relationships and interdependencies between people and other living elements. These connections are essential for resilient social and ecological systems; however, without direct interaction, they easily go unnoticed to those living in urban settings. Food cultivation is a good example of how people can build stronger and more meaningful relationships with the natural processes that support human life as they reveal the support required between humans and non-humans in creation.[69] Without this connection, people and especially children fail to recognize their surroundings (ground, air, food, and water) as a part of nature and become more susceptible to generational environmental amnesia.[70] The integration of community urban gardens can begin to address this disconnect by providing direct sensory encounters with living things as a method to build environmental awareness and pro-conservation behaviour.[71] A network of community urban gardens distributed throughout Mayfield West provides food services and can become a form of recreation, promoting healthier lifestyles and community engagement within the accessibility of the neighbourhood [Figure 2.29].[72] The act of planning, building, digging, planting, and maintaining gardens form moral affiliations, reminding children and adults that nature is found in everyday things and a product of ecological systems.[73] Through urban farming, cities can begin to counteract ecological illiteracy and improve overall human well-being and environmental resilience.

69 Rachael Walshe et al., "Understanding Environmental Generational Amnesia through Urban School Garden Learning Experiences in Gimuy/Cairns, Australia," *Local Environment* 30, no. 7 (2025): 863, https://doi.org/10.1080/13549839.2024.2394678.

70 Walshe et al., "Understanding Environmental Generational Amnesia through Urban School Garden Learning Experiences in Gimuy/Cairns, Australia," 865.

71 Walshe et al., "Understanding Environmental Generational Amnesia through Urban School Garden Learning Experiences in Gimuy/Cairns, Australia," 863.

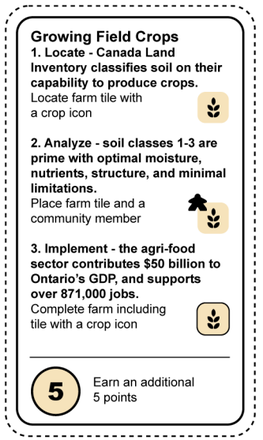
72 Livia Calcagni and Alberto Calenzo, "Growing Urban Health: Questioning the Role of Urban Gardening in Distressed Urban Areas," in *Urban-Rural Dialogue in Green City Design: Advancing Urban Social-Ecological Systems*, ed. Alessandra Battisti et al. (Springer Nature Switzerland, 2025), 135–36, https://doi.org/10.1007/978-3-031-88318-7_9.

73 Walshe et al., "Understanding Environmental Generational Amnesia through Urban School Garden Learning Experiences in Gimuy/Cairns, Australia," 862–63.

Chapter	Theory	Game Design
Two Section 2.2.1	The Solution Support community garden initiatives for ecological education and moral affiliations to nature.	Player Objectives Informs the content on player Objective cards within the game. For example, the "Growing Field Crops" card.

Figure 2.27

Chapter Two Section Two Part One theory and game design organization.

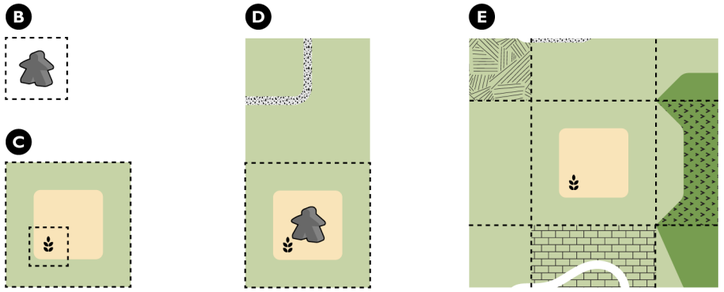


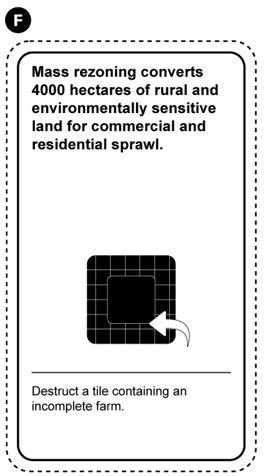
A Farm based Objective card

At the begining of the game, each player is dealt three Objective cards. Each player must select one objective to keep and complete during the game.

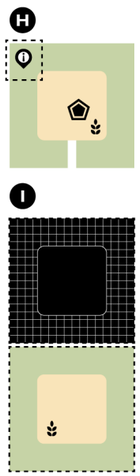
In this example, the player has selected to grow crops as their main objective and completing Farms will be their focus.

Below are two Information card examples regarding land tiles containing Farms. One is destructive, while the other is restorative, both may impact the success and/or failure of completing this objective.









Paving Paradise Rulebook

Mechanics

A Player selected Objective card

B Unplaced Community Member

C Gain possession of a tile containing a crop icon on a Farm

D Place the tile containing a crop icon by ensuring at least one side of the tile connects with another tile that has already been placed, and place a Community Member

E Complete the Farm containing a crop icon by ensuring it is completely surrounded with 8 adjacent tiles. The completed Farm is scored immediately, and the Community Member can be removed

F Example of an Information card where a tile containing a section of an incomplete Farm must be flipped over. Any points associated with this tile will not be scored

G Example of an Information card where a tile containing a section of an incomplete Farm that has previously been flipped over, can now be resotred. Any associated points can be scored

H Example of a tile containing an Information card symbol. When this tile is placed, an Information card must be drawn by the player that placed the tile

I Example of the back side (flipped over and destructed), and top side of a tile.

Figure 2.28

How to complete Farm-based Objective and Information cards in *Paving Paradise*.

Private property

Non-residential

Roads

Walking paths

Public parks

Protected Greenbelt

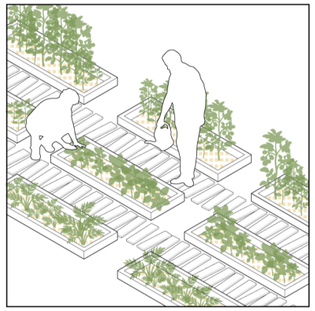
Water

Active transportation priority paths

Urban greening

Nature recreation

Food cultivation



Urban agriculture



A Information board location



Edible or other notable plantings with signage

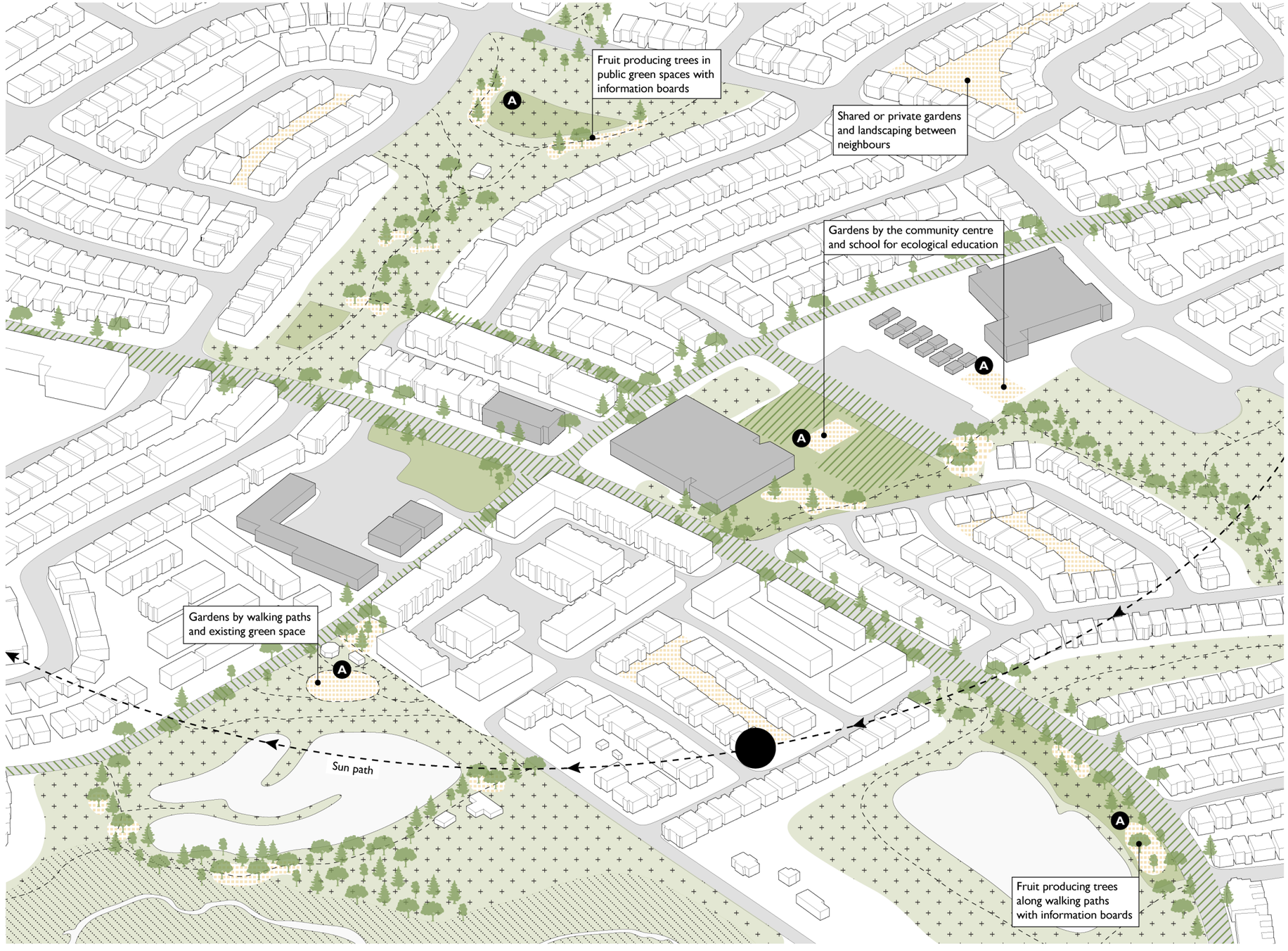


Figure 2.29

Spatialisation of proposed nature engagement interventions in Mayfield West.



Figure 2.30

Community garden in Jonathan Rogers Park in Vancouver.

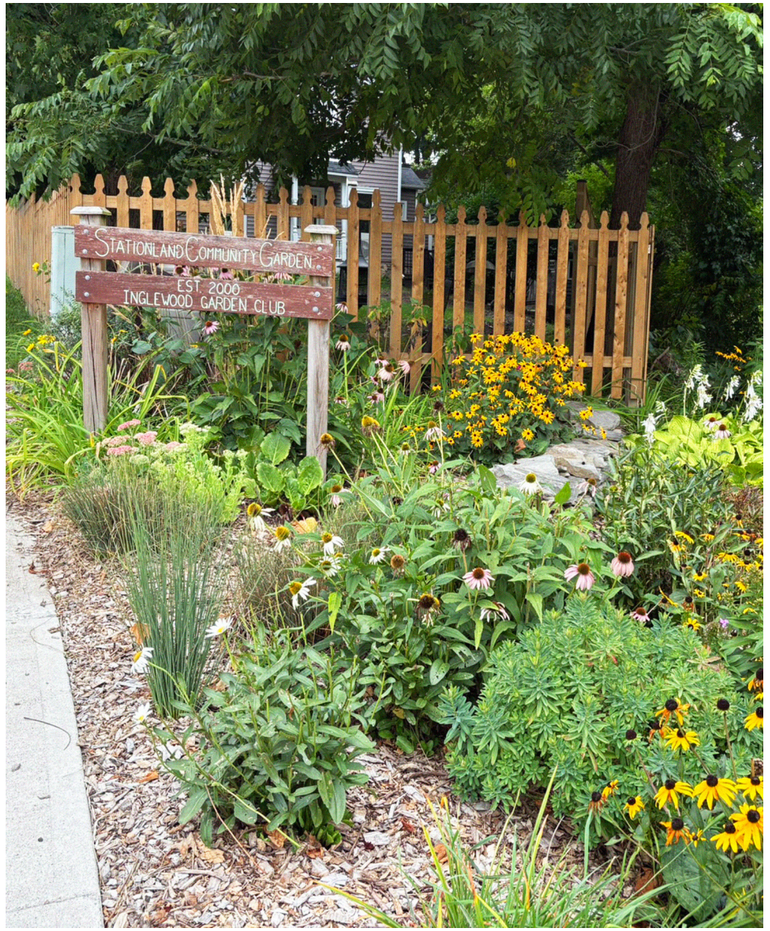


Figure 2.31

Community garden along a sidewalk in Inglewood.

Design for All Living Things and Natural Processes

Recognizing that humans share land with ecosystems, the built environment must prioritize the needs of these systems to protect, sustain, and enhance existing ecological services. The design of urban infrastructure can be formed to better support social-ecological functions by considering how living things and natural processes engage with cityscapes.[74] Introducing connected greenscapes in dense urban areas creates habitats for small animals and supports key species, such as pollinators and seed dispersers, enhancing biodiversity and urban resilience.[75] In addition to planting and natural features, infrastructure for urban water solutions, like permeable paving, are effective strategies for improving and retrofitting cities.[76] Integrating infrastructure to mimic and support the natural water cycle in urban areas will manage the effects of climate change and reduce flood risks.[77] Built environments with nature-based solutions, such as green roofs, can also improve urban greenscapes while delivering ecosystem services, including air purification and runoff control.[78]

Encourage Environmental Recreation and Education

In Mayfield West, greening active transportation routes creates corridors linking the Greenbelt to existing green spaces and retrofits nearby streets and property lots with permeable surfaces to support the water cycle and diversify suburban typologies [Figure 2.34]. With careful design consideration, urban green infrastructure can become a dimension for recreational activities that further enhances urban life by increasing greenery and engagement with natural processes.[79] Stormwater ponds can become outdoor classrooms that educate both children and adults about the importance of maintaining healthy water cycles to support human well-being.[80] With wayfinding and informative signage, green corridors and water infrastructure in Mayfield West can offer accessible and interactive opportunities for ecological learning. Implementing green infrastructure and water features in cities can reduce the impact of climate change, bring people closer to ecological services, and promote environmental education.

74 Colding et al., "Frontiers in Social–Ecological Urbanism," 11.

75 Colding et al., "Frontiers in Social–Ecological Urbanism," 11.

76 Colding et al., "Frontiers in Social–Ecological Urbanism," 12.

77 Abouaiana, "Constructed Wetlands as Green Infrastructure to Improve Quality of Life," 169.

78 Katia Perini and Enrica Roccotiello, "Urban Regeneration with Nature-Based Solutions: Human and Nature Perspectives," in *Urban-Rural Dialogue in Green City Design: Advancing Urban Social-Ecological Systems*, ed. Alessandra Battisti et al. (Springer Nature Switzerland, 2025), 106, https://doi.org/10.1007/978-3-031-88318-7_7.

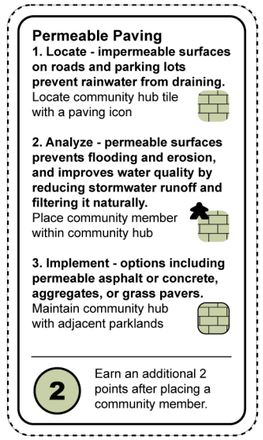
79 Abouaiana, "Constructed Wetlands as Green Infrastructure to Improve Quality of Life," 169.

80 Abouaiana, "Constructed Wetlands as Green Infrastructure to Improve Quality of Life," 169.

Chapter	Theory	Game Design
Two Section 2.2.2	The Solution Implement urban green retrofits and infrastructure to support animal and water movement through cities.	Player Objectives Informs the content on player Objective cards within the game. For example, the "Permeable Paving" card.

Figure 2.32

Chapter Two Section Two Part Two theory and game design organization.

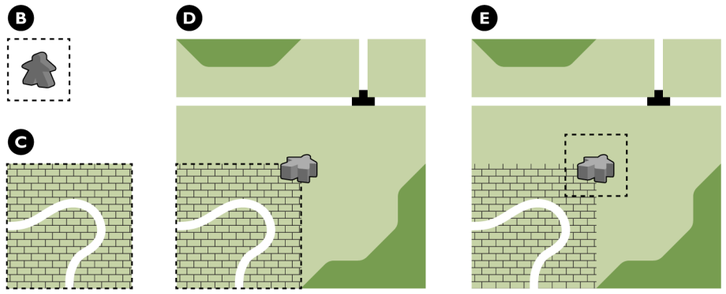


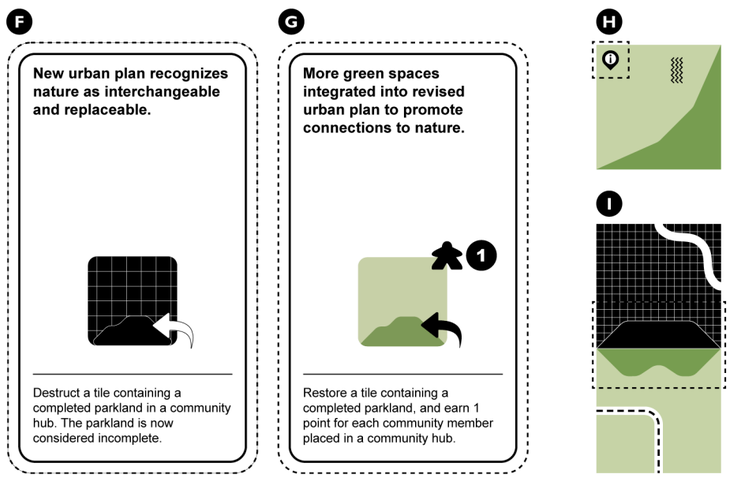
A Community Hub based Objective card

At the begining of the game, each player is dealt three Objective cards. Each player must select one objective to keep and complete during the game.

In this example, the player has selected permeable paving as their main objective and managing Community Hubs will be their focus.

Below are two Information card examples regarding land tiles containing Parklands. One is destructive, while the other is restorative, both may impact the success and/or failure of Community Hubs at the end of the game.





Paving Paradise Rulebook

Mechanics

A Player selected Objective card

B Unplaced Community Member

C Gain possession of a tile containing a Community Hub with the paving icon.

D Place the tile containing a Community Hub with the paving icon by ensuring at least one side of the tile connects with another tile that has already been placed, and place a Community Member

E The Community Member will stay on the board until the end of the game

F Example of an Information card where a tile containing a section of a completed Parkland must be flipped over. Any points associated with this tile will not be scored

G Example of an Information card where a tile containing a section of a completed Parkland that has previously been flipped over, can now be resotred. Any associated points can be scored

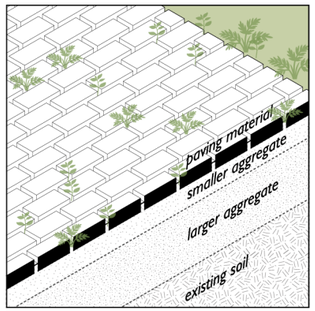
H Example of a tile containing an Information card symbol. When this tile is placed, an Information card must be drawn by the player that placed the tile

I Example of a completed Parkland that has been destructed and is now considered incomplete

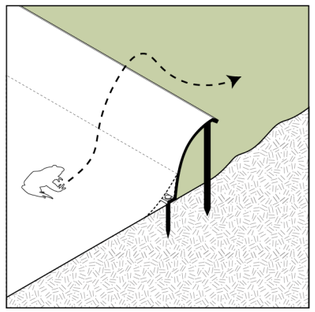
Figure 2.33

How to complete Community Hub-based Objective and Information cards in *Paving Paradise*.

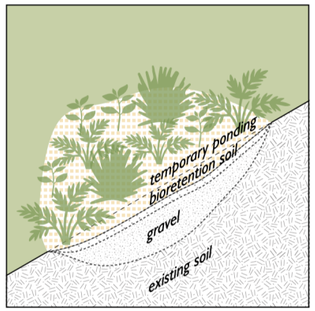
- Private property
- Non-residential
- Roads
- Walking paths
- Public parks
- Protected Greenbelt
- Water
- Active transportation priority paths
- Urban greening
- Nature recreation
- Food cultivation
- Green infrastructure
- Green connections
- Water solutions



Permeable paving



A Proposed wildlife fence locations



B Proposed rain garden locations

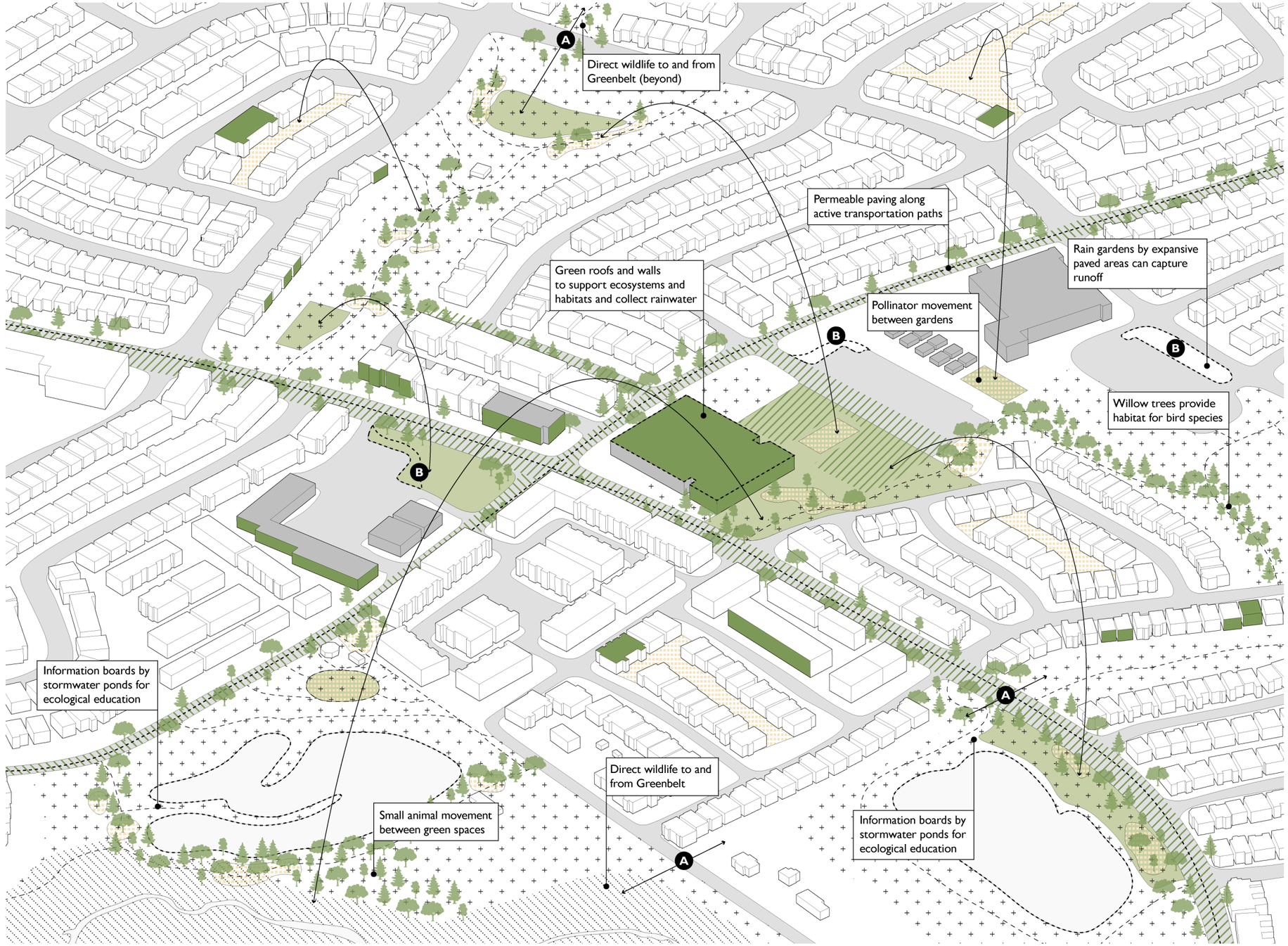


Figure 2.34

Spatialisation of proposed green infrastructure in Mayfield West.



Figure 2.35

Turtle crossing sign and turtle egg protective structures in Alton.

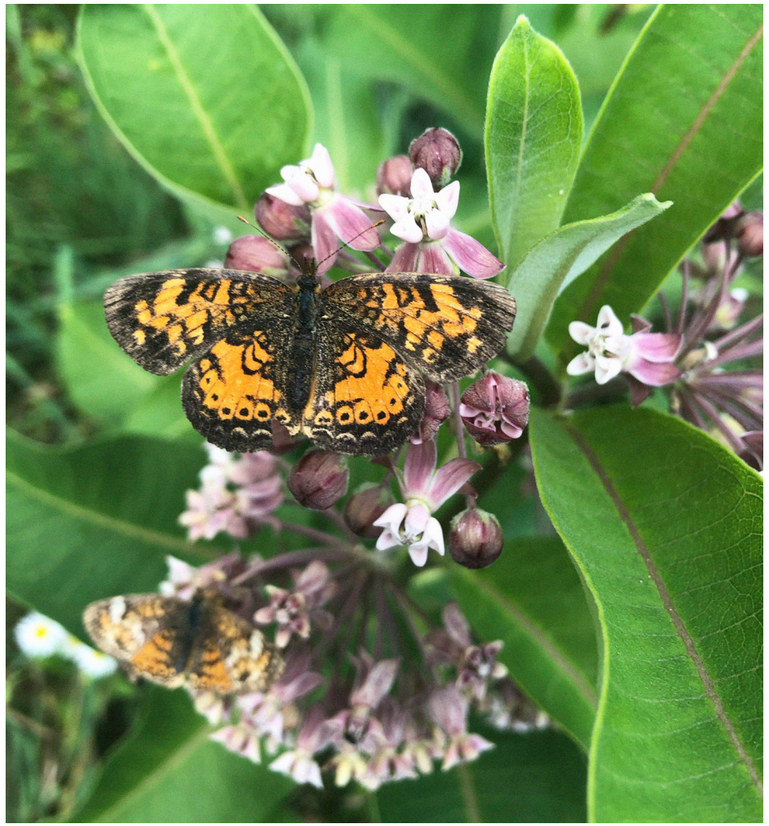


Figure 2.36

Butterflies on milkweed in a field in Alton.

Embedding ecological design into urban environments is essential for fostering resilient cities. Through integrating green infrastructure, food cultivation, biodiverse habitats, and water-sensitive design, Caledon can support critical ecosystem services while simultaneously supporting well-being and ecological literacy. These design proposals aim to raise awareness for urbanization methods, within Caledon and beyond, that can mitigate environmental impact and reconnect people to the natural processes that sustain life, reducing the effects of sprawling cities and generational environmental amnesia. Ultimately, a collaborative approach to development that recognizes the interconnection and interdependence of humans and ecological systems will build healthier communities and create resilient urban landscapes.



Figure 2.37

Tree plantings by a community centre and the Credit River in Inglewood.

2.3 Conclusion

Acknowledging the benefits of exposure to nature supports the need to integrate natural systems into architecture and infrastructure, ensuring social-ecological urban resilience that not only enhances adaptive capacity to climate change but also strengthens cognitive resilience, promotes ecological literacy, and develops pro-environmental behaviour through everyday sensory experiences with local ecosystems. While speculative, the design interventions outlined in Chapter 2 are intended to spark discussion and illustrate the potential of incorporating sustainable and green infrastructure into suburban neighbourhoods, challenging sprawl-oriented development patterns in favour of a more socially and ecologically resilient urban form. Significant integration of social and ecological considerations in planning requires engagement with local knowledge to respect social contexts as well as ecological and biophysical conditions.[81]

With a top-down governance structure that diminishes community voices, and increasing privatization of urban public space, there is a need for policies and diverse property rights arrangements that enable civic participation in protecting ecosystem services. Urban design should adopt a bottom-up approach that involves residents and their local experience. Within a social-ecological urbanism framework, collaborative planning is essential to mobilize collective action, as meaningful citizen influence over public resources has been shown to generate economic benefits and promote ecological learning.[82] Therefore, providing opportunities for participatory planning, stakeholder engagement, and knowledge sharing is critical when building sustainable communities.[83]

81 Colding et al., "Frontiers in Social–Ecological Urbanism," 13.

82 Colding et al., "Frontiers in Social–Ecological Urbanism," 9.

83 Abouaiana, "Constructed Wetlands as Green Infrastructure to Improve Quality of Life," 172.



Figure 2.39

Pond in Ken Whillans Conservation Area.

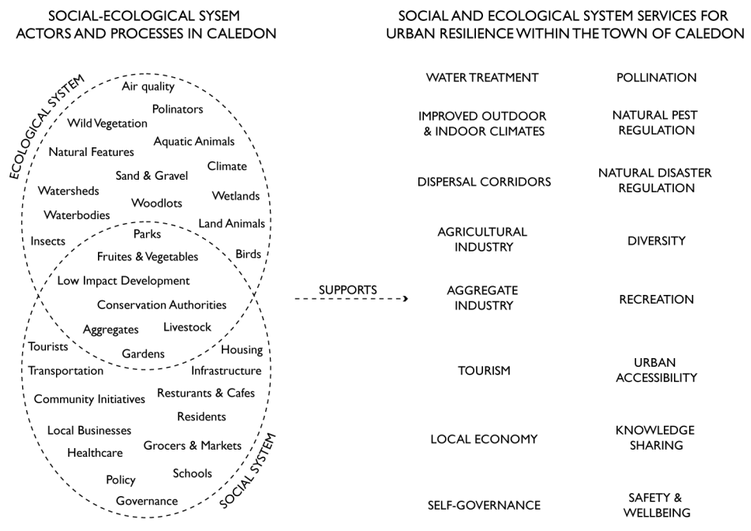


Figure 2.38

Social-ecological system services for urban resilience in Caledon. Inspired by a diagram in Barthel et al., Principles of Social-Ecological Urbanism – Case Study: Albano Campus, Stockholm (2025).

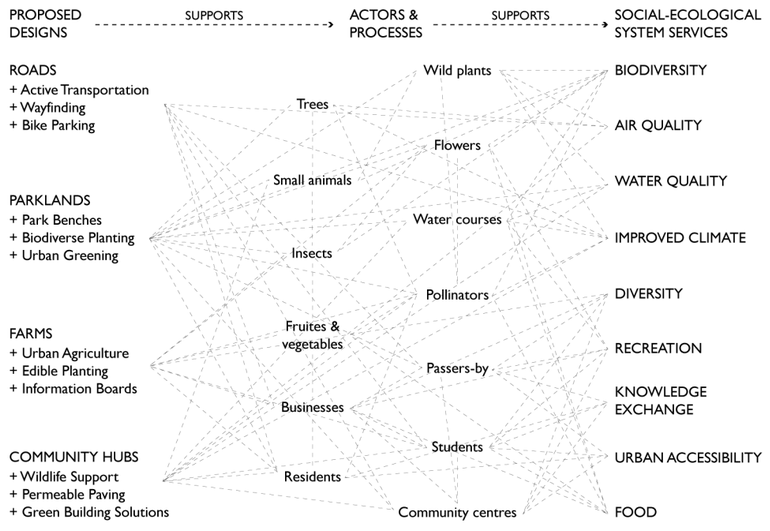


Figure 2.40

Social-ecological actors and processes supported by design proposals in Caledon. Inspired by a diagram in Barthel et al., Principles of Social-Ecological Urbanism – Case Study: Albano Campus, Stockholm (2025).

A tenet of C.S. Holling's resiliency framework is the ability to self-organize and restabilize after unexpected disturbances, whatever shape they take.[84] Game play can behave similarly as it is a complex system whose mechanics must be able to respond to unexpected moves made by a variety of players. Game mechanics ensure that each game presents distinct challenges and yields unique endings. Serious games can function as an effective tool for educating and engaging the public by translating complex interconnections, such as social-ecological systems, into accessible formats that allow participants to engage with planning challenges in their local contexts. Attributes of social-ecological urbanism frameworks applied to the Town of Caledon are synthesized and translated into game features and mechanics that will be further explored in the following chapter as a method to understand, communicate, educate, and engage with social-ecological systems and urban form.

The designed game enables players to explore the possibilities of a social-ecologically resilient approach to the town's urbanization through interaction, negotiation, and open discussion among players. By using gaming to level the playing field among a wide range of urban stakeholders, local communities and ecosystems can engage in shaping their environments equal to that of large developers and governing bodies. Frameworks for social-ecological urbanism emphasize that dialogue and knowledge sharing improves societies' ability to adapt, a principle echoed by Ekim Tan, founder of Games for Cities, who argues that games can become research and learning environments where urban knowledge is generated and evolved.[85] Serious gaming has the potential to build a greater foundation for community participation in planning processes, encouraging co-design practices, and help counteract the cycle of ecological illiteracy and generational environmental amnesia by providing residents with relevant local knowledge and agency.

84 Holling, "Resilience and Stability of Ecological Systems," 21.

85 Barthel et al., "Principles of Social-Ecological Urbanism - Case Study," 23; Ekim Tan, "Negotiation and Design for the Self-Organizing City. Gaming as a Method for Urban Design," *ResearchGate*, ahead of print, August 2014, 121, https://doi.org/10.7480/abe.2014.11.

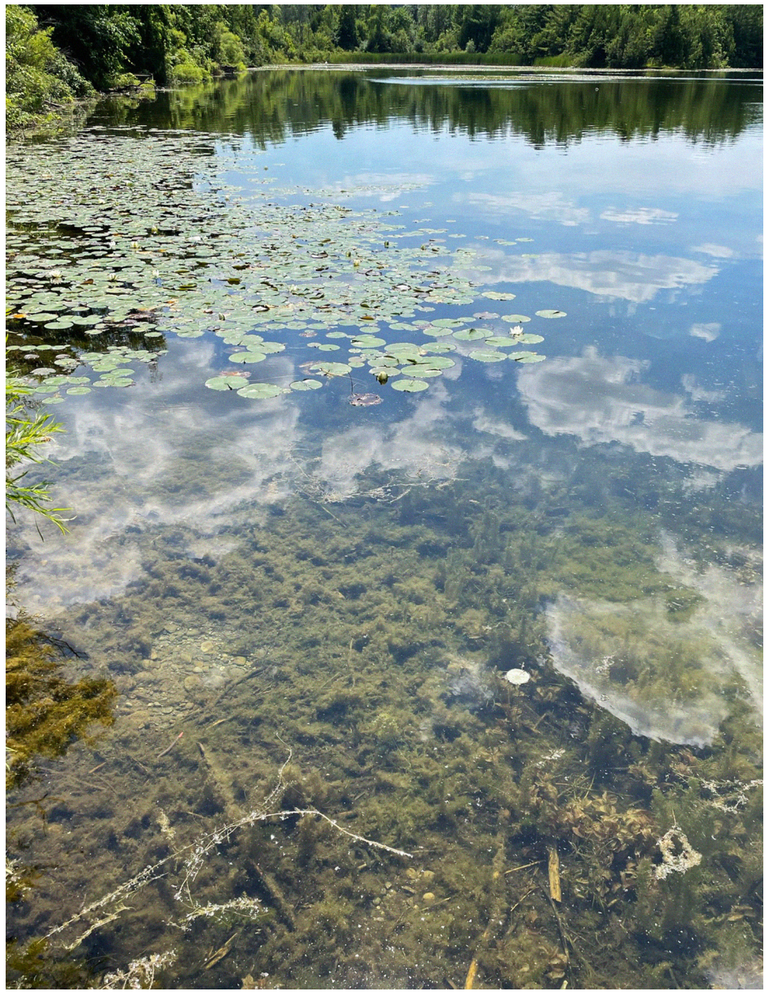
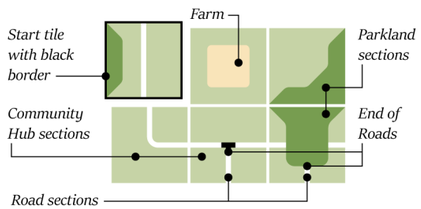


Figure 2.41

Ken Whillans Conservation Area.

Game Components



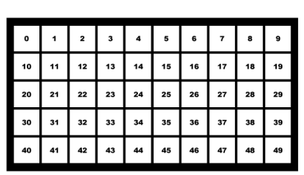
- 72 Land feature tiles (including 1 start tile with a black border) with Roads, Parklands, Fams, and Community Hubs.



- 32 Community Members in 4 colours: each player will have 8 Community Members and one of them will be used to keep score on the scoreboard.



- 32 Information cards
- 16 Objective cards



- 1 Scoreboard
- 1 Rulebook
- 1 Bag: to store tiles when drawing

Figure 2.42

Paving Paradise game components.

Game Setup

The start tile is placed top-side up on a table and the other tiles are shuffled and placed in the bag. Each player draws three tiles out of the bag and places them in front of themselves, this will be their tile reserve. Once a tile is removed from the reserve and played, players must draw another tile. Throughout the game, players must always have exactly three tiles in front of them, until the end of the game when there are no more tiles to draw. Shuffle the Objective and Information cards and place them in face-down stacks on the edge of the table along with the scoreboard to give players enough room to place more tiles. Each player is dealt three Objective cards and discards two at the start of the game. Their selected Objective card can be shown to the other players. Each player takes the 8 Community Members of their chosen colour and places one on the scoreboard starting at zero (0) points. Each player keeps the remaining seven Community Members as their personal supply. The group can decide who goes first, or simply let the youngest player start the game.

Objective Cards



Paving Paradise Rulebook

Game Components

- Farm based Objective cards, they are all worth 5 points.
- Parkland based Objective cards, they are all worth 4 points.
- Road based Objective cards, they are all worth 3 points.
- Community Hub based Objective cards, they are all worth 2 points.

Figure 2.43

Catalogue of all Objective cards in *Paving Paradise*.

Information Cards

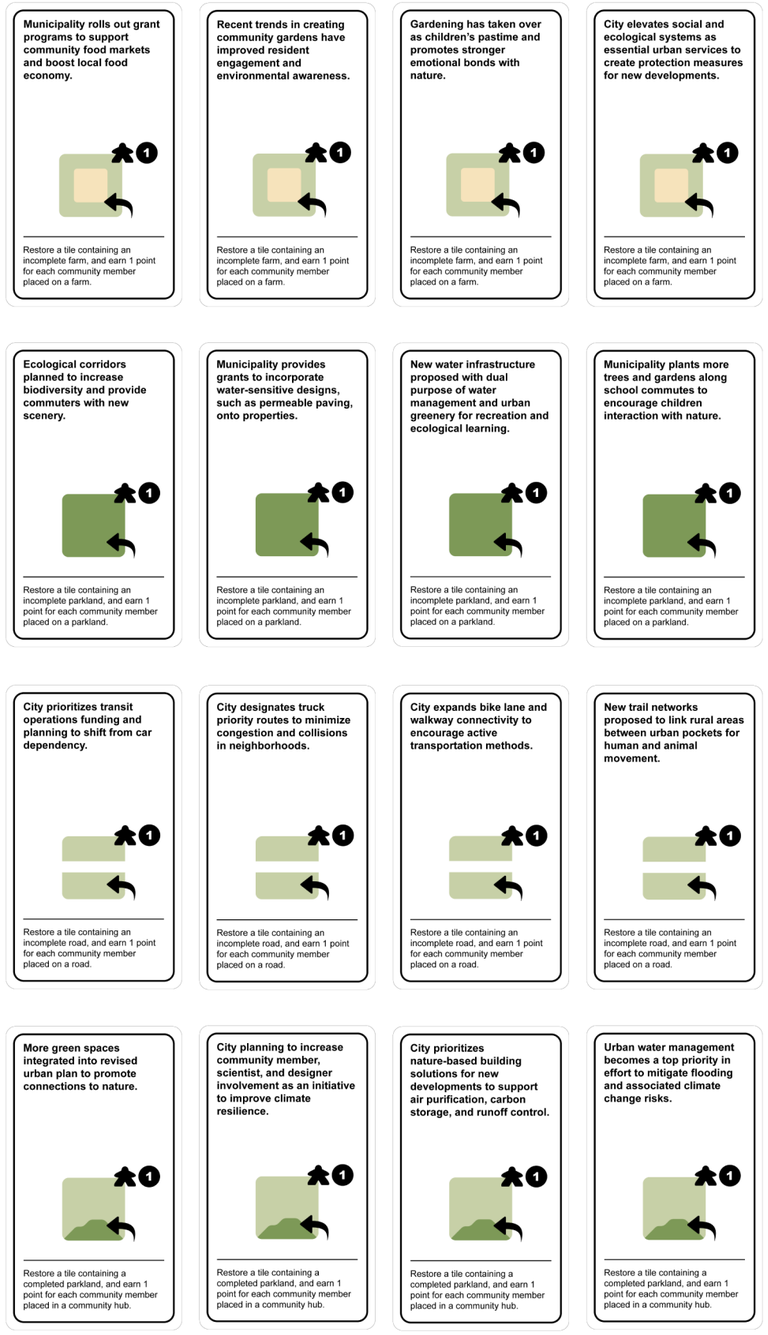


Figure 2.44

Catalogue of all supportive Information cards in *Paving Paradise*.

Information Cards

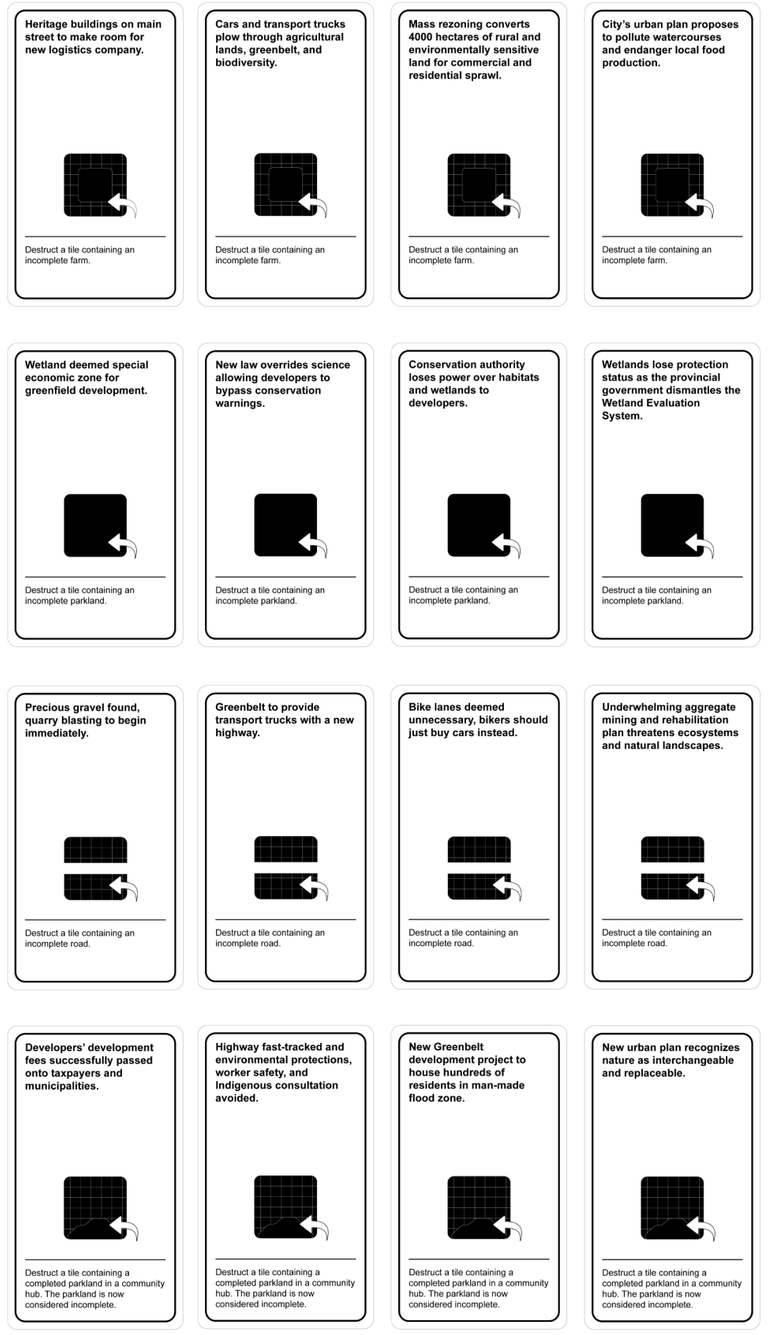


Figure 2.45

Catalogue of all destructive Information cards in *Paving Paradise*.

Chapter Three

Playing the Game

Water

Forested areas

Roads

Built-up area

Greenbelt

Niagara Escarpment

Oak Ridges Moraine

Figure 3.1

Layering of built-up areas, the Greenbelt, road networks, water bodies, and forested areas in Caledon.

3.0 Playing the Game

Dutch historian Johan Huizinga in his book *Homo Ludens* (1938) explains how play precedes human culture, "the great archetypal activities of human society are all permeated with play from the start."[86] By extension, our daily lives can be understood and explained through play. Huizinga uses the creation of language and metaphor as a "play on words" to describe the desire for humans to create "a second, poetic world alongside the world of nature," or in other words, a game-world.[87] For architects and urbanists, a poetic game-world can be used as an instrument to shape spaces of alternate realities, to prototype environments, and collaborate with the communities they design for to challenge existing urban structures and create more human-centric and sustainable environments.

Gaming has been widely adopted as a method for education as it allows players to take on roles outside of their daily life, receive immediate feedback from their actions without real-world risks, and supports learning through motivating, competitive, and engaging experiences.[88] The game format lends itself well to concepts of urban sustainability and resiliency in three major, but not exclusive, ways: the introduction of unexpected variables throughout time leading to an undetermined result, a context in which players can easily subscribe to an alternate universe, or game-world, to suspend knowledge of the realities in the real-world, and finally, necessity for interaction and engagement with other players and the contents of the game. Community engagement and civic ecological literacy are crucial for responding to environmental devastation from rapid urbanization. The development and use of a game can supplement this by providing an accessible platform for communication and learning to take place.

86 Johan Huizinga, *Homo Ludens: A Study of the Play-Element in Culture* (Martino Publishing, 1950), 4.

87 Huizinga, *Homo Ludens: A Study of the Play-Element in Culture*, 4.

88 Minju Kim et al., "Urban Gentri: Serious Game on Learning about Gentrification," *Journal of Planning Education and Research*, SAGE Publications Inc, September 20, 2024, 4, https://doi.org/10.1177/0739456X241280179.



Figure 3.2

A couple donkeys on a private farm in Caledon.

Participatory planning is an approach that makes design more meaningful by involving local communities in shaping their city through collaboration and knowledge sharing. The implementation of serious games in participatory planning is an attempt to prioritize the individual citizen and the collective in forming urban order incrementally (bottom-up) over preconstructed urban forms dictated by economic gain from large urban stakeholders (top-down). This approach to urban planning through serious gaming has gained traction with the growing belief that a single authority, like a governing body or the market, can not independently control a complex system like a city with hierarchical top-down planning structures.[89] To destroy the hierarchy, bottom-up approaches to planning need to be integrated, such as translating complex and interconnected social-ecological urban systems into an accessible game that gives agency to players across a wide range of disciplines.

The idea of grounding game rules and narratives in abstracted real-world contexts is not novel in contemporary participatory planning initiatives or even in popular board games. Games like IBM's *CityOne* (2010), Will Wright's *SimCity* (1989), and Buckminster Fuller's *World Game* (1960s) all reflect the interconnected nature of society and its systems. Even popular household games draw on real-world ideas and systems to create game narratives, including *Monopoly* (1935), *Catan* (1995), and *Pandemic* (2008). The goal of *Monopoly* is to achieve complete capital control, structurally ensuring disparity between players. To win *Catan*, players must expand their own territory, extract resources from the land, and build settlements. *Pandemic* is a cooperative game where players of different abilities must work together to eradicate an external threat. Games become an opportunity to foster participation and attract civic interest on new and alternative urban topics and ideas in an engaging and accessible way. For example, and the question of this thesis, how policy can influence urban sustainability and pro-conservation behaviour, and how design strategies can mitigate human-nature separation and build resilient cities.

Architects, designers, and urbanists, such as Ekim Tan and Janette Kim, have designed serious alternate reality games to iterate through planning problems and educate on sustainability within the built environment. The *Play the City* methods developed by Ekim Tan focus on researching and developing urban spaces through providing players the ability to influence development, build characters based on personal knowledge, and engage with real-world and game-world powers like laws and investments.[90] The success of *Play the City* games rely on the opportunity for players to reflect on their individual experiences to lead game play, strategize, and inevitably self-govern. Similar to building resilient social and ecological systems, promoting local knowledge and knowledge sharing is a key aspect in protecting ecosystem services and collective well-being through bottom-up self-organization. *Bartertown*, a community outreach game designed by Janette Kim, sets players in an alternate world of power-sharing where they must rethink their everyday lives, navigate flooding events, and explore property, creativity, generosity and mobility as forms of currency that could be traded and exchanged.[91] Tan's game engages with urban

89 Tan, "Negotiation and Design for the Self-Organizing City. Gaming as a Method for Urban Design," 107.

90 Ekim Tan, "Play the City," *Architekturen*, January 1, 2019, 266, https://www.academia.edu/84035209/Play_the_City.



Figure 3.3

Participants playing Janette Kim's *Bartertown*. Photo courtesy of Janette Kim. Source: "Bartertown," Urban Works Agency, California College of the Arts, https://www.urbanworks.cca.edu/bartertown

stakeholders and Kim's game with general communities to play out possible scenarios against alternate realities, in both cases the intersection of personal experience and urban problems create valuable commentary on the realities of cities.

Understanding that play and games can be abstractions of systems and structures, this creates an opportunity to model the game-world with "real-life quests, such as global warming, migration, or inequality, and changing some of their conditions to generate what-if scenarios."[92] The game designed for this thesis, titled *Paving Paradise*, engages with the influence of policy, social-ecological relationships, and the impact of humans on the land they occupy. While the content is grounded in the real world, the mechanics of the game are symbolic, and the narrative is simplified to ensure enjoyment. The intent and significance of the designed game is to explore the threat of sprawling development, spark discussion, educate, and engage local communities on resilient urban design solutions.

91 Janette Kim, "Daylighting Conflict: Board Games As Decision-Making Tools," Scenario Journal, December 2, 2019, https://scenariojournal.com/article/daylighting-conflict/.

92 Tan, "Play the City," January 1, 2019, 269.

3.1 Game Mechanics

Paving Paradise is derived from the existing modular tile-based board game, *Carcassonne*, created by Klaus-Jürgen Wrede and published in 2000, where players must control and expand their land to win the game. The scope of *Paving Paradise* is based on the Town of Caledon and reimagines *Carcassonne* into a serious game that thematically aims to address the policies and governing structures that impact ecological systems and literacy through urban development explored in Chapter One, and the possible design strategies towards increased human-nature connection and environmental education experienced in cities proposed in Chapter Two. Through the educational mechanics of playing a game, the goal of *Paving Paradise* is to bring awareness, spark discussion, and engage a larger audience on the complex relationships between ecological services and sustainable urbanization.

In addition to drawing conceptual and mechanical inspiration from *Carcassonne*, the design of *Paving Paradise* integrates selected elements from three widely recognized board games: *Monopoly*, *Pandemic*, and *Ticket to Ride*. These games were chosen due to their familiarity among general audiences and the clarity with which their mechanics convey complex systems and interactions. Their integration leverages specific mechanics that align with and support the thematic objectives of this thesis through structured gameplay. Each game contributes a distinct design quality that reinforces *Paving Paradise's* aim to critically engage players in questions of sprawling urbanization, sustainable design, and the role of collective agency in shaping resilient urban futures.

Carcassonne is the foundational framework, offering a tile-laying system and modular board that enables spatial storytelling and emergent urban form. *Monopoly* informs the incorporation of random event mechanics, such as Chance and Community Chest cards, which introduce variability and simulate external forces. *Pandemic* provides a model of cooperative gameplay in which players collectively confront external threats, reflecting the shared responsibility and interdependence inherent in ecological systems. *Ticket to Ride* introduces asymmetrical goals, allowing players to pursue diverse and potentially conflicting objectives, representing the urban stakeholders and the diverse motivations that drive development. By synthesizing these mechanics, *Paving Paradise* creates an interactive platform that enables players to explore the tensions between ecological resilience and urban expansion, allowing them to navigate the competing forces of urban growth and conservation. The game's structure promotes critical engagement, encourages systems thinking, and facilitates experiential learning through a speculative reimagining of urban futures grounded in environmental justice and collective agency.

Chapter	Theory	Game Design
One	The Problem	Player Threat
Two	The Solution	Player Objectives
Three	Implementation Use of existing game mechanics and playtesting to iteratively develop a serious game that critically engages with systems thinking and collective agency.	Finished Game *Paving Paradise* becomes a game for knowledge sharing and community engagement about urban policy and strategies to build resilient cities.

Figure 3.4

Chapter Three theory and game design organization.

Carcassonne

Klaus-Jürgen Wrede's *Carcassonne* is a competitive tile-laying game that requires players to randomly draw and place tiles to develop landscapes by forming roads, cities, farms, and monasteries. To earn points and win the game, players must form completed developments with the tiles and place their "followers," or little wooden figures, onto the board. The game is named after the medieval French fortified city, Carcassonne, and is inspired by the urban landscapes that surround it.[93] Inspired by Wrede's *Carcassonne*, *Paving Paradise* utilizes similar modular tiles and wooden figures. *Carcassonne* is used as the framework due to its modularity, which allows players to literally construct the game board, mirroring the iterative and negotiated nature of urban development. However, by redefining tile placement as a shift from exerting power over land to collaboratively designing a shared environment, *Paving Paradise* reframes development as a collective process aimed at social-ecological resilience.

The tile-laying mechanic results in different spatial configurations each round, shaped by player agendas, thereby reflecting the competing interests and priorities of various urban stakeholders. Simultaneously, the element of chance involved in drawing tiles requires players to adapt within formal constraints, encouraging strategic responses to unforeseen environmental conditions. *Paving Paradise* constructs a narrative of urban development that engages with the influence of both top-down policy and sustainable design strategies, portraying a landscape shaped by institutional forces yet transformed through individual and collective resilience, adaptation, and ecological stewardship.

93 Klaus-Jürgen Wrede, *Carcassonne*, board game (Munich: Hans im Glück Verlag, 2000; English ed., Z-Man Games); Christof Tisch, *Carcassonne: Official English Rulebook*, board game rulebook (Sterling, VA: Z-Man Games, 2012).



Figure 3.5

Carcassonne game board, by Angus the Bull, licensed under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/). Source: BoardGameGeek, https://boardgamegeek.com/image/82760/carcassonne.

Playing the Game

Players take turns sequentially in a clockwise direction, beginning with the first player. On their turn, each player must perform the following actions in the order listed below:

1. (*Optional*) Request a new Objective card.
2. (*Optional*) Negotiate to trade tiles.
3. Select and place a tile from your reserve or play the negotiated tile.
4. (*Optional*) Then, you can take one (1) of your Community Members from your supply and put it on the tile you just placed.
5. (*If applicable*) If placing a tile results in the completion of one or more features (such as Roads, Parklands, or Farms), the Community Member on that feature is removed, and the feature is scored immediately.
6. (*If applicable – see Information Cards*) Draw an Information card and play the actions as described on the card, either flipping over tiles and/or collecting points, and then discard the card.
7. (*If applicable)* Draw a new tile and place it into your tile reserve.

Placing Tiles

At the start of their turn, a player can examine their reserve tiles along with the reserve tiles of the other players. The player must place a tile on the table either from their own reserve or negotiate for a tile from someone else's reserve to place. Next, the player places the tile on the table while following the placement rules [Figure 3.6].

Placing Community Members

After placing a tile, a player may choose to place one of their Community Members on it, following the rules outlined below [Figure 3.7]:

- Only 1 Community Member can be placed per turn.
- The Community Member must be from the player's supply.
- The Community Member can only be placed on the tile the player just placed.
- The player must decide where they will place their Community Member. As such, the Community member can occupy a Road, Parkland, Farm, or Community Hub.
- A Community Member may not be placed on a Road, in a Parkland or in a Community Hub if that section is connected to another tile where there already is a Community Member (no matter which player placed that Community Member).
- If a player has used all of their Community Members, they continue placing one tile per turn. Players cannot retrieve their Community Members from tiles. A Community Member is only returned when the Road, Parkland, or Farm they occupy is completed and scored.
- At this point, the player's turn is over and the next player takes their turn, followed by the next one, and so on.

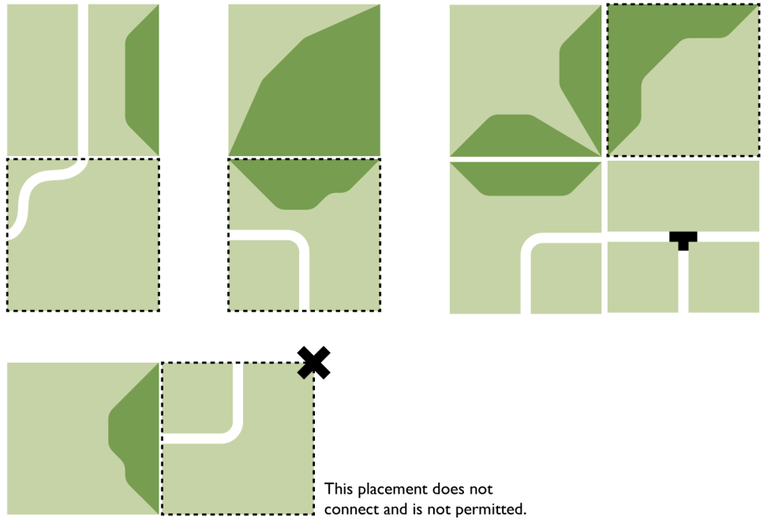


Figure 3.6

How to place tiles in *Paving Paradise*.

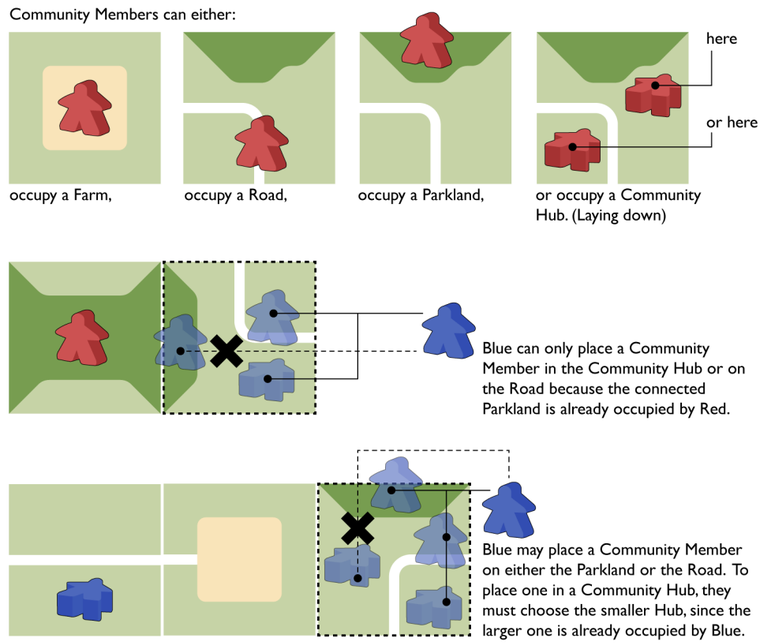


Figure 3.7

How to place Community Members in *Paving Paradise*.

Monopoly

In 1904, Lizzie G. Magie designed *The Landlord's Game*, a board game based on highlighting the potential for landlords to exploit their tenants. This game gained popularity as homemade versions circulated in the United States until 1935 when Charles B. Darrow sold the idea to Parker Brothers, patenting the game known today as *Monopoly*.[94] *Monopoly* is a competitive turn-based board game in which players roll dice to move around the board to buy and trade properties, develop buildings, and collect rent from other players.[95] To win the game, players must bankrupt their opponents by acquiring assets and developing properties. Two key mechanics in *Monopoly* integrated into *Paving Paradise* are the Chance and Community Chest cards. These cards are drawn randomly and introduce elements of unpredictability and external influence to the individual player who drew the card, such as receiving money, paying fines, going to jail, or advancing to specific board locations. This game mechanic simulates the real-world unpredictability and external forces that can alter individual or group trajectories within the urban fabric, reflecting the political shifts that occur. While not present in *Carcassonne*, this mechanic has been incorporated into *Paving Paradise* to introduce an additional layer of uncertainty and risk. It aims to reflect the influence of top-down decision-making that can either support or undermine ecological systems and human well-being. The mechanic critiques policy and urban planning practices that are often detached from the land and its biophysical realities, highlighting their potential to displace communities, erase cultural heritage, and degrade ecosystems.

94 "Monopoly," Britannica, September 17, 2025, https://www.britannica.com/sports/Monopoly-board-game.

95 Charles Darrow, *Monopoly*, board game (Salem, MA: Parker Brothers, 1935).

Pandemic

Pandemic was designed by Matt Leacock and published in 2008 by Z-Man Games.[96] It is a cooperative board game where players, each with unique roles and abilities, work together to cure four diseases spreading across a global map. Through drawing infection cards, new infections emerge randomly each turn, creating ongoing pressure and requiring coordinated, strategic responses to prevent outbreaks. *Paving Paradise* incorporates similar card mechanics that can pose external threats or advantages to all players equally, in contrast to Chance and Community Chest cards in *Monopoly* that only impact the individual. This mechanic reflects the realities of urban development, where communities are often subject to predetermined planning frameworks imposed by top-down authorities. Advantage cards will also be incorporated to highlight initiatives that can improve biodiversity and support ecosystems in urban landscapes. Within this structure, players must navigate and respond to external constraints, much like communities seeking to assert agency in rigid urban systems. This is intended to create a sense of collective urgency, shared responsibility, and shared reward, forcing players to communicate, negotiate, and make difficult trade-offs. The game speaks to a broader objective of participation, collective knowledge, and mutual support in planning to enhance ecological sustainability and strengthen human-nature relationships.

96 Matt Leacock, *Pandemic*, board game (Roseville, MN: Z-Man Games, 2008).



Figure 3.8

Monopoly board by: Fir0002/Flagstaffotos, licensed under CC BY-NC 4.0 (https://creativecommons.org/licenses/by-nc/4.0/). Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Monopoly_board_on_white_bg.jpg.



Figure 3.9

Pandemic board game by: U.S. Centers for Disease Control and Prevention. In public doamin.



Figure 3.10

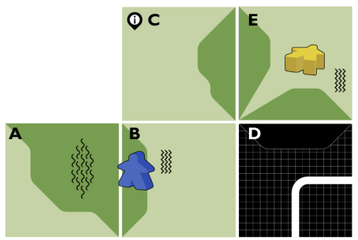
Information card symbol located on 20/72 game tiles in *Paving Paradise*.

Information Cards

Out of the 72 tiles, there are 20 tiles with an Information card icon. When a tile with an Information card icon is placed, an Information card must be drawn and played by the player that placed the tile within the same turn. Information cards can be good or bad, with the potential to rehabilitate features and reward points, or pave over features for sprawling development.

Destroying and flipping over tiles because of sprawling development

If the described action on the Information card requires a completed Parkland, or incomplete Road, Parkland, or Farm to be destructed and flipped over, the player that drew the card can decide which placed tile matching the Information card's description will be flipped [Figure 3.11].



If the drawn Information card requires an incomplete Parkland to be flipped over, in this example, the player can choose to flip tiles A or B.

They may not flip over C or E as those tiles are a part of a completed Parkland, and they may not flip over D as that tile has already been flipped.

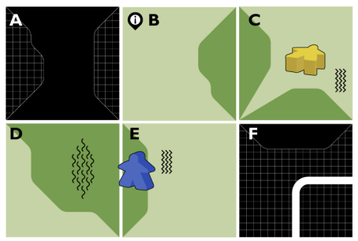
Note: Any icons on tiles that are flipped over will lose their value and could potentially prohibit a player from achieving their objective.

Figure 3.11

How to play destructive Information cards in *Paving Paradise*.

Restoring and flipping back tiles after land feature rehabilitation

If the described action on the Information card requires a completed Parkland, or incomplete Road, Parkland, or Farm that was previously destructed to be restored and flipped back, the player that drew the card can decide which placed tile matching the Information card's description will be flipped back [Figure 3.12].



If the drawn Information card requires an incomplete Parkland to be restored and flipped back, in this example, the player can flip back A or F.

Flipping A will allow Blue to receive the 2 points associated with the tile if they later complete the Parkland.

While flipping F will allow Yellow to receive 3 points at the end of the game associated with the completed Parkland. (Therefore, in this example, Yellow will receive a total of 6 points).

Figure 3.12

How to play supportive Information cards in *Paving Paradise*.

Ticket to Ride

Ticket to Ride was designed by Alan R. Moon and published in 2004 by Days of Wonder.[97] It is a competitive board game in which players collect train cards to claim railway routes across a map. To start the game, each player randomly receives unique destination ticket cards that outline specific railway routes connecting one city to another that they must complete. These objectives vary in difficulty and reward and guide each player's strategy throughout the game. Completing a route earns points, while failing to do so results in a penalty, creating an asymmetric playing experience that shapes long-term planning and how players navigate the shared game board, finite resources, and overlapping interests. Similarly, *Paving Paradise* provides each player with a unique Objective card at the beginning of the game, reflecting different urban planning stakeholders with diverse and sometimes conflicting visions for the city. As players pursue their individual goals without coordination, they may block others or create conflict. The asymmetry of goals in the game challenges players to balance multiple agendas within a single urban landscape. *Paving Paradise* engages stakeholders in negotiation, and knowledge sharing to align goals, resolve conflicts, and support social and ecologically conscious development. Sustainable urban planning depends on recognizing the interconnectedness of human and non-human stakeholder objectives and working toward shared outcomes that support both community and ecological well-being.

97 Alan R. Moon, *Ticket to Ride*, board game (Los Altos, CA: Days of Wonder, 2004).

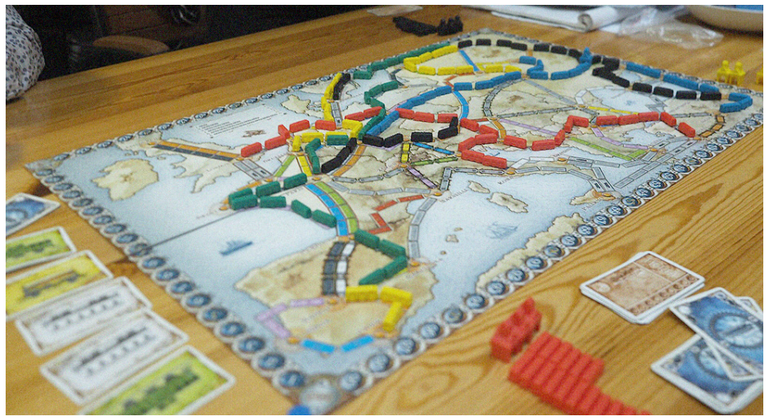


Figure 3.13

Ticket to Ride by JIP, licensed under Creative Commons Attribution-ShareAlike 4.0 International (CC BY-SA 4.0), https://creativecommons.org/licenses/by-sa/4.0/. Adapted from original. Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Ticket_to_Ride_Europe_in_Hattula.jpg

Objective Cards

At the start of the game, each player is dealt three Objective cards which they can review and strategize with their tile reserve (and other player's tile reserves). Each player must discard two Objective cards which must be kept secret and keep one that must be revealed to other players. The kept card will be the player's objective throughout the game. Once the objective is completed, the card is discarded, and the points are scored immediately. If a player does not complete their objective by the end of the game, the number of points they would have received by completing the objective will be deducted from their total points.

After a player has completed their objective, in any of their following turns, they may request another Objective card if they wish. They will once again be dealt three Objective cards, from which they keep one. The same Objective card rules will apply.

Paving Paradise
Rulebook

Objective Cards



Figure 3.14

Catalogue of all Objective card Icons located on game tiles in *Paving Paradise*.

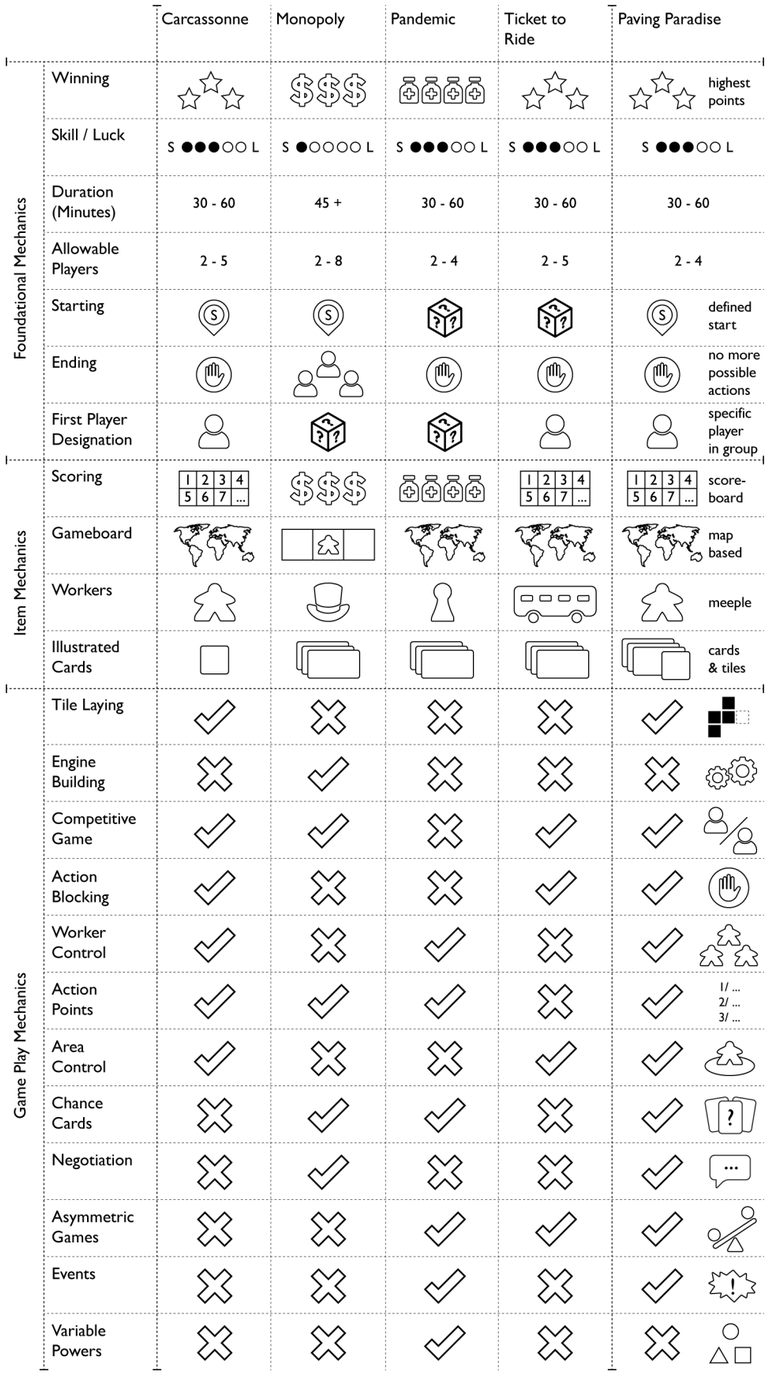


Figure 3.15

Game mechanic comparison chart between *Paving Paradise*, *Carcassonne*, *Monopoly*, and *Ticket to Ride*.

By drawing on game mechanics from *Carcassonne*, *Monopoly*, *Pandemic*, and *Ticket to Ride*, *Paving Paradise* constructs an interactive platform that mirrors the complex and interlinked social-ecological systems of urban development. Through applying design mechanics that allow for spatial storytelling, pressure from external forces, cooperative problem-solving, and asymmetrical objectives, *Paving Paradise* reflects the competing dynamics of ecological resilience and rapid urbanization. These mechanics form the foundational structure and narrative of the game, which will be further developed and refined through playtesting. The final game intends to invite players to engage with urban and environmental tensions critically, promote ecological literacy, and learn from experience in an accessible and playful format. *Paving Paradise* becomes a speculative tool for understanding urban landscapes rooted in sustainable development and a vehicle for dialogue and participatory planning.

3.2 Playtesting

Games, like urban systems, function as complex, dynamic systems composed of interdependent and continuously evolving components. Their complexity is further amplified by the unpredictability of human behaviour, making outcomes and interactions difficult to anticipate or fully comprehend. To facilitate the successful design of a board game that promotes ecological literacy on topics of social-ecological systems, volunteers will be recruited to participate in playtesting to inform the game design process. Four rounds of playtesting will be conducted with participants from the University of Waterloo School of Architecture. The playtesting structure developed for this thesis is informed by Frank West's playtesting process for his board game, *The City of Kings*.[98] Each session will be guided by a structured framework outlining specific objectives, areas of focus, and discussion points, to systematically evaluate and refine the game's mechanics, narrative, and educational potential.[99]

The playtesting for this project will involve participants exclusively from the University of Waterloo School of Architecture. This decision is based on a combination of practical, pedagogical, and conceptual considerations aligned with the research goals and constraints of the study. Logistically, selecting participants from within the institution ensures accessibility for multiple rounds of testing and structured feedback. While the game uses Caledon as a case study, it is designed to be adaptable to various urban contexts, therefore, familiarity with Caledon itself is not required. Additionally, architecture students offer a valuable mix of perspectives. Although many may have exposure to sustainable urban development, they are not specialists in ecological systems, which reflects the intended audience of the game, aiming to increase ecological literacy among those with limited prior knowledge. Their foundational understanding of urban design also makes their input valuable in evaluating how well the game's mechanics convey urbanization processes and stakeholder dynamics. Finally, as emerging contributors to the built environment, these students are well-positioned to benefit from and contribute to the game's aim of fostering ecological awareness and more sustainable planning approaches.

As a critical component of this thesis, playtesting is used to both evaluate and develop the design o*f Paving Paradise*. It enables the iterative refinement of game mechanics, narrative structure, and visual communication, while assessing the game's potential to enhance ecological literacy and player engagement with themes of sustainable urban development. Given that the game is designed as a multiplayer experience, playtesting with a group of participants is essential to assess not only individual interaction with the mechanics but also key aspects tied to the game's representation of urban planning processes, including collective dynamics, decision-making, and negotiation.

The playtesting process is designed to be iterative and collaborative, involving the same group of participants across all four rounds. This continuity enables cumulative feedback, where each session builds upon insights from previous iterations. Rather than relying exclusively on designer observation, participants become co-designers in shaping the game's mechanics, narrative, and educational potential, supporting a process of co-creation. An iterative structure allows the game to evolve through a continuous cycle of testing, analysis, redesign, and reflection. Each round of playtesting follows a structured manual that builds upon previous rounds to guide the game's development:[100]

- Iterative Rounds (Section 3.2)

  Round One - Mechanics: Assess functionality and overall playability, ensuring the game operates as intended.

  Round Two - User Experience: Assess the game's flow, enjoyment, and engagement, ensuring it builds upon Round 1 and aligns with the thematic goals.

  Round Three - Visuals and Graphics: Evaluate the legibility and aesthetics of the game, ensuring that the graphics align with the game's narrative.

- Finished Game (Section 3.3)

  Final Round - Engagement and Education: Assess effectiveness in promoting engagement with social-ecological systems and players' awareness of the interdependencies in urban development processes.

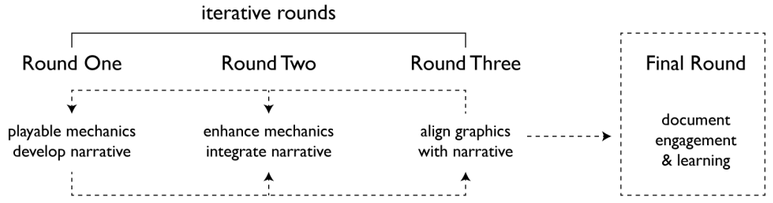


Figure 3.16

Playtesting rounds and structure.

As a result of playtesting, the design process yields a practical outcome for a functioning educational game, along with a theoretical understanding of game mechanics as a method for representing and communicating complex social-ecological systems. Rounds 1-3, presented in Section 3.2 *Playtesting*, will inform the development of the finished game. The fourth and final round, documented in Section 3.3 *Playtest Final Round*, will include participant interviews and a discussion of the completed game, assessing its alignment with the thesis objectives of fostering ecological awareness and promoting meaningful engagement with sustainable urban design.

98 Frank West, "How Do You Playtest Board Games," *The City of Games*, December 8, 2022, https://thecityofkings.com/news/how-do-you-playtest-board-games/.

99 For the complete Playtest Guide, see page 197 of the Appendix.

100 For the complete Playtest Guide, see page 197 of the Appendix.

3.2.1 Playtest Round One: is it Playable?

The focus of Round 1 was to explore the playability of *Paving Paradise* and ensure it is operational. At this stage, the mechanics of the game were still flexible and to be further iterated through in playtesting, during which observations were made on how the mechanisms functioned in practice. Since *Carcassonne* already exists as a successful game, the primary focus was on how the newly introduced mechanics integrated with the existing game. Key questions included how well existing *Carcassonne* game items and narratives can be altered thematically to align with the research questions, whether the newly introduced Objective and Information cards work effectively, and whether gameplay continues to flow smoothly and intuitively. The game instructions were delivered verbally, which allowed the rules to adapt and evolve as players interacted with the material for the first time. Additionally, questions and discussions that arose during gameplay and learning was documented to inform further development.

Key findings from the first round of playtesting indicated that the Objective and Information cards functioned as intended but require further refinement to improve accessibility, minimize disruption to game flow, and achieve a more balanced point system. These cards also presented an opportunity to incorporate educational content and real-world stakeholder initiatives, while simultaneously simulating resource scarcity as the tiles are depleted, which promoted conflict, negotiation, and collaboration among players. Flipping tiles over to symbolize destructive urban practices was a significant new mechanic that proved effective but will require further graphic development to enhance clarity. The tile-laying system successfully supported gameplay mechanics and served as an analogue to zoning practices. The rigid tiled grid offered structural organization but contrasted with the dynamic and evolving forms illustrated on the tiles, reflecting the fluidity of landscapes shaped by bottom-up social-ecological processes. Finally, the strategic use of Community Members in Community Hubs was advantageous, thematically reinforcing the value of expanding parkland within urban landscapes.

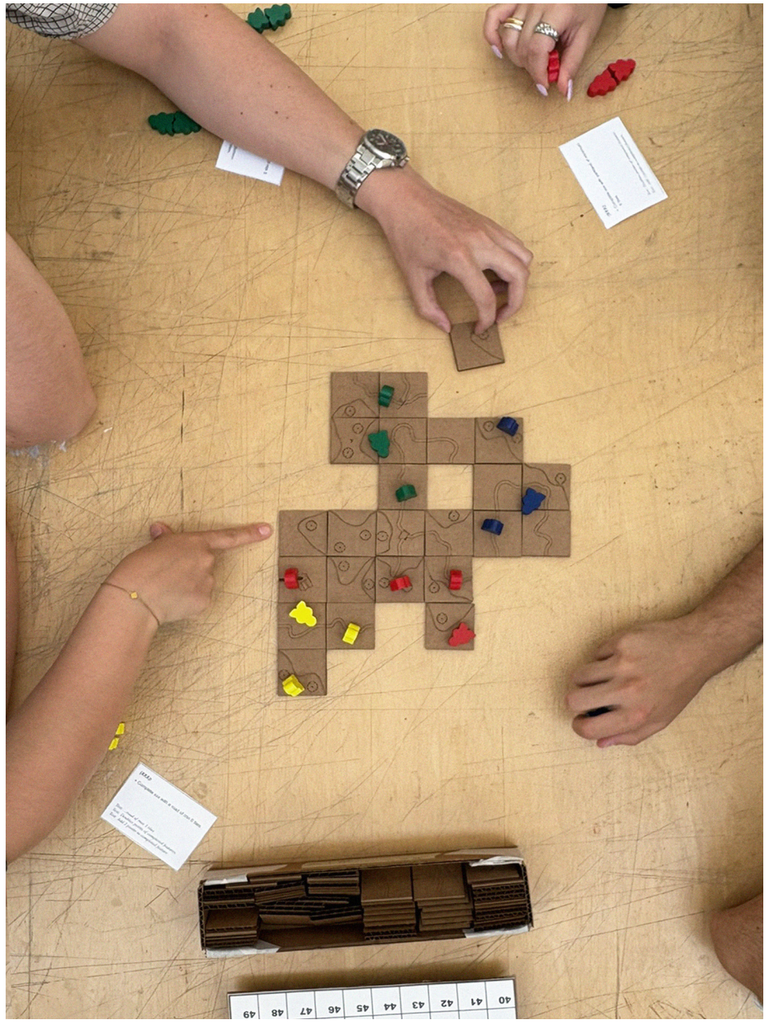


Figure 3.17

Playtesting round one documentation.

Community Members
Each player gets 8 Community Members, 1 is placed on the scoreboard to track points and the remaining 7 are used during gameplay.



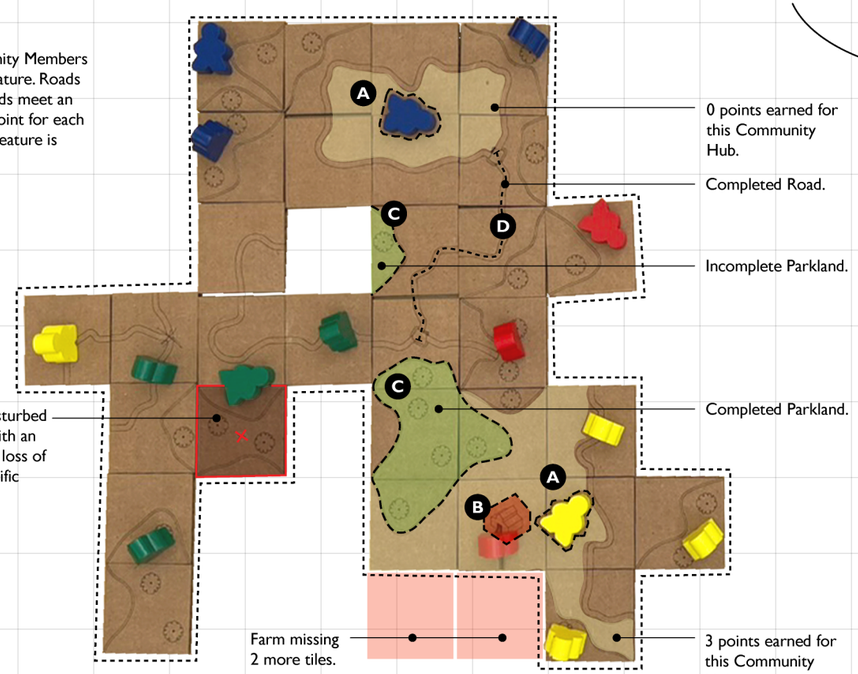


A Community Hubs
Community Hubs are the spaces between Parklands, Roads, and Farms. To work on a Community Hub, Community Members are laid down on the feature. Players earn 3 points per completed Parkland within their Community Hub.

B Farms
To work on a Farm, Community Members are placed standing on the feature. Farms are completed once it is completely surrounded by tiles. Players earn 9 points for a completed Farm (1 point per tile).

C Parklands
To work on a Parkland, Community Members are placed standing on the feature. Parklands are completed once a continuous boarder is formed. Players earn 2 points for each tile the Parkland is on once the feature is completed.

D Roads
To work on a Road, Community Members are placed standing on the feature. Roads are completed when both ends meet an intersection. Players earn 1 point for each tile the Road is on once the feature is completed.



0 points earned for this Community Hub.

Completed Road.

Incomplete Parkland.

In this iteration, disturbed tiles are marked with an 'X' resulting in the loss of points for the specific feature that was disturbed.

Completed Parkland.

Farm missing 2 more tiles.

3 points earned for this Community Hub.

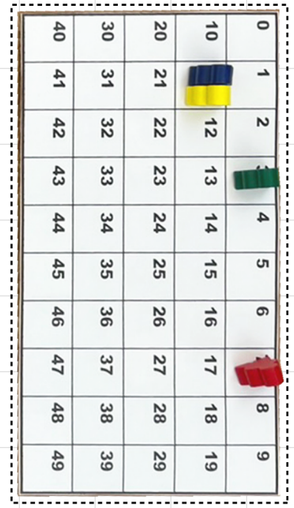
Tiles
Each player draws a new tile each round revealing a fragment of a land feature they can place.



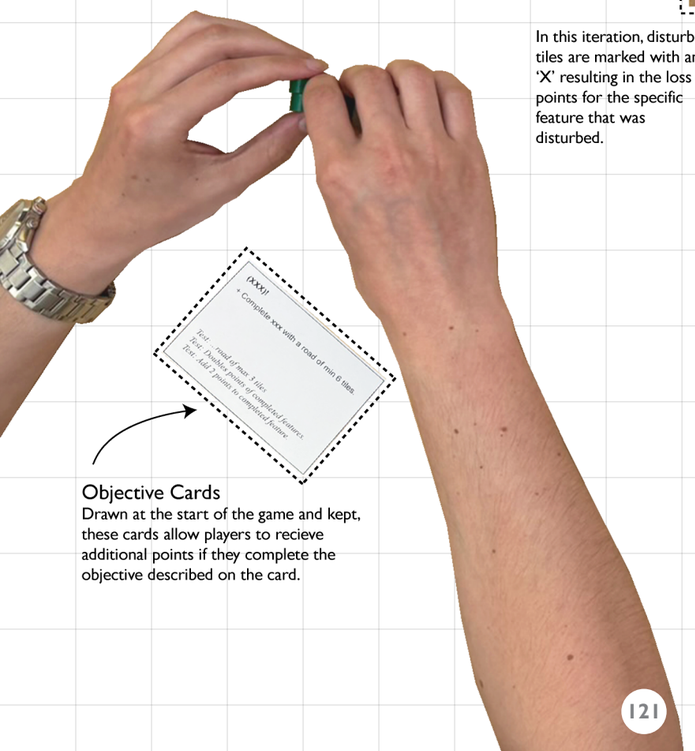


Information cards
Located in a stack to be drawn throughout the game.





Scoreboard
1 Community Member per player is placed on the scoreboard to track points throughout the game.



Objective Cards
Drawn at the start of the game and kept, these cards allow players to recieve additional points if they complete the objective described on the card.



Information cards
Drawn throughout the game and played during the turn they were drawn. These cards can reward players with points, or disturb land features.



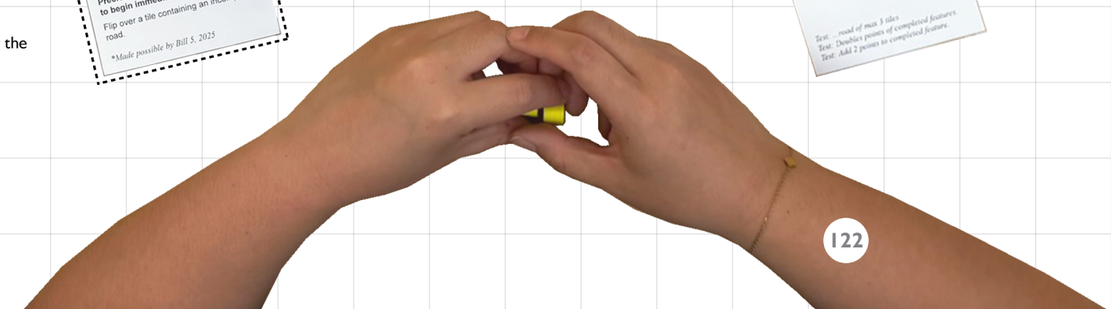
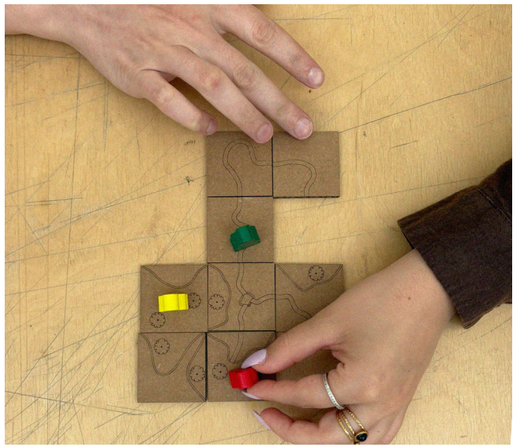
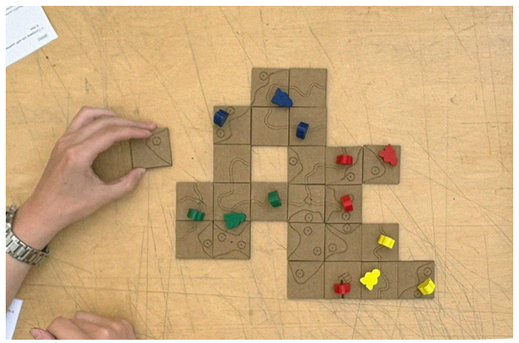
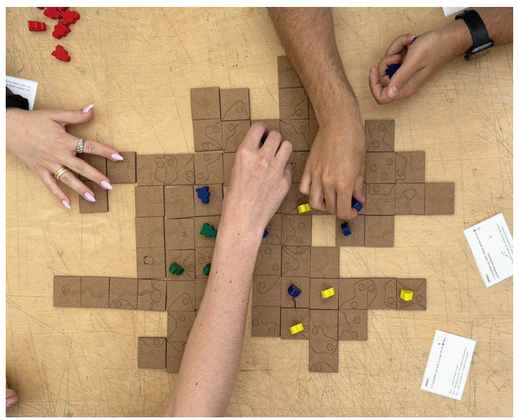


Figure 3.18

Playtesting round one game components and mechanics.







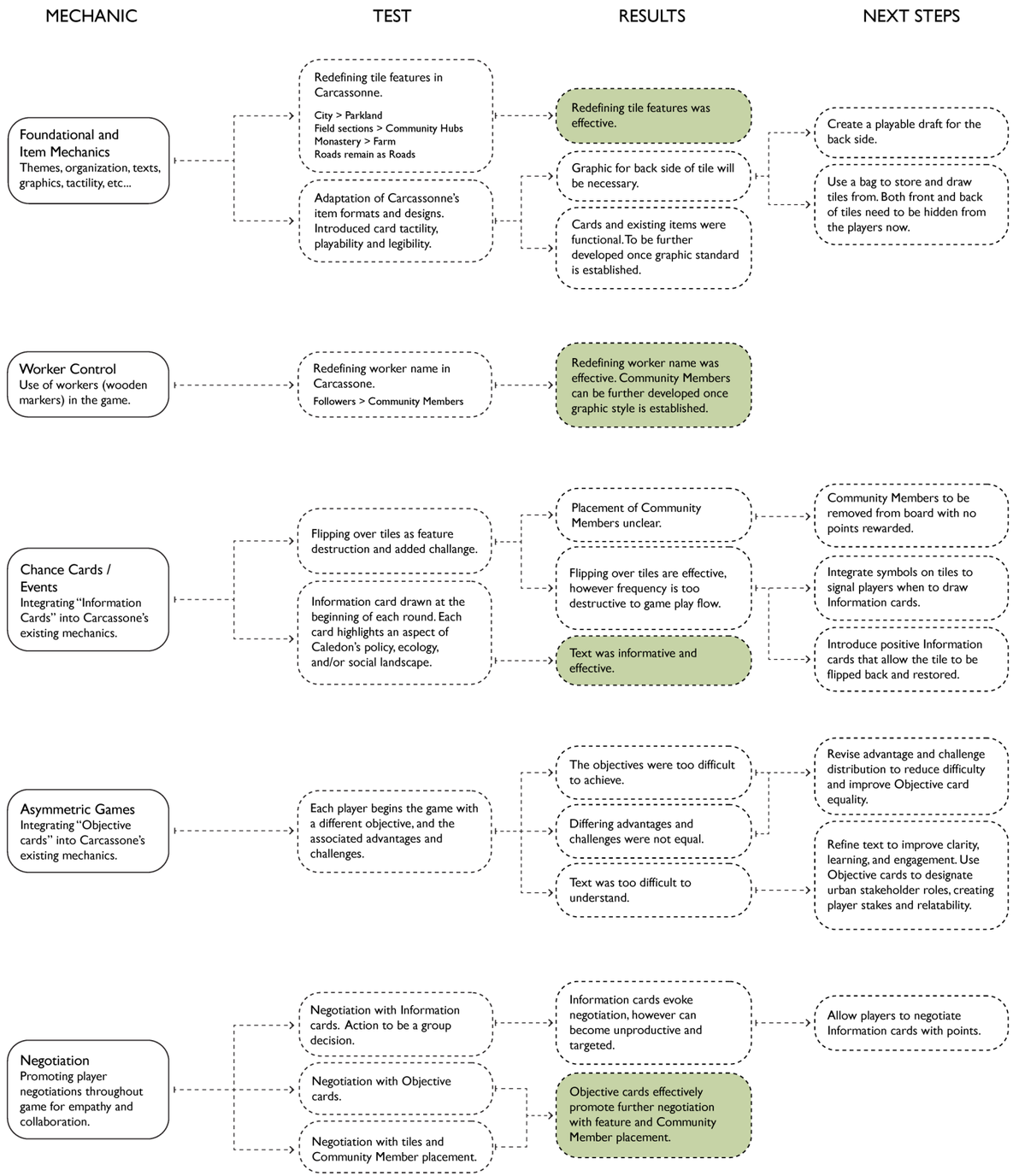


Figure 3.19

Playtesting round one results and next steps flow chart.

3.2.2 Playtest Round Two: is it Fun?

The focus of round 2 shifted from testing core mechanics to assessing user experience, including game flow, enjoyment, and engagement, while ensuring alignment with the thematic and narrative goals established in round 1. During this playtest, the mechanics were functional, allowing for testing that emphasized how players interacted with and experienced the game. Player thinking times, decision-making processes, and emotional responses were documented. Particular attention was given to evaluating the clarity and effectiveness of the Objective and Information cards to determine whether the text was easy to understand and effectively communicated its purpose. Additionally, the first round of discussion questions was introduced to gather feedback from participants regarding both the mechanics and their overall experience of the game to help shape future iterations.[101]

Round 2 demonstrated that the Objective cards were effective in providing players with a sense of identity and creating stakes; however, revisions are necessary to make these objectives more attainable and relevant across the duration of gameplay. Information cards required clearer instructional text to specify point allocation and adjustments to the frequency with which they were drawn. Both Objective and Information cards would benefit from refined wording to align more closely with the research questions and enhance their educational and engagement value. Further mechanical adjustments were needed to ensure the smoother integration of player actions within the game flow. The tile-flipping mechanic was found to be both enjoyable and effective, as it heightened player awareness of the interconnectivity of land features and produced visually dynamic tile arrangements. The use of a bag to conceal the double-sided tiles was functional and supported fair play. Overall, participants reported a positive experience, noting that the conflicts and negotiations that emerged throughout gameplay were both engaging and entertaining. However, the findings underscore the importance of clearer graphics to improve legibility and comprehension.

101 For playtest round 2 discussion questions, see page 197 of the Appendix.

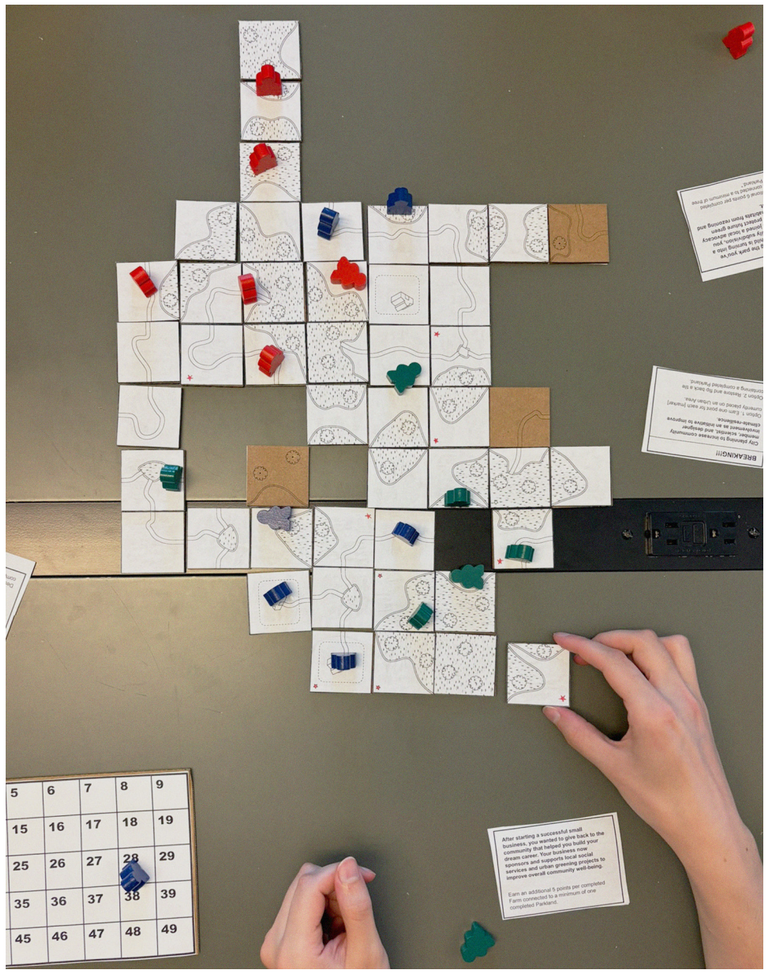
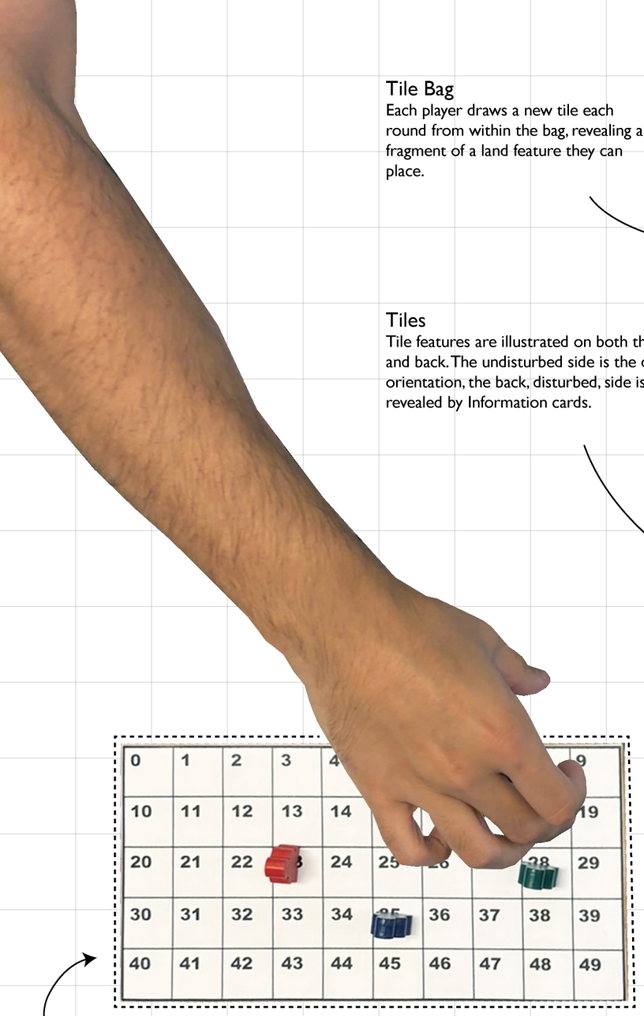


Figure 3.20

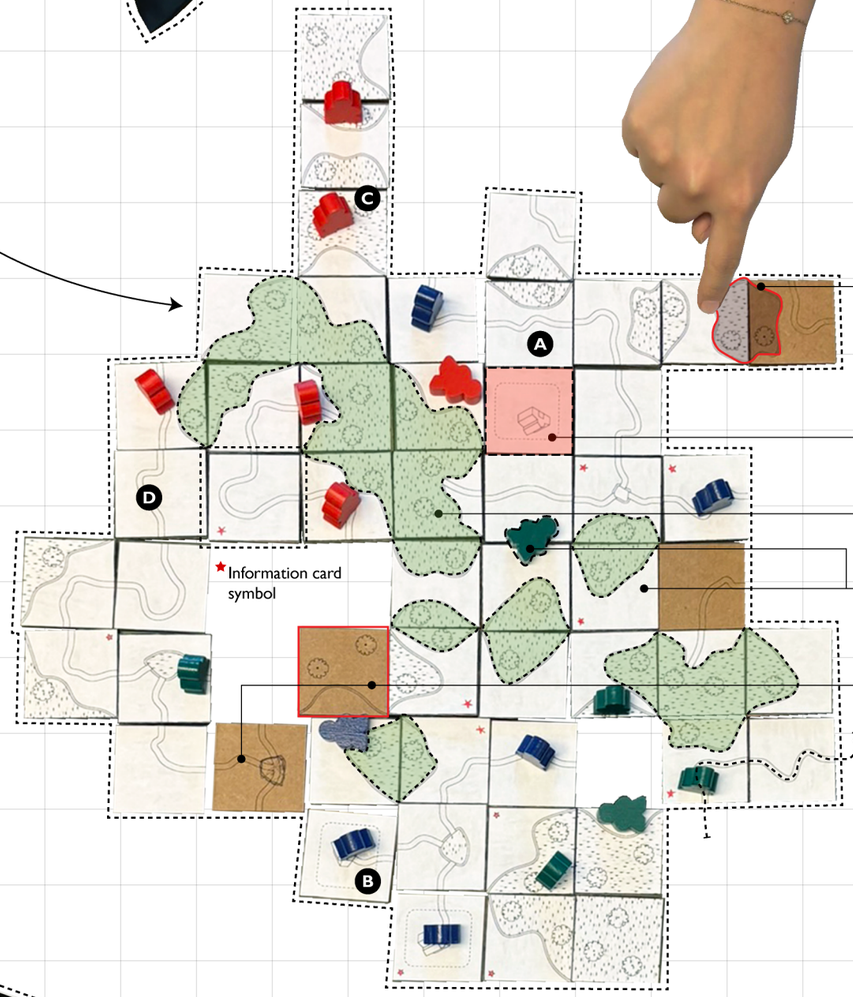
Playtesting round two documentation.

Tile Bag
Each player draws a new tile each round from within the bag, revealing a fragment of a land feature they can place.

Tiles
Tile features are illustrated on both the front and back. The undisturbed side is the default orientation, the back, disturbed, side is revealed by Information cards.



Scoreboard
1 Community Member per player is placed on the scoreboard to track points throughout the game. Remaining 7 Community Members per player are used during gameplay.



Flipped tile disturbs Parkland feature, Parkland becomes incomplete and Community Member in Community Hub will not earn points for this Parkland.

Completed Farm earns 9 points (1 point per tile).

This completed Parkland earns 18 points (2 points per tile).

18 points earned for this Community Hub (3 points per completed Parkland within its boarders).

Disturbed land, tile flipped.

Incomplete Road.

Information card tile symbol
A symbol is placed on tiles to inform players that an Information card needs to be drawn. (Not to scale).



- **A** Community Hubs
- **B** Farms
- **C** Parklands
- **D** Roads

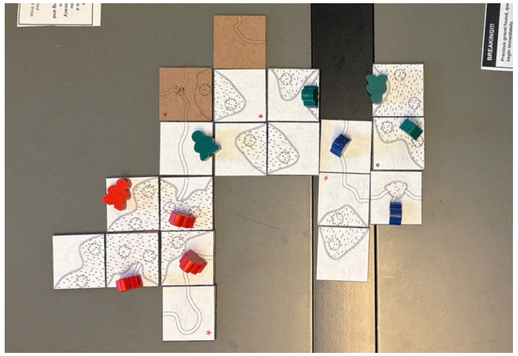
Information cards (good)
Positive Information cards result in additional points and/or the ability to restore a tile, and therefore the land feature and points associated.

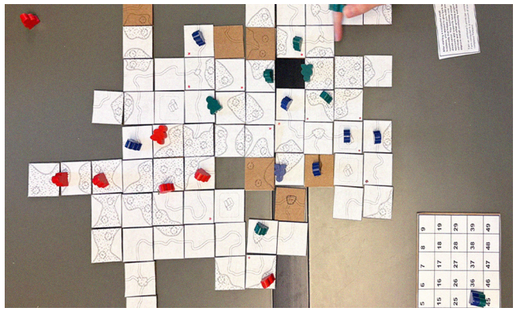
Information cards (bad)
Negative Information cards result in a tile being flipped over, therefore disturbing the land feature and the Community Member effected lose points.

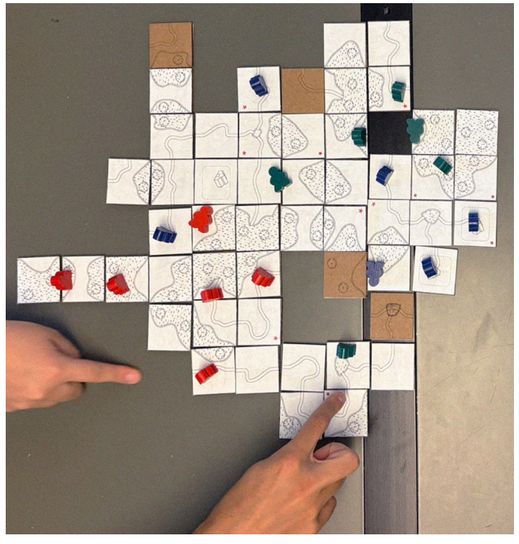
Objective cards
Drawn at the start of the game and kept, these cards allow players to recieve additional points if they complete the objective described on the card.

Figure 3.21

Playtesting round two game components and mechanics.







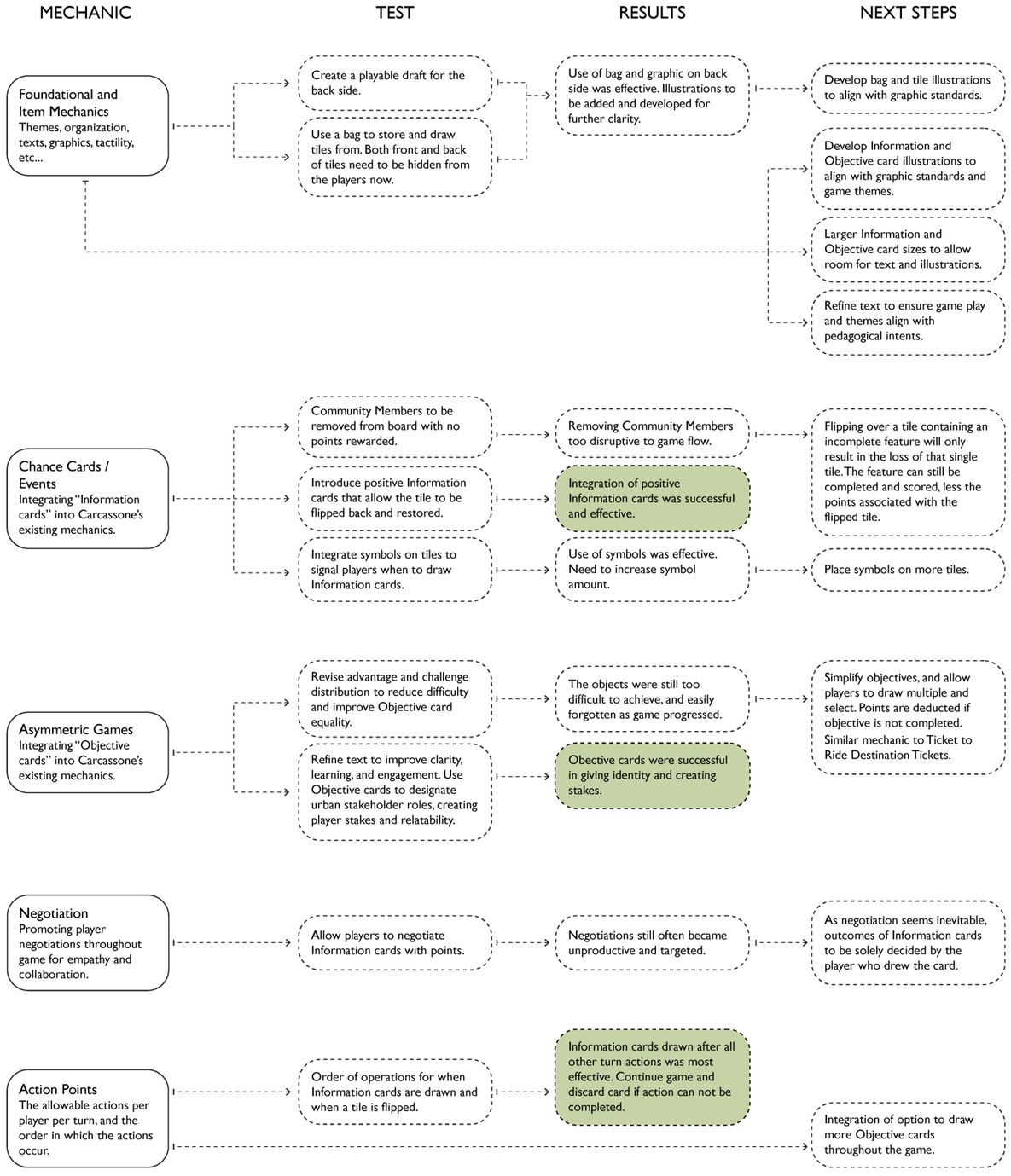


Figure 3.22

Playtesting round two results and next steps flow chart.

3.2.3 Playtest Round Three: is it Legible?

The focus of round 3 was primarily on visuals and graphics, to assess their legibility, aesthetics, and alignment with the game's overall narrative. As the mechanical design of the game was largely complete, attention shifted toward refining art, construction, and graphic elements. Observations of the play through concentrated on whether the graphics serve as an effective educational tool and successfully reflect the central themes of the game. This stage also assessed whether the visuals are intuitive and accessible to general audiences. Additionally, a second round of discussion questions were introduced to gather further feedback on player experience and engagement with the enhanced graphical components.[102]

The results from the third round of playtesting confirmed that participants found the game enjoyable, and while frustrating when their land features were destroyed, it encouraged thought-provoking and strategic game play to succeed. The players also found the balance between competition and collaboration to be positive, with constant communication and teamwork during tile placements, despite the game's competitive structure. The illustrations on the cards and the accompanying information and instructions aligned well with the tiles and core game mechanics. However, it was highlighted that the illustrations felt distant from the thematic and narrative content written on the Objective and Information cards. A greater degree of abstraction was needed to ensure the graphics on the game pieces are effective symbolic representations of the potential urban conditions described on the Objective and Information cards.

The most significant challenge identified was completing Parkland-based objectives, as the necessary end pieces were scarce and drawing them relied heavily on luck. Participants developed a strategy where each player always holds three tiles in reserve and can choose which tile to play on their turn. This strategy enhanced strategic depth when selecting Objective cards at the start of the game, reduced reliance on luck when drawing tiles, and fostered greater collaboration and negotiation when deciding which tiles to place. A stockpile of tiles allowed players to negotiate and trade tiles based on their individual objectives, while collaborating on similar objectives, to earn additional points. With more tiles in play each round, Objective cards could become more involved and foster stronger engagement with the content and negotiation with the tiles. Overall, iteration three of the game was well received, and created a rewarding sense of accomplishment when physically completing a land feature.

102 For playtest round 3 discussion questions, see page 197 of the Appendix.



Figure 3.23

Playtesting round three documentation.

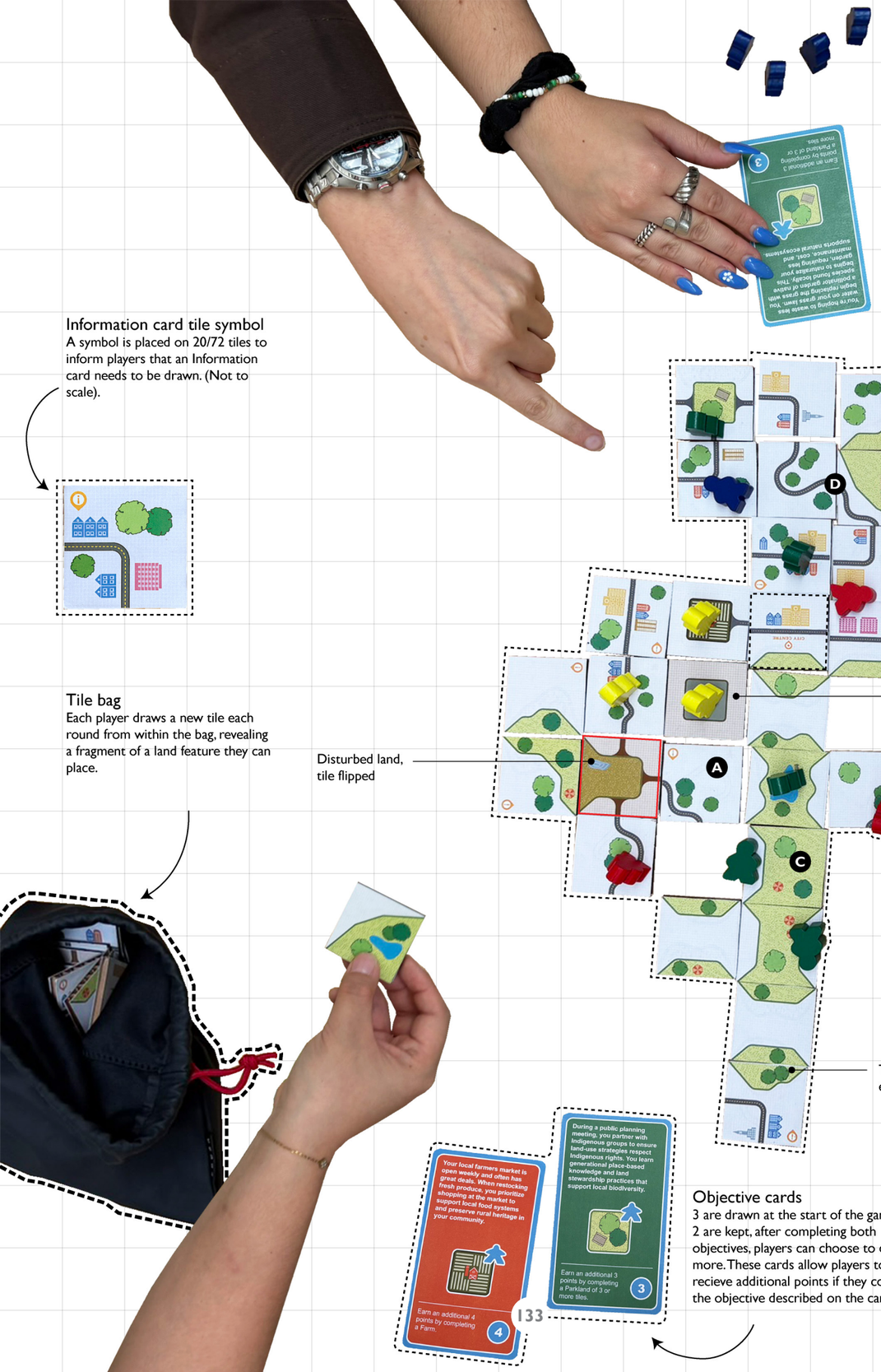
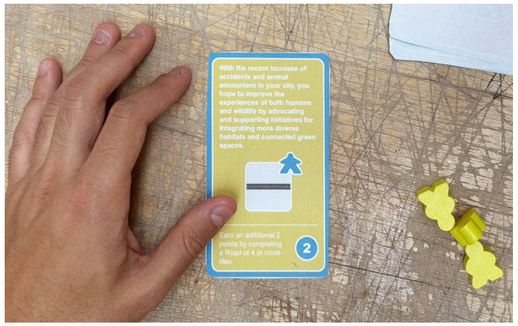
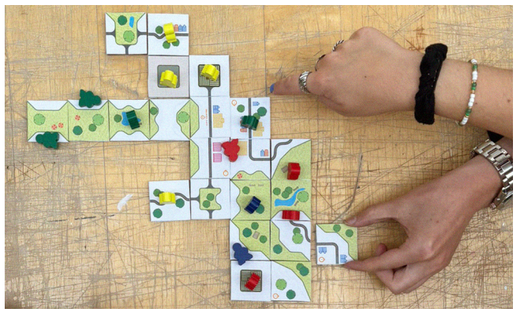


Figure 3.24

Playtesting round three game components and mechanics.







PLAYTEST PHOTOS

MECHANIC

TEST

RESULTS

NEXT STEPS

Foundational and Item Mechanics
Themes, organization, texts, graphics, tactility, etc...

Development and refinement of card and tile graphics, text, and tactility. Use of illustrations, larger cards, "did you know" text, and a bag for drawing tiles.

Overall refinements and final product was effective. Illustration at road intersections can be easily confused with Parkland.

Redesign of road intersection tiles.

Potential for tile graphics to be more abstract and simple. Allow for better integration with research content.

Redesign of front and back of tiles.

Chance Cards / Events
Integrating "Information cards" into Carcassone's existing mechanics.

Flipped over tile only resulting in the loss of that single tile when counting points.

This was successful and improved flow of the game.

Increase amount of Information cards played per game to 20.

This was successful, created more stakes, and made game play more interesting.

Asymmetric Games
Integrating "Objective cards" into Carcassone's existing mechanics.

Simplifying objectives and allowing players to draw multiple to select from.

Overall Objective card challenges and points are well balanced. Completing Parkland and Farms are the most difficult as it heavily relies on luck.

Players to be able to collaborate on objectives if they are sharing a Parkland, Road, or Community Hub.

Negotiation
Promoting player negotiations throughout game for empathy and collaboration.

Information cards to only effect the player who drew the tile and associated card.

Maintains a productive level of negotiation, while players are against one another, there is still collaboration and discussion on where tiles should be placed and flipped.

Action Points
The allowable actions per player per turn, and the order in which the actions occur.

Allowing players to have the option of drawing more Objective cards after successfully completing their initial two objectives.

Drawing and discarding Objective cards work mechanically. Potential to make success of completing objectives less luck based.

Allow players to draw 3 tiles at the start of the game along with Objective cards to facilitate more strategy rather than luck, and offer more flexibility. Players can keep 3 tiles flipped over throughout the game to use and trade to encourage collaboration.

Successful playtest result

Figure 3.25

Playtesting round three results and next steps flow chart.

3.3 Playtest Final Round: is it Engaging and Educational?

The fourth and final playtest gathered observations that informed a set of focus group questions discussed in Section 3.3.1: *Game Play Summary, Interviews, and Analysis*. At this stage, the game is considered complete, and the *Carcassonne* rulebook has been updated to reflect the new mechanics and art style of *Paving Paradise*. Participants completed one final play through, and any questions that arose while reading the rulebook or playing was documented for any minor revisions to improve legibility. The focus group questions explored the game's core themes, including policy, social-ecological systems, and sustainable urbanization, to assess how effectively the game supports engagement and learning around these topics. Player interaction with the game materials was closely observed and documented to determine engagement and responses to the finalized physical game design.

The Community Member pieces are wooden figures painted in red, yellow, green, and blue, purchased online. The land tiles were made from 3 mm thick plywood that was laser cut into 45 mm by 45 mm squares. The tile graphics were designed in Rhinoceros 3D and Adobe Illustrator, printed on premium matte vinyl sticker paper, then hand-cut and applied to both sides of each tile. Wood was selected for its durability, as the tiles are frequently handled during play and require resistance to wear. The scoreboard was laser cut and made from the same 3 mm plywood as the tiles. Its graphic was printed on the same sticker paper and hand-cut and applied. The tile-draw bag used during gameplay is a repurposed black fabric pouch. Its soft interior helps protect the tiles from damage and allows players to shake and draw tiles comfortably. The Objective and Information cards were produced using museum board, laser cut to 70 mm by 121 mm. Their graphics were created in Illustrator and printed on the same premium matte vinyl sticker paper used for the tiles. Each sticker was hand-cut and adhered to the front and back of the cards. Finally, the game box was custom-built from the same plywood material as the tiles and scoreboard to ensure a cohesive look and feel. It was designed to store and transport all game components easily.

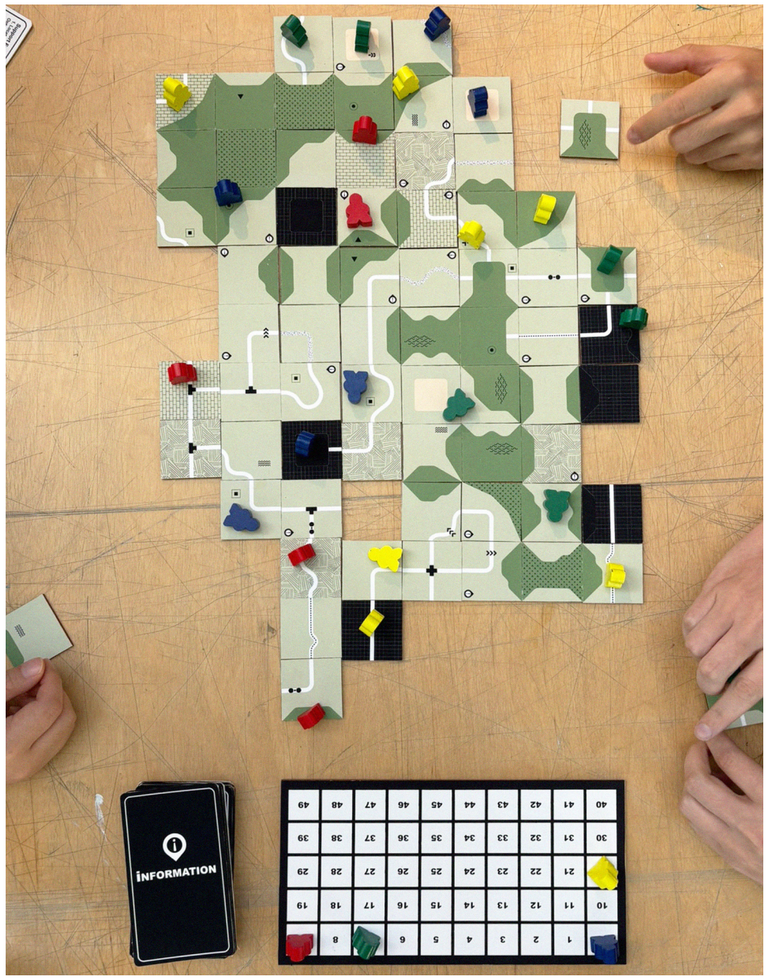
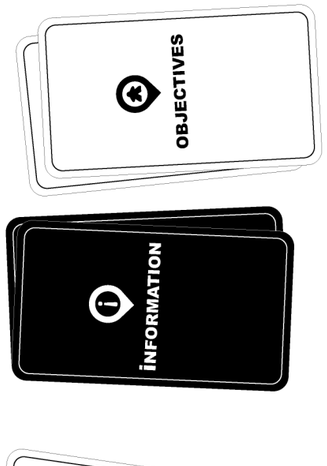
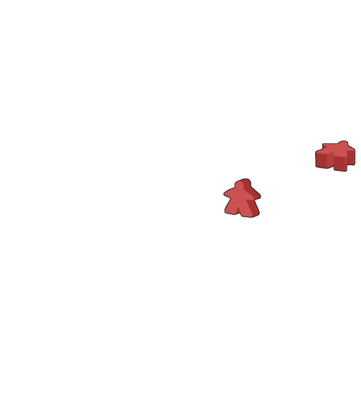


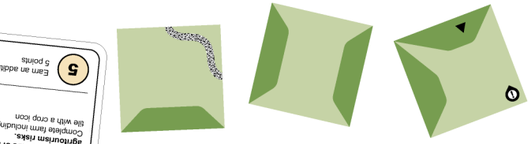
Figure 3.26

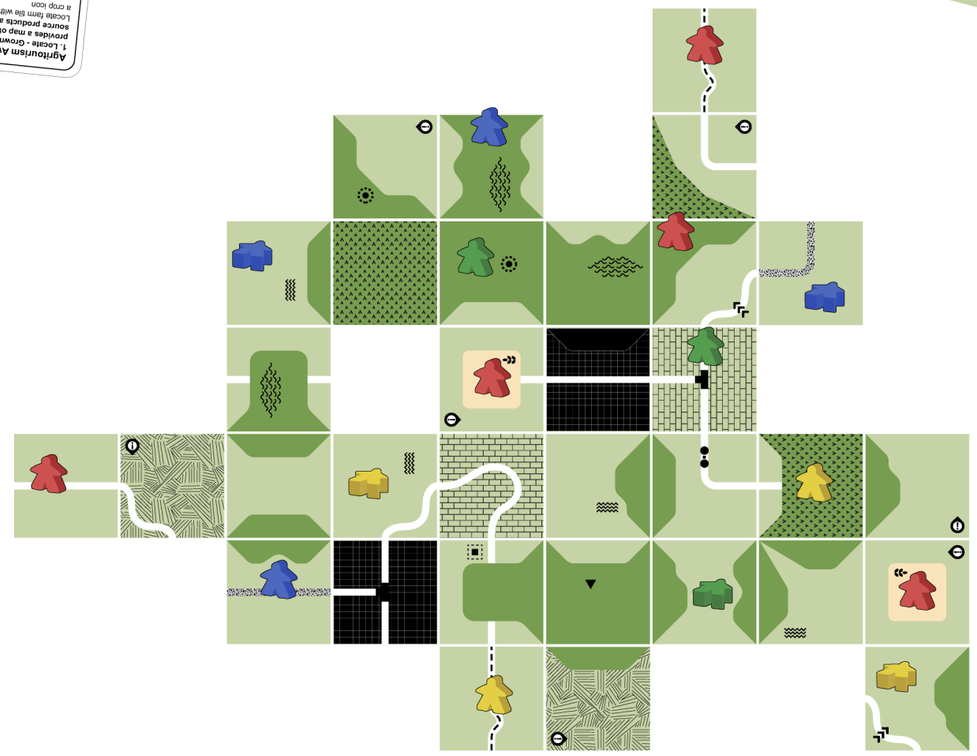
Playtesting final round documentation.

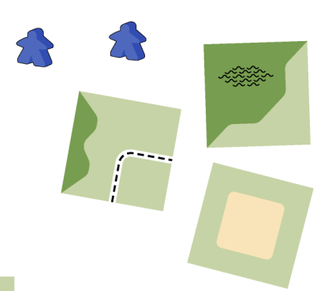


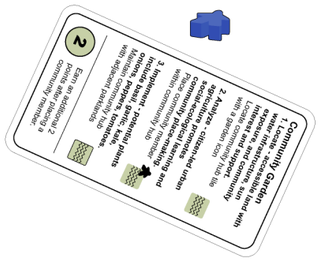


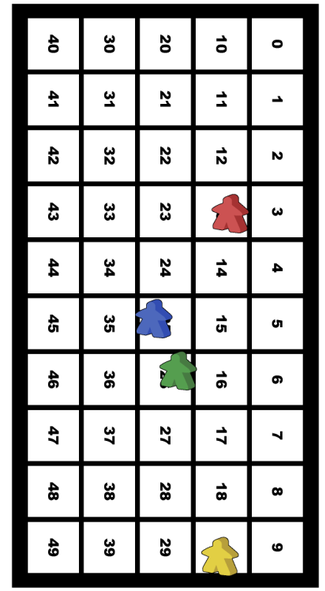


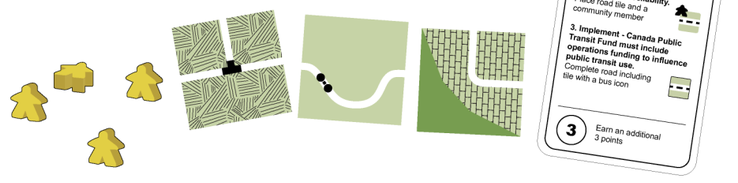












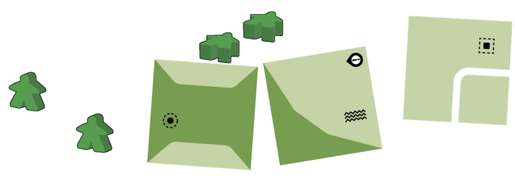




Figure 3.27

Paving Paradise game board illustration.

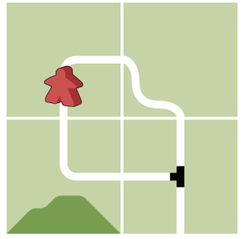
Overall, players found *Paving Paradise* entertaining, clear in educational intent, and easy to understand. Some participants noted that Objective cards would benefit from additional visual reference guides in the rulebook to support comprehension when learning the game for the first time. The collaboration incentives were positively received, and the added descriptive text on the Objective cards helped players process the content and make informed, strategic decisions, which enhanced gameplay and reinforced the real-world relevance of Objective card topics as real-world objectives.

The updated tile graphics, especially the abstracted icons corresponding to the Objective cards, made the game more visually accessible. Players enjoyed spotting and using these icons while placing tiles and observing the icons other players had in their tile reserve, which encouraged more active strategizing and negotiation. There is a potential to expand the use of these icons beyond their current functions if the game continues to evolve.

The Objective and Information cards were clear and broadly applicable to real urban conditions, prompting players to connect in-game scenarios to their own lives. Players found that the Objective cards gave them a sense of role and purpose within the game, anchoring their decisions in longer-term goals rather than isolated moves. The act of flipping tiles and reading the card prompts aloud also created moments of shared attention and dialogue, turning individual actions into opportunities for group interaction and reflection. Information cards introduced a mix of destructive and rewarding effects, creating dynamic interactions. Players frequently attempted to collaborate in response to disruptive cards, though sabotage also occurred, often in playful ways that led to “I owe you” moments. These interactions created a high-stakes, entertaining experience that encouraged communication, group strategy, and thoughtful decisions about tile placement, offering a strong balance between luck and strategy.

The game’s setting provided a valuable space for players to engage with its themes and naturally extend conversations to explore how these ideas could be applied in real-world urban planning and community participation. Negotiation was a particularly engaging element, supported by players’ ability to see all tiles currently in play and plan several moves ahead. The abstracted graphics made land features and icons easy to distinguish, which not only improved clarity but also made the game adaptable to different cities and landscapes. The visual flexibility encouraged players to imagine urban forms based on their personal experiences and consider how these might translate into real-world contexts.

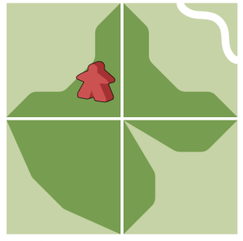
Scoring Completed Features and Community Hubs



In this example, Red scores 4 points (1 point per tile).

Scoring Completed Roads

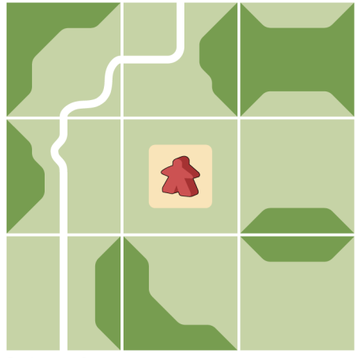
To complete a Road, both ends must connect to a crossroad, a Parkland section, a Farm, for the Road must loop onto itself. When a Road is completed, the player with a Community Member on that Road earns 1 point for each tile that forms it.



In this example, Red scores 8 points (2 points per tile).

Scoring Completed Parklands

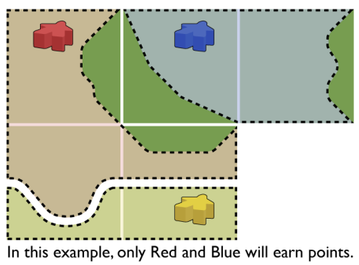
A Parkland is considered complete when it is fully enclosed by its border, with no openings or gaps within the boundary or the Parkland itself. When a Parkland is completed, the player with a Community Member on it earns 2 points for each tile that makes up the Parkland.



Red earns 9 points.

Scoring Completed Farms

A Farm is considered complete when it is fully enclosed by surrounding tiles. Once completed, the player with a Community Member on that Farm earns 9 points.



In this example, only Red and Blue will earn points.

Scoring Community Hubs

Connected Community Hub sections form a single, larger Hub. Once placed, a Community Member stays in that Hub until the end of the game and is never returned to the player’s supply. Hubs are divided by Roads, Parklands, or the edge of the board. Community Hubs only earn points if there are completed Parklands in it.

Figure 3.28

How to score completed features and Community Hubs in *Paving Paradise*.

3.3.1 Gameplay Summary, Interviews, and Analysis

The fourth playtest unfolded with a mix of collaboration, strategy, and simmering rivalries. Each player began the round with a distinct objective. Player 1 (P1) set out to protect wetlands by completing a Parkland containing a water icon. Player 2 (P2) focused on supporting farmers' markets by finishing a Farm with a barn icon. Player 3 (P3) aimed to conserve the endangered butternut tree through completing a Parkland featuring a tree icon, and Player 4 (P4) worked to maintain the Bruce Trail by completing a Road with a gravel icon.

P4: "I learned so much! The Bruce Trail... It's 900 km from Niagara to somewhere..."

P1: "To Tobermory!"

P4: "Yeah that's right, we read the cards."

From the outset, P1 and P3 recognized a shared interest in Parkland tiles and teamed up to co-develop a larger landscape feature. Their cooperation paid off as they both completed their objectives and gained the bonus for collaborative work. At this time, it was still early in the game, and P1 decided to draw a new objective: growing field crops. P1 now needed to complete a Farm using a tile with a crop icon.



Figure 3.29

Playtesting final round documentation.

Tension arose when P4 drew a destructive Information card and decided to flip one of P3's Parkland tiles. P4 restored it immediately when given the chance, but this event changed the trajectory of P3's playing style. Meanwhile, P2 and P4 began their own collaboration, working out the sequence of tile placements needed to combine their Parklands and earn some additional collaboration points.

The first alliance began to unravel when P3, while drawing tiles, pulled one that P1 desperately needed to complete their new objective. It was one of the two Farm tiles with a crop icon. P3 refused to trade it without an equally valuable swap, and the disagreement turned into a feud that carried through the rest of the game.

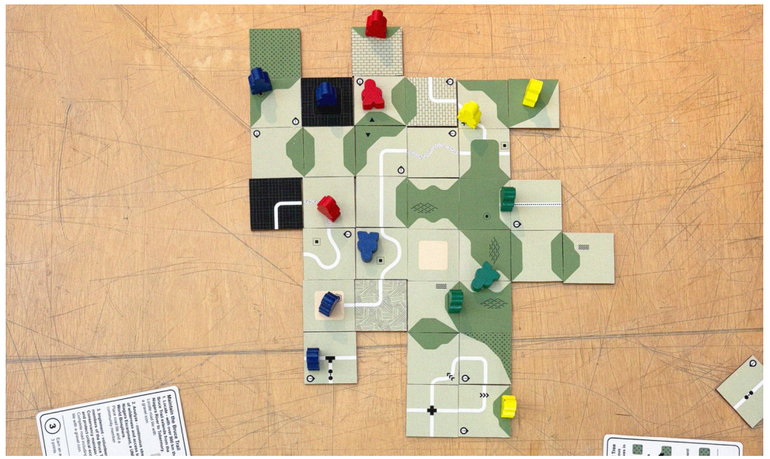


Figure 3.30

Playtesting final round documentation.

As the tiles depleted with each round, P2's Farm was one tile away from completion; however, there was only one possible tile left that could be placed in that position while still respecting the rules of the game. P1 needed that exact tile as well, the Farm tile with a connected Road, because it carried the crop icon central to their second objective. P2, P4, and P1 formed a pact, where if any of them drew the tile, they would give it to P1 as long as they placed it in the spot P2 needed to complete their own Farm. It was an alliance built on trust, with the expectation that present help would be repaid in the future when needed.

P3, on the other hand, worried about being taken advantage of and did not believe goodwill alone would serve them. That distrust isolated P3, and the game eventually split into a three-versus-one dynamic. When P3 drew another destructive Information card, they used it to deliberately sabotage P2 instead of flipping a neutral tile. This maneuver resulted in P2 failing their objective and deducted points at the end of the game.

Strategically, P2, P4, and P1 decided to combine their efforts into completing one large Parkland feature, while P3 shifted toward scattering multiple smaller Parklands within their Community Hub to secure end-of-game points. As the game neared its end, every draw brought suspense and tension, especially when P3 took their turn, since the Farm-with-Road tile could surface at any moment.

Q: "If you were to play again, would you attempt different strategies?"

P4: "Well I think big park was really good."

P2: "Big park was so good."

P1: "Yeah, and developing Community Hubs are the two most rewarding strategies. Like trying to get a well placed Community Hub and trying to make a big Parkland."

P2: "I think playing Community Hubs as a strategy is really interesting. There's a potential to gain a lot of points by placing one down at the beginning of the game because the tiles start from the centre and you're kind of in a good position to connect with most of the board and you can plan Roads and Parklands around it. Towards the end it becomes more difficult to place a strategic Community Hub."

P1: "The objectives are also big point scorers."

P4: "A collaborative approach was also good because then you can complete even bigger parks more easily. And also help each other complete Farms like we did. You don't have to just focus on completing your own park anymore, you can do multiple strategies."

P3: "On the flip side of big park, I was trying to complete multiple small parks within my community area as a strategy to earn points at the end of the game. Strategies with Parkland sizes and locations is a good way to play the game. But then my small parks kept getting destroyed by Information cards so it didn't really work out in the end."

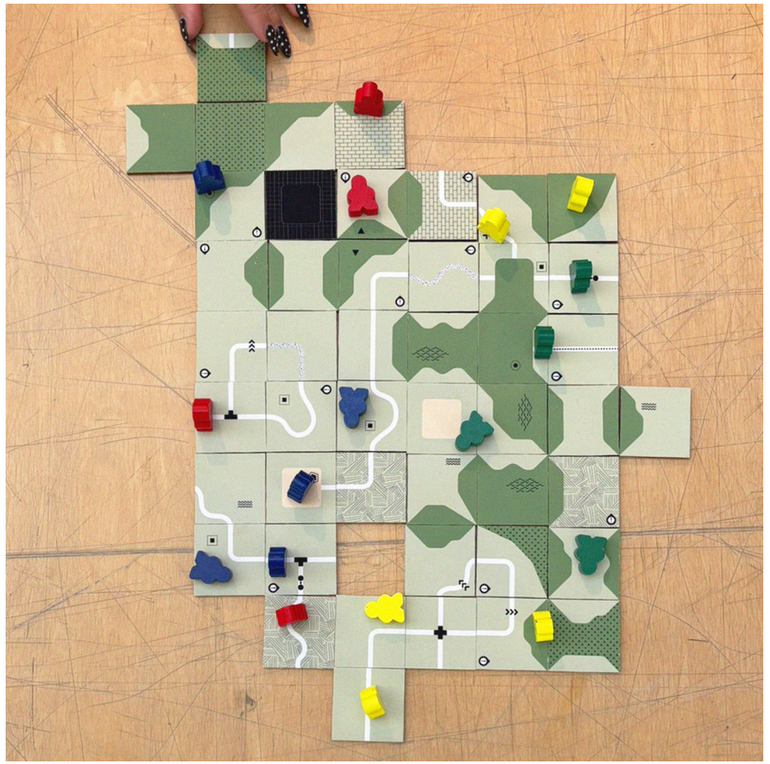


Figure 3.31

Playtesting final round documentation.

Finally, during P1's draw, the long-awaited tile appeared, and celebration and relief filled the game table. Rather than rushing to place it, P1 held onto it strategically, waiting to see whether P2's sabotaged tile could be restored before completing the Farm feature. P2 had already resigned themself to last place but was content as long as either P4 or P1 finished ahead of P3.

With only a few tiles left, P1 finally placed the crucial tile, securing their objective and the win. The game ended with P1 in first, followed by P4, then P3, and P2 in last place, although P2 and their team considered it a shared victory.

Q: "What was the outcome of the game, and can you describe, in your opinion, what events took place that led to this outcome?"

P1: "Well I mean, I won! The only reason I won is because P2 and P4 helped me, like, put me into their big park."

P2: "We used the collaboration rules, and we collaborated because we really wanted to beat another player [group laughter]... but yeah collaborating on creating a large Parkland was really beneficial for all of us."

Q: "Were any decisions made during the game influenced by or intended to influence the other players of the game?"

P2: "... No." [Group laughter]

P3: "I think there was a bit of targeting..."

P4: "Yeah there was definitely a bit of targeting, some difficult negotiations that went on, and there were consequences to that." [Group laughter]

P1: "Yeah definitely, I think some of it was a product of the behaviours of the game."

P3: "The targeting was because I was worried I was trying to be taken advantage of because I had a land feature that people really wanted."

P1: "From our perspective, the refusal to work together was the challenge, and this was a byproduct of that."

P2: "But I like how you can make it an individual game if you want."

P1: "Yeah I liked the different types of stakeholders."

P2: "Yeah like you can treat it as, I have my set strategy and I'm doing this. Or you can work with people. I like that it's not a whole team, and kind of reflects real life."

P1: "I mean definitely, in real life, it's always a negotiation between different groups of people. And it resembles real conflict around these matters and different approaches to resolution."

Paving Paradise mirrors the complexities of real-world urban planning, particularly around collaboration, power, and resource management. Player interactions in playtesting reflected the diversity of perspectives, values, and trust dynamics that emerge when multiple stakeholders work toward shared, but not always aligned, objectives. Because the graphics on the tiles are abstracted and geographically non-specific, players were able to connect the mechanics and events to their own lived experiences in urban and suburban environments.

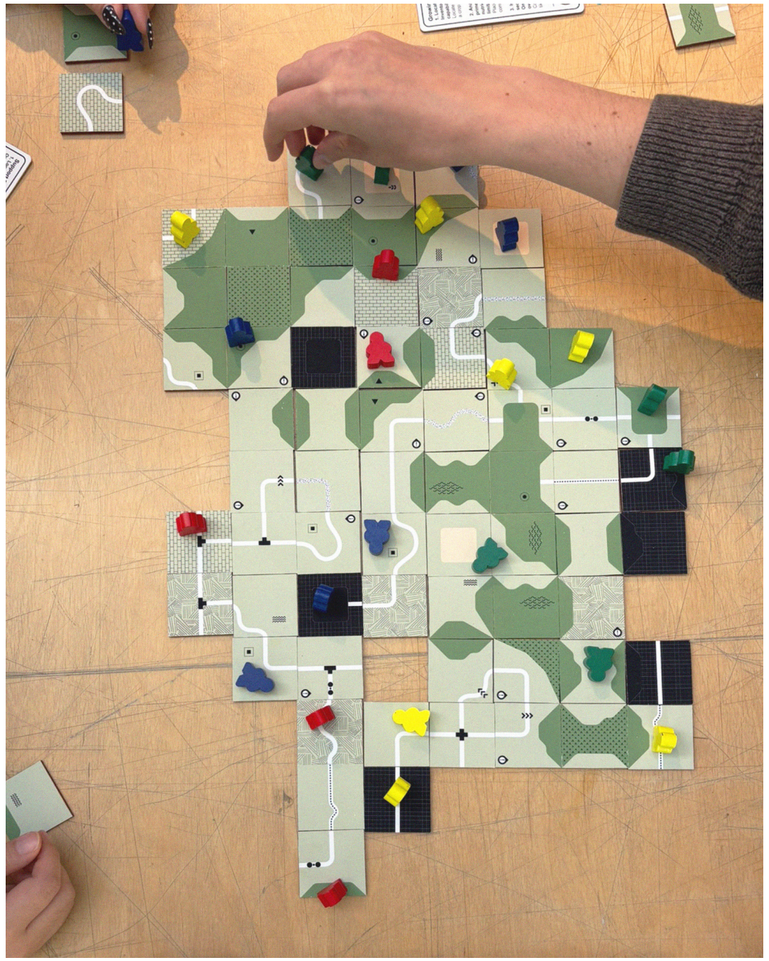


Figure 3.32

Playtesting final round documentation.

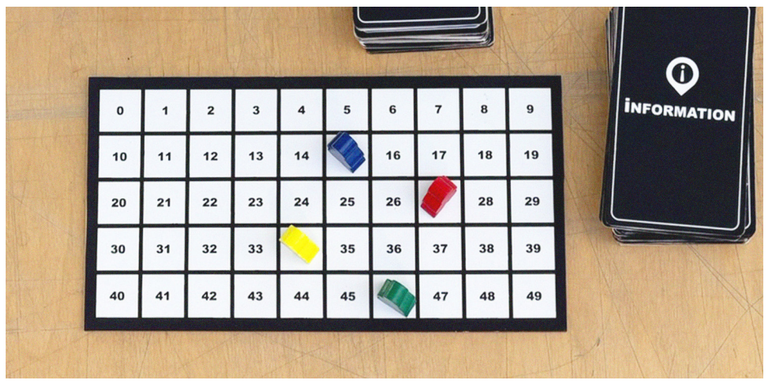


Figure 3.33

Playtesting final round documentation.

Q: "A lot of the Information cards are derived from recent policy, can you recall any of them, and if so, do you feel similar events have manifested, or how do you see these situations manifesting if your own neighbourhood?"

P3: "The removal of bike lane one was crazy, it was just like 'go buy a car instead' and then we had to flip over a Road tile."

P4: "Even the Objective cards, I was reading through all of them, and I like how the information applied to real-world initiatives but was also integrated into the steps of how to play the game."

P3: "And another one that was like 'destroy a Farm because of zoning so they could build more development,' that one really hit close to home."

P4: "Yeah also the bike lane one reminded me of how Doug Ford recently got rid of bike lanes in Toronto. And when playing the game, by needing to actually flip over a tile and lose points over it, it was kind of real."

P1: "Some of them were a bit abstract, where someone who isn't aware of policy might not even realize that's a thing. But maybe that's also a good thing because through reading the card and everyone talking, it can begin to inform them. They're good conversation starters."

P4: "And I like that you can probably go to any community and talk about these issues. Like the way the board is designed they're not specific to a place, and can apply in any urban area, neighbourhood, or like city in Southern Ontario."

P3: "People can imagine the events written on the Information cards happening in their life, but like also on the board when it ruins a strategy they have been working towards."

The Objective cards, in conjunction with detailed explanations within the rulebook, played a key role in delivering awareness around social-ecological systems. Many players gained new insights into conservation, agriculture, and stewardship relevant to their individual local contexts. The Information cards, in contrast, embodied the disruptive nature of policy changes and top-down planning. Players often felt that decisions landed suddenly and without collective input, paralleling the real-world influence of powerful developers or government authorities whose actions can override community needs.

Q: "What were each of your Objective cards, and how did it influence your playing strategy and/or experience? Or, what was going through your head when you read the card, and how did that translate to how you wanted to play?"

P1: "I mean, it was like, I need to complete my objective and protect the wetlands, and I will stop at nothing..."

P2: "The objectives really took over in the first half. For half the game I was like searching for my Farmland tile, I wasn't getting any points, and then realized I also need to start doing something else."

P3: "I was a little confused at first, by the instructions on the card. I didn't quite understand what it was telling me to like find... I think the additional written instructions, or like a more in-depth legend and visual reference in the rulebook that I could refer to throughout the game it would've helped me be less confused at the beginning of the game."

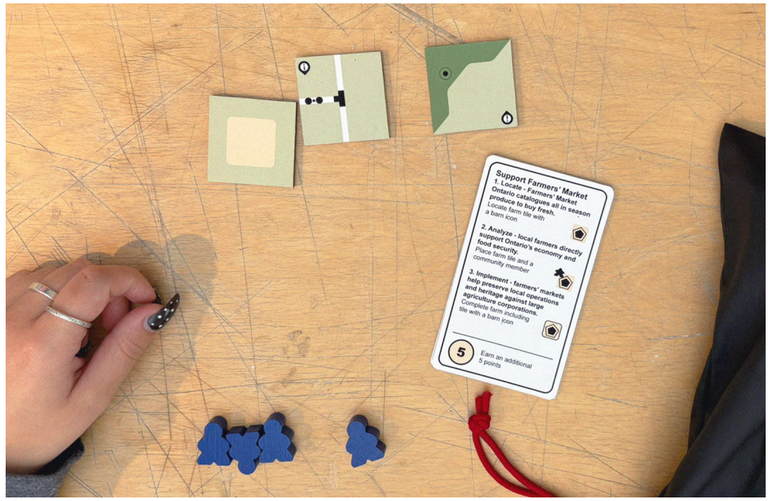


Figure 3.34

Playtesting final round documentation.

Resource control and spatial strategy emerged as central tensions, similar to real planning processes. Every placement affected access, land use, and relationships between systems. In the game, the locations of Farms and the distribution of Parklands all impacted Community Hubs, and the design of Roads enabled or restricted movement. Furthermore, flipping a Parkland tile often also altered an adjacent Road or Community Hub on the same tile, demonstrating how modifying one element inevitably influences others and reflecting the principles of systems thinking. This interdependence reinforced the idea that individual decisions reverberate across ecological landscapes and stakeholder interests.

Q: "How did you find the process of negotiating and collaborating with your teammates?"

P1: "Fun."

P2: "It was actually so fun. I liked it"

P3: "I found I was open to negotiating, but they were not offering anything where I had anything to gain. They were saying you have something that we could benefit from, but they didn't have anything that I could really benefit from."

P1: "That's fair, it can be beneficial to play it safe before you know who you can trust."

P3: "I also think I had my guard a little higher because you guys knew I didn't fully understand the rules at first..." [Group laughter] "Whenever someone would be like this helps you out, I just don't know if I can believe you yet."

P4: "I also viewed it as kind of like good faith. Like if I give you a good tile, then maybe in the future, you'll also give me a good tile."

P1: "And that's exactly how it played out in the end. Like once you start agreeing to work together, that sort of builds a rapport."

P2: "Because when you help someone out, in the future they will hook you up because you've helped them before. It's like, I scratch your back, you scratch mine. It might not be an immediate benefit, but it's mutually recognized it's for a greater good."

The cards also sparked meaningful discussion. They encouraged consideration of current policies, social-ecological challenges, and potential futures, such as conservation acts, the removal of bike infrastructure, or the integration of gardens in neighbourhoods. For players, flipping a tile symbolized a disruption to the landscape, rendering it incomplete and unable to provide benefits (or points), much like how degraded social-ecological systems struggle to sustain the services essential to human well-being. The game became a space for reflection and curiosity about how real environments are shaped and could be improved.

Most importantly, the negotiation and collaboration mechanics showcased the value of cooperative planning. The incentive structure rewarded players for working together, leading to open dialogue, strategic thinking, and collaborative problem-solving. Playing *Paving Paradise* as an activity aligns with contemporary approaches to participatory urban design, where iterative, creative, and relationship-based engagement is essential for resilient, community-driven outcomes.[103]

103 Elizabeth M. Cook et al., "Setting the Stage for Co-Production," in *Resilient Urban Futures*, ed. Zoé A. Hamstead et al. (Springer International Publishing, 2021), 102, https://doi.org/10.1007/978-3-030-63131-4_7.

Q: "Final thoughts and suggestions, do you have any key takeaways from the game in relation to policy, sustainability, and urban development in your communities you'd like to share?"

P1: "I think it's definitely an accessible way for people to understand policy because, unless it's like on the news or whatever, nobody's going onto the Ontario website to see what new thing has been enacted. So yeah, I think it's a good way to make policy accessible to people. And also on the Objective cards, it's a good way to just communicate facts about the environment and sustainability."

P2: "Also, this is more about gameplay, but being able to collaborate fostered good communication, and it also opened up more strategies, like making a huge connected big park."

P1: "Which I think mimics real life too, because you're like planning ahead in order to minimize environmental threats or issues or whatever it is when there's development."

P4: "I liked the collaboration too because then it can also encourage people to talk more about these policies to each other, and when a tile gets destroyed in something we've been working on building together, it impacts everyone."

3.4 Conclusion

Within an alternate game-world reality, *Paving Paradise* players engage in resilience-building as they anticipate unpredictable events while actively interacting with other players and the physical game itself.

The initial design began as an adaptation to an existing and well-loved game, *Carcassonne*, which provided a solid mechanical game structure and ensured that players would not have to learn an entirely unfamiliar system. Playtesting became a vital method in developing *Paving Paradise* beyond the mechanics of *Carcassonne*. The rigorous playtesting and collaboration with actual players in prototyping ensured a player-centric experience.[104] Participants brought new ideas, challenged the game design, exposed misunderstandings, and helped clarify rules, graphics, and interactions. Player feedback highlighted both opportunities and contradictions that might otherwise have gone unnoticed without playtesting. It also reaffirmed that, for a game intended for general audiences, iterative collaboration is essential to creating something that is legible, engaging, and inclusive. The material construction and graphic adjustments also benefited directly from repeated play. Observing what players noticed, or ignored, shaped the design of the tiles, cards, and illustrations in practical ways that support the overall understanding and enjoyment of the game.

The playtesting sessions also revealed conceptual tensions that may guide future iterations. For instance, while placing tiles symbolically represents human agency in shaping landscapes, it risks reinforcing the notion of total control rather than reciprocal stewardship with the existing ecology and biophysical conditions of a given site. Similarly, collaboration and competition coexist in complicated ways. In the final playtest, three players teamed up against one individual, mirroring potential real-world alliances, power struggles, and uneven trust. This helped expose how negotiation, conflict, and collaboration are inseparable from planning practice. In a game setting meant for community involvement with a varying range of stakeholders, a bit of tension can spark honest dialogue and new ideas, while total agreement often means real disagreements are being suppressed.[105] The challenge is creating a space where conflict can be expressed safely, without overpowering the group, so all participants feel heard, boundaries are clear, and marginalized voices are actively supported.[106]

The final iteration of *Paving Paradise* within the scope of this thesis communicates municipal and provincial policy, and social-ecological relationships within Caledon in a format that is accessible, tactile, and enjoyable. While it does not deliver instruction, it creates a platform where players engage in discussions, debates, laughter, and reflection while exploring urban sustainability themes. *Paving Paradise* can act as "laboratory tests" for new policies or decisions, providing a platform to discuss urban topics before they are implemented in real-world situations.[107] The design process demonstrated that serious gaming could synthesize research into a format that fosters ecological literacy and community participation.

104 Steffen Walz, *Toward a Ludic Architecture* (ETC Press, 2010), 24.

105 Cook et al., "Setting the Stage for Co-Production," 105.

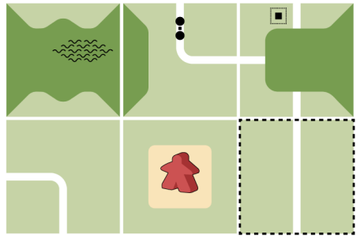
106 Cook et al., "Setting the Stage for Co-Production," 105.

107 Tan, "Negotiation and Design for the Self-Organizing City. Gaming as a Method for Urban Design," 129.

Bonus Collaboration Points

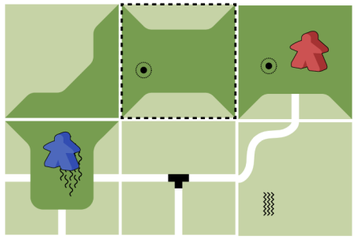
Bonus collaboration points can be scored multiple times throughout the duration of a game and are scored immediately. To earn bonus points, do as follows:

1 Point - Place a tile adjacent to a Farm with another player's Community Member placed on it.



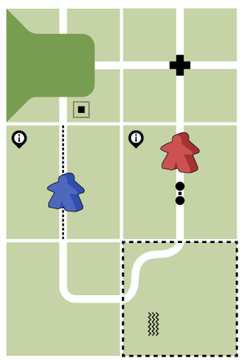
Simply receive 1 extra point by placing this tile for helping Red complete their Farm!

1 Point each - When a player connects a section of a feature they occupy with another player's section.



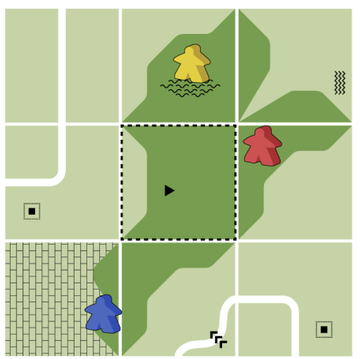
If Red or Blue placed this tile, both players will receive 1 extra point for connecting their Parklands!

3 Points each - When two or more players collaborate on completing a feature that achieves both of their Objective cards.



If Red or Blue placed this tile, both players will receive 3 extra points for collaborating on completing a feature that achieves both their objectives!

4 Points each - Complete a Parkland with 6 or more tiles when two or more players have Community Members placed on it.



If Red, Blue, or Yellow placed this tile, all three players will receive 4 extra points for connecting their Parkland of 6 or more tiles!

Figure 3.35

How to score bonus collaboration points in *Paving Paradise*.

Game End

The game concludes after a player places the final tile. Following this, final scoring begins.

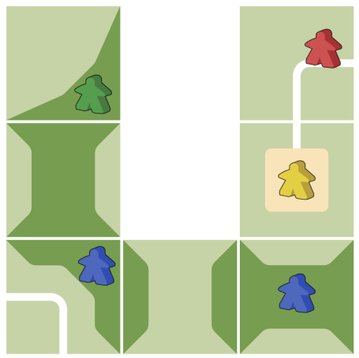
Final Scoring

Scoring Incomplete Objectives

If any players have incomplete Objective cards, the number of points they would have received by completing the objective will be deducted from their total points.

Scoring Incomplete Roads, Parklands, or Farms

In the final scoring, any unfinished Roads, Parklands, or Farms are scored. Players with a Community Member on an incomplete feature earn 1 point per tile. If multiple players have Community Members on the same incomplete feature, scoring follows the same rules as for completed features where each player will receive points regardless of the number of Community Members on the feature.



In this example,
Red scores 2 points for the incomplete Road.
Yellow scores 3 points for the incomplete Farm.
Blue scores 6 points in total for two separate incomplete Parklands.
Green scores 4 points for the incomplete Parkland on the left.

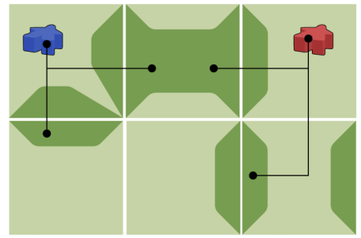
Figure 3.36

How to score incomplete Roads, Parklands, or Farms at the end of the game.

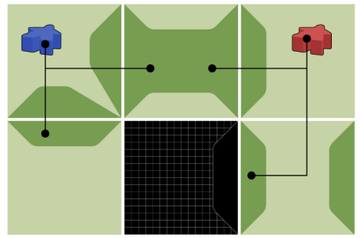
Scoring Community Hubs

- When scoring Community Members occupying Community Hubs, only completed Parklands are counted. Any Parkland containing one or more tiles that have been destructed and flipped over are considered incomplete.
- The Community Member must be placed in a Community Hub adjacent to at least one completed Parkland. The number of tiles between the Community Member and the Parkland is irrelevant.
- For every completed Parkland adjacent to the Community Hub, each player with a Community Member in that hub earns 3 points.
- A Community Hub only earns points if it is adjacent to at least one completed Parkland. Multiple Community Hubs can touch and score the same Parkland.

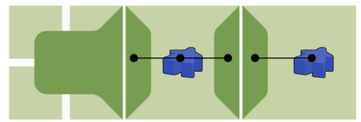
Scoring Community Hub Examples



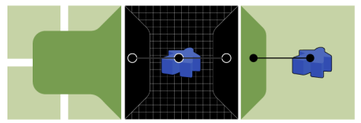
In this example, Blue earns 6 points and Red earns 6 points.



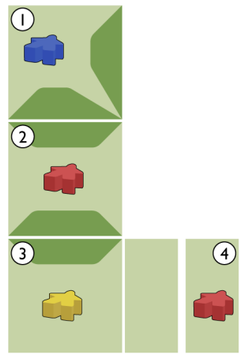
In this example, Blue earns 6 points and Red earns 3 points.



In this example, Blue earns 9 points.

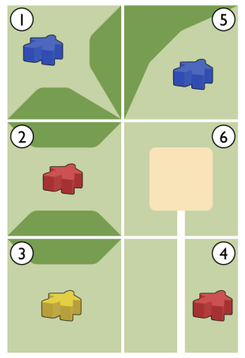


In this example, Blue earns 0 points.



(#) Shows the order the tiles were placed in

In this example, Red earns 6 points, Yellow earns 3 points, and Blue earns 3 points.



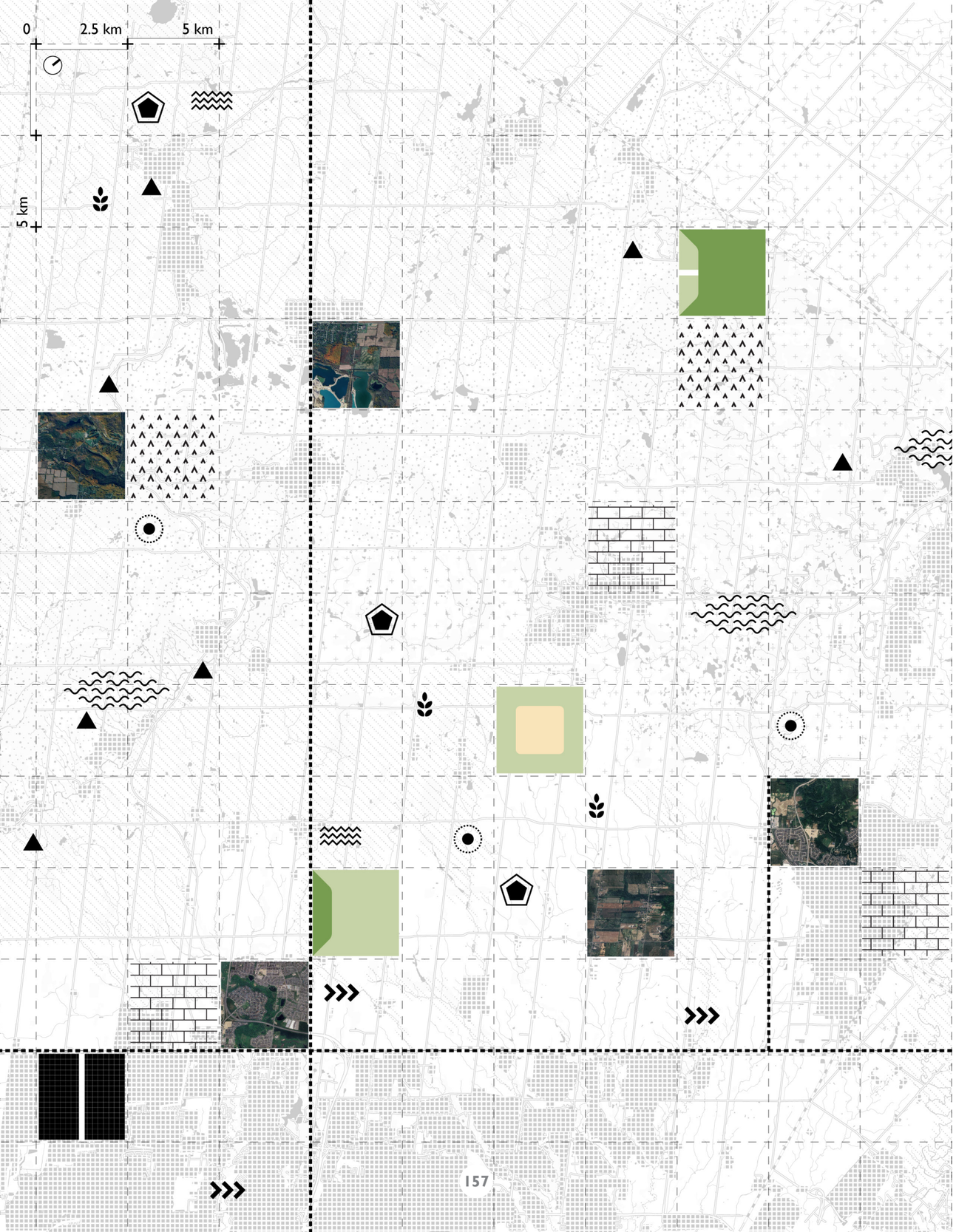
In this example, Red and Yellow both score 6 points. Blue is in a separate Community Hub and the same Community Hub as Red and Yellow, and therefore, scores a total of 9 points.

Figure 3.37

How to score Community Hubs at the end of the game.

After all Community Hubs have been scored, the final scoring is complete, and the game ends.

The player with the most points wins, having contributed the most towards Caledon's social-ecological resilience and sustainable urban landscape!



Conclusion

Play Again?



Paving Paradise Objective card icons

Figure 4.1

Layering of *Paving Paradise* tiles, Objective card icons, and screenshots from Google Earth, showing imagery © Google, and © Airbus, dated 2023-2025.

4.0 Play Again?

As an approach to community participation in planning, serious games are intended to engage and educate individuals on matters that impact the communities they inhabit. *Paving Paradise* utilizes the organizational and rule-based properties of traditional games as a method to engage with social-ecological systems in the built environment, thereby enhancing ecological literacy and engagement. The Town of Caledon, as the base for the game, is used to analyze the differing incentives and objectives from various levels of stakeholder powers that drive the Town's development. Playing the game forms a speculative urban landscape where the city is not designed by a single authority, but collaboratively through community participation, knowledge sharing, and negotiation. While the game is not concerned with replicating real-world problems in the context of proposing feasible solutions, it aims to utilize game mechanics as an engaging and educational tool to counteract the normalization of environmental degradation, stemming from declining environmental memory and ecological literacy.

Paving Paradise reframes *Carcassonne*'s ownership and territorial expansion game mechanics as tools for co-design and for communicating the dynamics of social-ecological systems and services. The act of designing *Paving Paradise* became a sandbox for understanding new systems of governance and policies as a prototype for more resilient cities. From conception to design to execution, the designed game reflects real human action against varying social situations across a varying range of perspectives present in developing cities. *Paving Paradise* was directly derived from the research conducted in Chapters 1 and 2, which provided a strong conceptual grounding for the game narrative and mechanics. Chapter 1 focused on how current policies negatively contribute to pro-conservation behaviours by shaping Caledon's urban form into a sprawling, car-dependent landscape. Chapter 2 outlined social-ecological urbanism frameworks to retrofit suburban neighbourhoods into active and biodiverse environments that strengthen human-nature connections. Together, Chapters 1 and 2 informed themes, policy references, and social-ecological systems embedded in the game. However, translating such a dense body of knowledge into game form proved challenging.



Figure 4.2

Dam at the Alton Mill.

Much of the research integrated into *Paving Paradise* had to be distilled so the game did not become too tedious or complicated. As a result, while players became immersed in the game, the content on the Objective and Information cards sometimes lost prominence as attention naturally shifted to gameplay. Similarly, the game's visual language was intentionally abstracted to enhance accessibility and allow the mechanics to apply across diverse scenarios and conditions. Yet this abstraction inevitably reduced the game's tangibility, since the tiles no longer corresponded to specific locations within players' own communities affected by development or policy change. This generalization also simplified the ecological specificity required to convey the complexity of biodiversity and the design considerations essential for sustainable urban systems. A potential benefit is the game's ability to balance between an enjoyable and replayable experience, while still planting seeds of awareness about policy, development pressures, and ecological systems. As the goal of *Paving Paradise* was to design a platform that invites people into conversations about the built environment, the research abstractions felt appropriate to the scope.

The game design process revealed that a game can successfully synthesize research, but finding a middle ground between accessible play and meaningful content was the most significant design tension. With more experience or future revisions, there is room to develop more nuanced game mechanics without compromising enjoyment. In a speculative future, *Paving Paradise* lays the groundwork for activities in co-production by creating space for interacting with diverse people in imaginative ways. Co-production can drive urban transformation and resilience; however, its goals are often aspirational, and only through careful attention to the challenges of collaboration can it build lasting capacity for continued engagement and co-learning.[108]

Meaningful co-production requires a shared commitment among all stakeholders to address urban challenges informed by history and politics that extend beyond conflicts, uncertainties, and power dynamics.[109] Deliberate spaces for co-learning around collective goals must be designed to allow assumptions to unravel, contested ideas to be reconciled, and new shared understandings of urban resilience to emerge.[110] *Paving Paradise* incentivises both collaboration and conflict in a lighthearted manner where players must explore common ground and reconciliation while juggling varying attitudes towards trust, negotiation, and resolution to win (whether they collectively define winning as a group initiative to achieve an objective, as seen in the last playtest, or as the player with the most points). A serious game board can become an iterative and reflective platform to facilitate activities focused on building rapport and relationships with all participants. Outreach is another key component for successful and inclusive co-production in urban design. A method to communicate research between academic, community, and municipal partners where clear expectations about project scope, resources, and intended outcomes must be established.[111] Objective and Information cards in *Paving Paradise* can be tailored or adapted to address the needs of all partners, and disseminate academic outputs with accessible, actionable implementation strategies for broader audiences to support long-term co-learning and collaboration.

108 Cook et al., "Setting the Stage for Co-Production," 108.

109 Cook et al., "Setting the Stage for Co-Production," 102.

110 Cook et al., "Setting the Stage for Co-Production," 102.

111 Cook et al., "Setting the Stage for Co-Production," 106.

The final iteration of *Paving Paradise* developed for this thesis can function as a complementary tool within participatory planning initiatives by offering an activity that helps redistribute power, reduce social barriers, and facilitate dialogue and interaction in the context of urban problem-solving. Although the current version does not incorporate or translate all the nuances of how urban form shapes and influences social-ecological services in Caledon, it serves as an effective entry point to draw attention to urban processes and natural systems that participants may not have previously recognized and can now engage with more critically to improve urban resilience. The foundational mechanics of the game also possess the capacity to be adapted and aligned with other geographic contexts and urban challenges beyond Caledon. When integrated into community outreach or participatory planning settings, the game's narrative can operate as a communication strategy that enables participants from diverse backgrounds to co-learn, access relevant resources, and engage with ongoing urban resilience research in support of co-production.

Paving Paradise adapts tile-laying and territory-building game mechanics to design conditions that enable people to imagine, negotiate, and potentially co-create urban futures together. Within the thesis scope, the research outcome affirmed that a serious game can function as both an educational tool and a civic catalyst to investigate resilient urban form through shared play and collective learning.

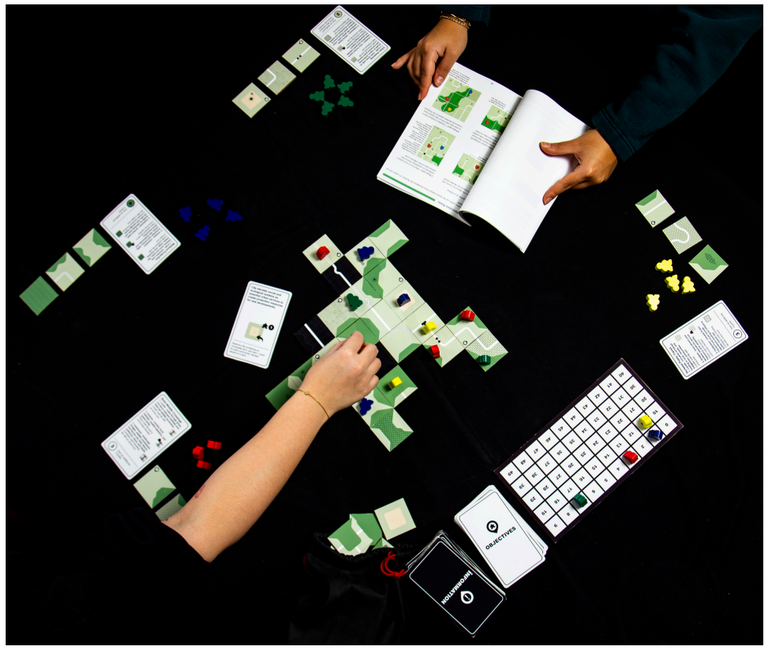
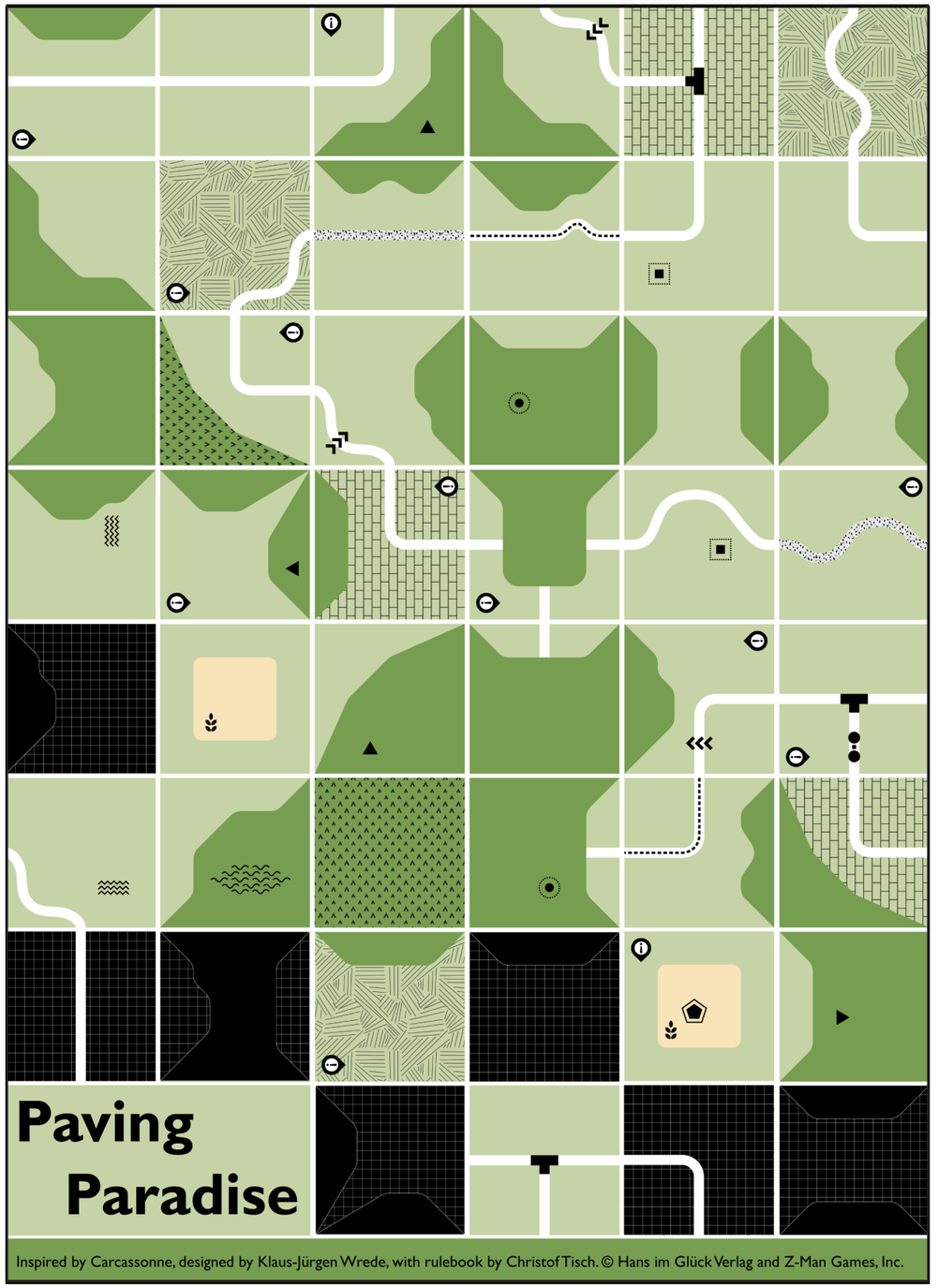


Figure 4.3

Paving Paradise game model. For additional photographs, see page 229 of the Appendix.


Paving
Paradise
Inspired by Carcassonne, designed by Klaus-Jürgen Wrede, with rulebook by Christof Tisch. © Hans im Glück Verlag and Z-Man Games, Inc.

PAVING PARADISE

A tile laying game for 2 to 4 players.
Inspired by *Carcassonne*, by Klaus-Jürgen Wrede.

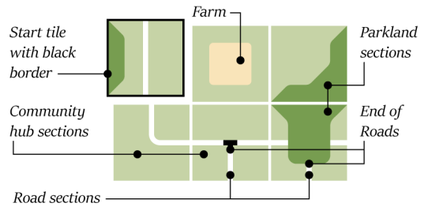
Introduction

The design of *Paving Paradise* is influenced by the realities of urban sprawl within the Town of Caledon and aims to raise awareness and create dialogue on protecting its cultural and ecological significance. The Town of Caledon is a Canadian city known for its natural landscape, countryside charm, and pockets of historic villages. The city today is urbanizing to welcome more residents but is at risk of sprawl-oriented development and ecological devastation. In this game, players must develop Caledon with sustainability in mind to ensure the well-being of its residents through the protection and enhancement of social-ecological services. Players will place their Community Members onto Roads, Parklands, Farms, and Community Hubs. Only the most judicious placements will gain the points required to stop urban sprawl and win the game.

Game Overview

At the beginning of the game, each player draws Objective cards. On their turn, players place one tile at a time to create Roads, Parklands, Farms, and Community Hubs. However, this is also how Roads, Parklands, Farms, and Community Hubs can be paved over. To score points, players must negotiate, collaborate, and place Community Members on these tiles. Points are scored during and at the end of the game. After the final scoring, the player who scored the most points will have contributed the most towards Caledon's social-ecological resilience and sustainable urban landscape.

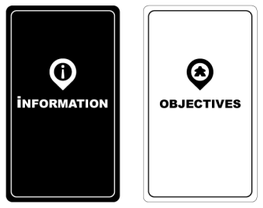
Game Components



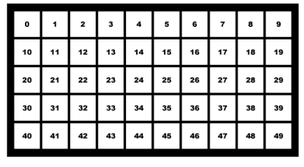
- 72 Land feature tiles (including 1 start tile with a black border) with Roads, Parklands, Farms, and Community Hubs.



- 32 Community Members in 4 colours: each player will have 8 Community Members and one of them will be used to keep score on the scoreboard.



- 32 Information cards
- 16 Objective cards



- 1 Scoreboard
- 1 Rulebook
- 1 Bag: to store tiles when drawing

Game Setup

The start tile is placed top-side up on a table and the other tiles are shuffled and placed in the bag. Each player draws three tiles out of the bag and places them in front of themselves, this will be their tile reserve. Once a tile is removed from the reserve and played, players must draw another tile. Throughout the game, players must always have exactly three tiles in front of them, until the end of the game when there are no more tiles to draw. Shuffle the Objective and Information cards and place them in face-down stacks on the edge of the table along with the scoreboard to give players enough room to place more tiles. Each player is dealt three Objective cards and discards two at the start of the game. Their selected Objective card can be shown to the other players. Each player takes the 8 Community Members of their chosen colour and places one on the scoreboard starting at zero (0) points. Each player keeps the remaining seven Community Members as their personal supply. The group can decide who goes first, or simply let the youngest player start the game.

Playing the Game

Players take turns sequentially in a clockwise direction, beginning with the first player. On their turn, each player must perform the following actions in the order listed below:

1. (*Optional – see Objective Cards*) Request a new Objective card.

2. (*Optional*) Negotiate to trade tiles.
   a. If negotiation is successful, two players may either trade tiles within their three reserved tiles, or the player offering their tile may immediately draw a new tile to replace their reserve.
   b. The player receiving the negotiated tile must play that tile within the turn.

3. Select and place a tile from your reserve or play the negotiated tile.

4. (*Optional*) Then, you can take one (1) of your Community Members from your supply and put it on the tile you just placed.

5. (*If applicable*) If placing a tile results in the completion of one or more features (such as Roads, Parklands, or Farms), the Community Member on that feature is removed, and the feature is scored immediately.

6. (*If applicable – see Information Cards*) Draw an Information card and play the actions as described on the card, either flipping over tiles and/or collecting points, and then discard the card.
   a. Information cards must be drawn in the same turn as when a tile with an Information card icon is placed.

7. (*If applicable)* Draw a new tile and place it into your tile reserve.
   a. If a player is placing a negotiated tile that was not traded for one of their own, they should still have three tiles in reserve and will not need to draw a new tile this turn.

At this point, your turn ends and the next player will follow the same sequence of actions.

Objective Cards

At the start of the game, each player is dealt three Objective cards which they can review and strategize with their tile reserve (and other player's tile reserves). Each player must discard two Objective cards which must be kept secret and keep one that must be revealed to other players. The kept card will be the player's objective throughout the game. Once the objective is completed, the card is discarded, and the points are scored immediately. If a player does not complete their objective by the end of the game, the number of points they would have received by completing the objective will be deducted from their total points.

After a player has completed their objective, in any of their following turns, they may request another Objective card if they wish. They will once again be dealt three Objective cards, from which they keep one. The same Objective card rules will apply. (*See page 18-19 for achieving objective examples*).

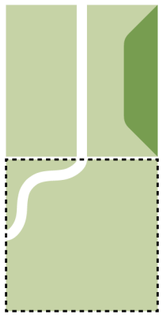
Objective Card Icons

- Crop - Farm based
- Bike - Road based
- Barn - Farm based
- Trail (Gravel) - Road based
- Animal - Parkland based
- Green Corridor (Arrow) - Road based
- Tree - Parkland based
- Garden - Community Hub based
- Water - Parkland based
- Urban Wildlife (Square) - Community Hub based
- Significant Feature (Triangle) - Parkland based
- Green Infrastructure (Paving) - Community Hub based
- Bus - Road based
- Urban Greening (Hatched) - Community Hub based

Placing Tiles

At the start of their turn, a player can examine their reserve tiles along with the reserve tiles of the other players. The player must place a tile on the table either from their own reserve or negotiate for a tile from someone else's reserve to place. Next, the player places the tile on the table while following these placement rules:

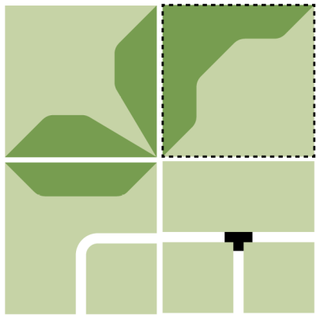
- The new tile (shown with a black dashed border in the examples) must be positioned so that at least one of its edges aligns with an existing tile. Tiles may not be connected by corners alone.
- Each new tile must connect and continue an existing Community Hub, Parkland, or Road.
- In the rare case that a tile cannot be placed anywhere on the board (as agreed by all players), the player discards that tile from the game and draws a new one to replace it.



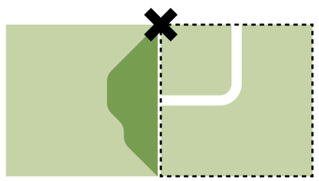
The newly placed tile connects a Road and Community Hub.



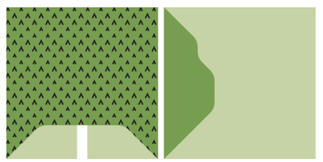
The newly placed tile connects a Parkland.



One side of the newly placed tile connects a Parkland and the other connects a Community Hub.



This placement does not connect and is not permitted.





Select tiles may have icons and hatches over top of the land feature (these correspont with Objective cards). When placing tiles, as long as the base colour aligns, the placement is allowed. The two examples above are both allowed.

Placing Community Members

After placing a tile, a player may choose to place one of their Community Members on it, following the rules outlined below:

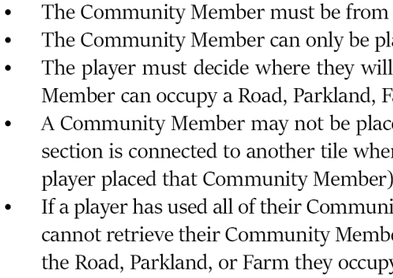
- Only 1 Community Member can be placed per turn.
- The Community Member must be from the player's supply.
- The Community Member can only be placed on the tile the player just placed.
- The player must decide where they will place their Community Member. As such, the Community Member can occupy a Road, Parkland, Farm, or Community Hub. (*See example*)
- A Community Member may not be placed on a Road, in a Parkland or in a Community Hub if that section is connected to another tile where there already is a Community Member (no matter which player placed that Community Member). (*See example*)
- If a player has used all of their Community Members, they continue placing one tile per turn. Players cannot retrieve their Community Members from tiles. A Community Member is only returned when the Road, Parkland, or Farm they occupy is completed and scored.
- At this point, the player's turn is over and the next player takes their turn, followed by the next one, and so on.

Important: When placing a tile results in the completion of any Roads, Parklands, or Farms, those features are scored immediately before the next player takes their turn.

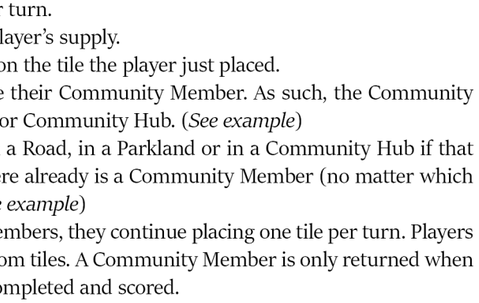
Community Members can either:



occupy a Farm, occupy a Road, occupy a Parkland, or occupy a Community Hub. (Laying down)



Blue can only place a Community Member in the Community Hub or on the Road because the connected Parkland is already occupied by Red.



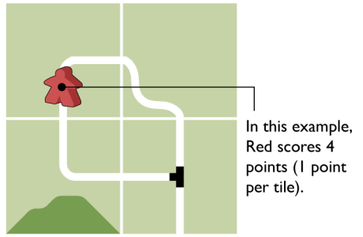
Blue may place a Community Member on either the Parkland or the Road. To place one in a Community Hub, they must choose the smaller Hub, since the larger one is already occupied by Blue.

Scoring Completed Features and Community Hubs

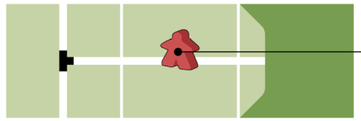
Scoring Completed Roads

To complete a Road, both ends must connect to a crossroad, a Parkland section, a Farm, for the Road must loop onto itself. The amount of Road sections between the ends do not matter.

When a Road is completed, the player with a Community Member on that Road earns 1 point for each tile that forms it. Only the number of tiles is counted, not the segments of Road.



In this example, Red scores 4 points (1 point per tile).

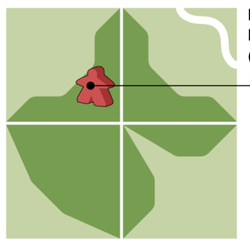


In this example, Red scores 3 points.

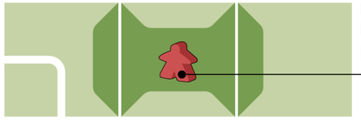
Scoring Completed Parklands

A Parkland is considered complete when it is fully enclosed by its border, with no openings or gaps within the boundary or the Parkland itself. The Parkland may contain any number of connected sections.

When a Parkland is completed, the player with a Community Member on it earns 2 points for each tile that makes up the Parkland. Only the total number of tiles is counted, even if a single tile contains multiple Parkland sections, it still counts as one.



In this example, Red scores 8 points (2 point per tile).

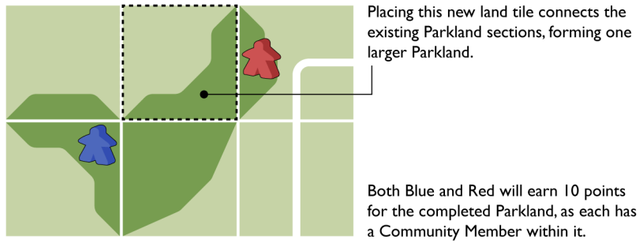


In this example, Red scores 6 points.

Can there be more than one Community Member on a completed Road or Parkland?

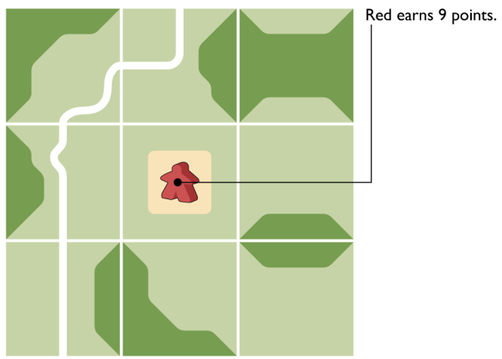
Strategic tile placement can link separate Road or Parkland sections, creating a shared feature occupied by Community Members from multiple players. Regardless of the player with the greatest amount of Community Members on a Road or Parkland, each player with a Community Member on the feature will receive points as normal.

Important: There is potential to earn bonus points! (*See page 14 for bonus collaboration points*)



Scoring Completed Farms

A Farm is considered complete when it is fully enclosed by surrounding tiles. Once completed, the player with a Community Member on that Farm earns 9 points (one point for each tile, including the tile with the Farm).

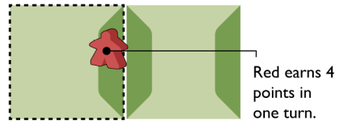


After scoring, Community Members go back into their player's supply!

Once a Road, Parkland, or Farm has been scored, the Community Members involved are returned to their owner's supply. These returned Members may then be placed on a Road, Parkland, Farm, or Community Hub in future turns.

To record points earned during the game, a player advances their Community Member along the scoreboard by the number of points scored. If the Community Member passes space 49, the player lays it on its side to show they have exceeded 49 points, then continues moving it along the track from the beginning of the scoreboard as normal.

A player may place a Community Member, complete and score a Road, Parkland, or Farm, and have that same Community Member returned to their supply all within the same turn. However, these actions must always be carried out in the following order:





1. Place a new tile that completes a Road, Parkland, or Farm.
2. Place a Community Member on the completed feature on that tile.
3. Immediately score points for the completed feature.
4. Return the Community Member to the player's supply.

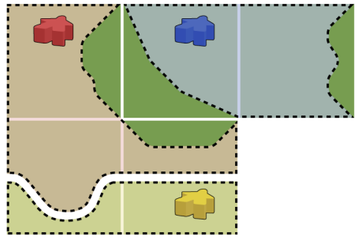
Remember to check for bonus collaboration points!

Something to keep in mind, while focused on individual player objectives, there may be potential for even more points if players work together! As sustainable urban planning is reliant on community collaboration and participation!

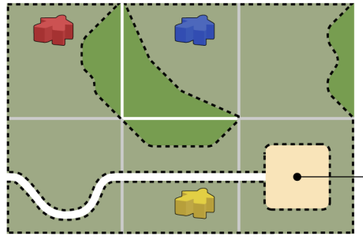
Score bonus collaboration achievements immediately as they are completed throughout the game. (*See page 14 for bonus collaboration points*)

Scoring Community Hubs

Connected Community Hub sections form a single, larger Community Hub. Unlike Roads, Parklands, or Farms, Community Hubs are not scored during the game. Players may place Community Members in a Community Hub section, but these Members only earn points during the final scoring. Once placed, a Community Member stays in that Hub until the end of the game and is never returned to the player's supply (place the Member lying down on the tile to indicate this). Community Hubs are divided by Roads, Parklands, or the edge of the board.



Each of the three Community Members occupies a separate Community Hub. Roads and Parklands segment the area, creating three distinct Hubs.



Placing this new tile merges the three separate Community Hubs into a single Hub, with each player having a Community Member within it.

Remember to check for bonus collaboration points as this strategic tile placement can reward each player with additional points!

Note: The player placing this tile cannot add a new Community Member to the hub, as it already contains at least one Member (three in this example).

Information Cards

Out of the 72 tiles, there are 20 tiles with an Information card icon. When a tile with an Information card icon is placed, an Information card must be drawn and played by the player that placed the tile within the same turn. Information cards can be good or bad, with the potential to rehabilitate features and reward points, or pave over features for sprawling development.

a. If an Information card is drawn and the described action on the card can not be completed, all players must agree, the card can be discarded and the game proceeds.

Destroying and flipping over tiles because of sprawling development

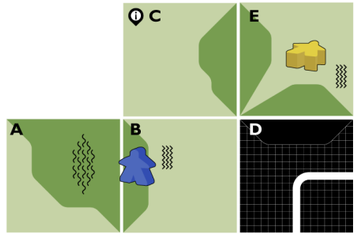
If the described action on the Information card requires a completed Parkland, or incomplete Road, Parkland, or Farm to be destructed and flipped over, the player that drew the card can decide which placed tile matching the Information card's description will be flipped.

If a tile is flipped containing an incomplete Road, Parkland, or Farm with Community Members occupying the feature, the Community Member must remain. The player who placed the Community Member can continue to try and complete the feature as usual. Upon completing the feature, the Road, Parkland, or Farm will be scored normally with points per tile, however, any flipped over tiles within the completed feature will not be counted or scored.

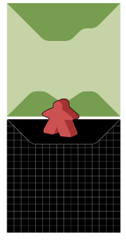
When scoring Community Members occupying Community Hubs at the end of the game, any Parkland with a destructed and flipped tile touching the Community Hub will not be scored. The player who placed the Community Member in the Community Hub will not receive 3 points for that Parkland. The number of destructed and flipped tiles containing sections of the Parkland does not matter. (*See page 22-23 for Information card examples*)

If the drawn Information card requires an incomplete Parkland to be flipped over, in this example, the player can choose to flip tiles A or B. They may not flip over C or E as those tiles are a part of a completed Parkland, and they may not flip over D as that tile has already been flipped.

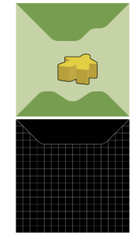
Note: Any icons on tiles that are flipped over will lose their value and could potentially prohibit a player from achieving their objective.



Red will only get 2 points for completing their Parkland as one tile is flipped over.



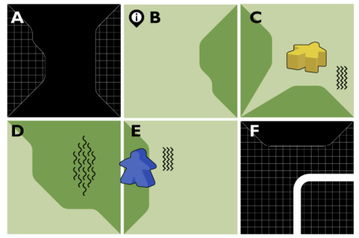
At the end of the game, yellow will get 0 points in this example.



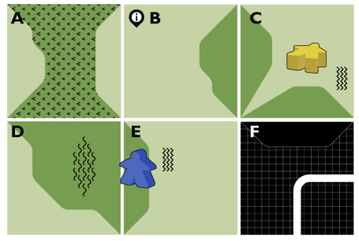
Restoring and flipping back tiles after land feature rehabilitation

If the described action on the Information card requires a completed Parkland, or incomplete Road, Parkland, or Farm that was previously destructed to be restored and flipped back, the player that drew the card can decide which placed tile matching the Information card's description will be flipped back. The player that drew the card will also receive points as described on the card which will be scored immediately.
If a tile is flipped back containing an incomplete Road, Parkland, or Farm, with Community Members occupying the feature, the tile is back in play and will be counted towards the player's score once the feature is completed. (*See page 22-23 for Information card examples*)

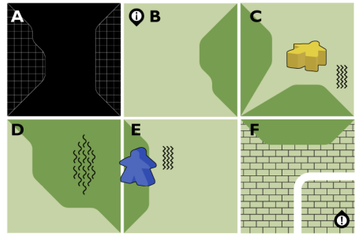
If the drawn Information card requires an incomplete Parkland to be restored and flipped back, in this example, the player can flip back A or F.



Flipping A will allow Blue to receive the 2 points associated with the tile if they later complete the Parkland.



While flipping F will allow Yellow to receive 3 points at the end of the game associated with the completed Parkland. (Therefore, in this example, Yellow will receive a total of 6 points).



Game End

The game concludes after a player places the final tile.

Following this, final scoring begins.

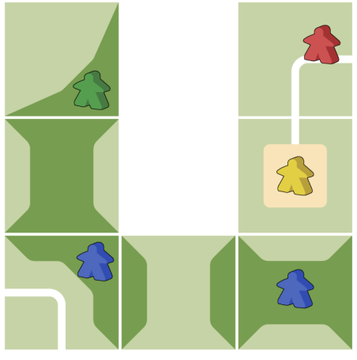
Final Scoring

Scoring Incomplete Objectives

If any players have incomplete Objective cards, the number of points they would have received by completing the objective will be deducted from their total points.

Scoring Incomplete Roads, Parklands, or Farms

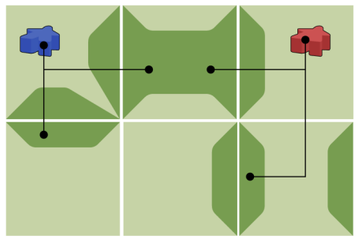
In the final scoring, any unfinished Roads, Parklands, or Farms are scored. Players with a Community Member on an incomplete feature earn 1 point per tile. If multiple players have Community Members on the same incomplete feature, scoring follows the same rules as for completed features where each player will receive points regardless of the number of Community Members on the feature. After scoring a feature, return the Community Members to their respective players to avoid scoring errors.



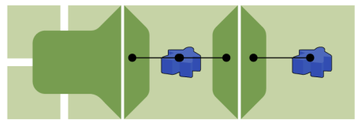
In this example,
Red scores 2 points for the incomplete Road.
Yellow scores 3 points for the incomplete Farm.
Blue scores 6 points in total for two separate incomplete Parklands.
Green scores 4 points for the incomplete Parkland on the left.

Scoring Community Hubs

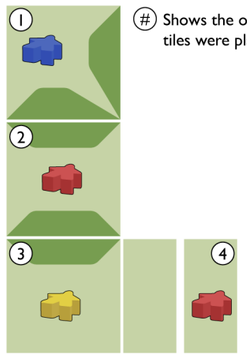
- When scoring Community Members occupying Community Hubs, only completed Parklands are counted. Any Parkland containing one or more tiles that have been destructed and flipped over are considered incomplete.
- The Community Member must be placed in a Community Hub adjacent to at least one completed Parkland. The number of tiles between the Community Member and the Parkland is irrelevant.
- For every Parkland adjacent to the Community Hub, each player with a Community Member in that Hub earns 3 points. The size of the Parkland is irrelevant.
- A Community Hub only earns points if it is adjacent to at least one completed Parkland. Multiple Community Hubs can touch and score the same Parkland. Each Hub is scored according to the rules described below.



In this example, Blue earns 6 points and Red earns 6 points.

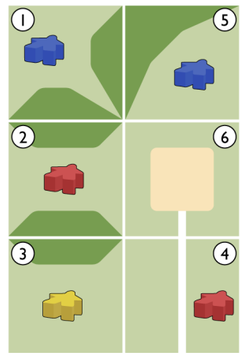


In this example, Blue earns 9 points.



(#) Shows the order the tiles were placed in

In this example, Red earns 6 points, Yellow earns 3 points, and Blue earns 3 points.



In this example, Red and Yellow both score 6 points. Blue is in a separate Community Hub and the same Community Hub as Red and Yellow, and therefore, scores a total of 9 points.

After all Community Hubs have been scored, the final scoring is complete, and the game ends.

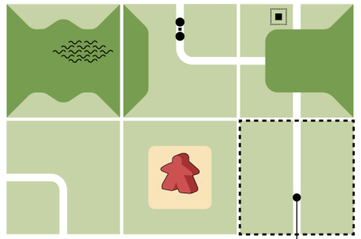
The player with the most points wins, having contributed the most towards Caledon's social-ecological resilience and sustainable urban landscape!

Bonus Collaboration Points

Bonus collaboration points can be scored multiple times throughout the duration of a game and are scored immediately.

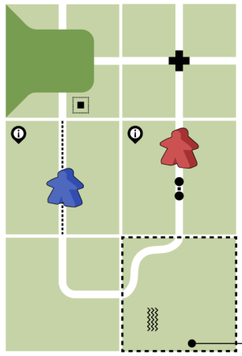
To earn bonus points, do as follows:

1 Point - Place a tile adjacent to a Farm with another player's Community Member placed on it.



Simply receive 1 extra point by placing this tile for helping Red complete their Farm!

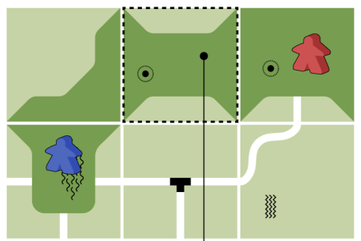
3 Points each - When two or more players collaborate on completing a feature that achieves both of their Objective cards.



In this example, Blue's objective is completing a Road with a bus icon, and Red's objective is completing a Road with a bike icon.

If Red or Blue placed this tile, both players will receive 1 extra point for connecting their Roads, AND 3 extra points for collaborating on completing a feature that achieves both their objectives!

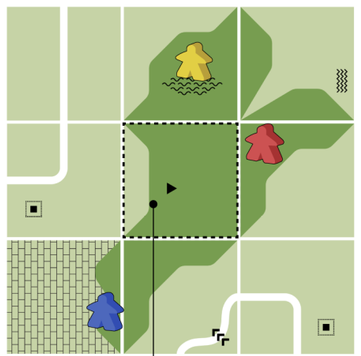
1 Point each - When a player strategically connects a section of a feature they occupy (with a Community Member) with another section of the same feature that 1 or more different players occupy.



If Red or Blue placed this tile, both players will receive 1 extra point for connecting their Parklands!

This bonus can apply to connecting Roads and Community Hubs too!

4 Points each - Complete a Parkland with 6 or more tiles when two or more players have Community Members placed on the Parkland.



If Red, Blue, or Yellow placed this tile, all three players will receive 4 extra points for connecting their Parkland of 6 or more tiles!

Scoring Summary

Scoring completed features during the game



Road
1 point per tile.
Flipped over tiles, where the backside is on top at the time of feature completion do not count towards points.

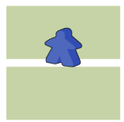


Parkland
2 points per tile.
Flipped over tiles, where the backside is on top at the time of feature completion do not count towards points.



Farm
9 points.
Flipped over tiles, where the backside is on top at the time of feature completion do not count towards points.

Scoring incomplete features at the end of the game



Road
1 point per tile.
Flipped over tiles, where the backside is on top do not count towards points.

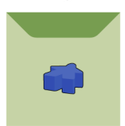


Parkland
1 point per tile.
Flipped over tiles, where the backside is on top do not count towards points.



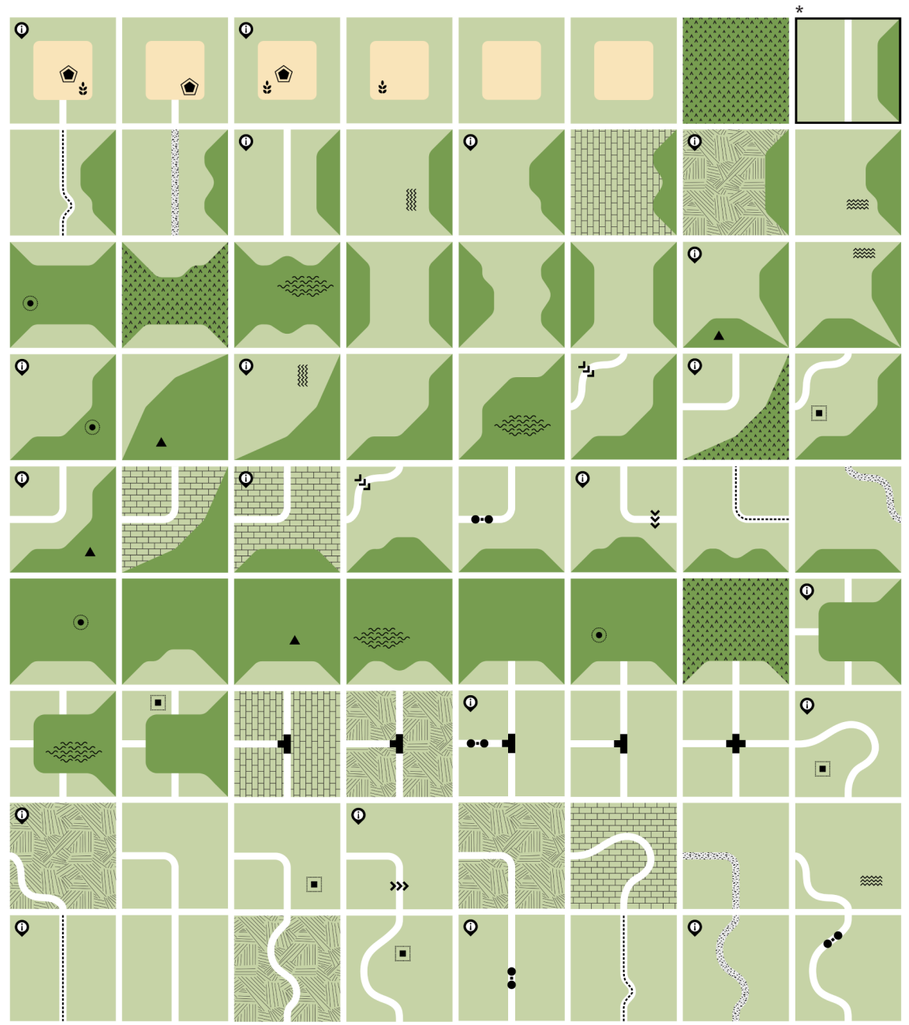
Farm
1 point per tile.
Flipped over tiles, where the backside is on top do not count towards points.

Scoring Community Hubs at the end of the game



3 points per completed Parkland in the Community Hub or adjacent to the Community Hub.
Any completed Parklands with flipped over tiles, where the backside is on top do not count towards points.

All 72 Land Feature Tiles Included

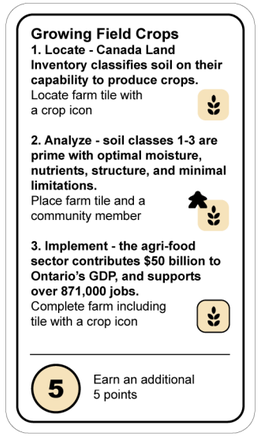


*Tile with black border is the starting tile.

All 16 Objective Cards Included



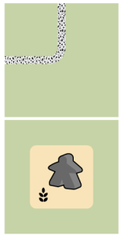
Example: Completing Objective Card (Farm based)



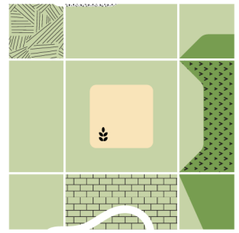
In this example, the player has selected to grow crops as their main objective and completing Farms will be their focus.



Step 1:
Find a tile with the icon shown on the Obective card.



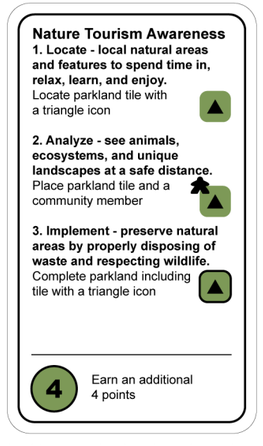
Step 2:
Place a Community Member within the Farm that contains the icon.



Step 3:
Complete the Farm.

Note: You do not need to be the player that places the final tile that completes the Farm.

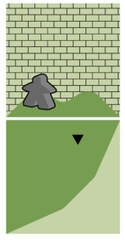
Example: Completing Objective Card (Parkland based)



In this example, the player has selected to raise nature tourism awareness as their main objective and completing Parklands will be their focus.

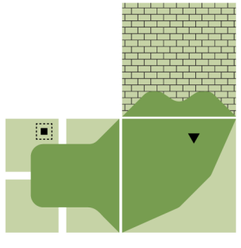


Step 1:
Find a tile with the icon shown on the Obective card.



Step 2:
Place a Community Member within the Parkland that contains the icon.

Note: You do not need to be the player that placed the tile with the icon. You simply need to occupy a Parkland connected to the tile with the icon. If there is already a Community Member in the feature, some strategic tile placements may be necessary.



Step 3:
Complete the Parkland.

Note: You do not need to be the player that places the final tile that completes the Parkland.

Example: Completing Objective Card (Road based)

Improve Active Transport

1. Locate - routes connecting downtown cores, schools, public spaces, and commercial zones.
Locate road tile with a bike icon

2. Analyze - support bike lanes in major cities to improve rider safety and traffic congestion.
Place road tile and a community member

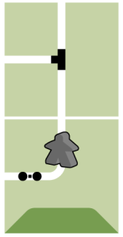
3. Implement - Repeal Acts like Bill 212 that allows removal of bike lanes.
Complete road including tile with a bike icon

3 — Earn an additional 3 points

In this example, the player has selected to improve active transportation as their main objective and completing Roads will be their focus.

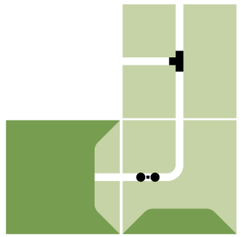


Step 1:
Find a tile with the icon shown on the Obective card.



Step 2:
Place a Community Member on the Road that contains the icon.

Note: You do not need to be the player that placed the tile with the icon. You simply need to occupy a Road connected to the tile with the icon. If there is already a Community Member in the feature, some strategic tile placements may be necessary.



Step 3:
Complete the Road.

Note: You do not need to be the player that places the final tile that completes the Road.

Example: Completing Objective Card (Community Hub based)

Permeable Paving

1. Locate - impermeable surfaces on roads and parking lots prevent rainwater from draining.
Locate community hub tile with a paving icon

2. Analyze - permeable surfaces prevents flooding and erosion, and improves water quality by reducing stormwater runoff and filtering it naturally.
Place community member within community hub

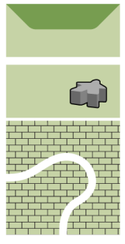
3. Implement - options including permeable asphalt or concrete, aggregates, or grass pavers.
Maintain community hub with adjacent parklands

2 — Earn an additional 2 points after placing a community member.

In this example, the player has selected permeable paving as their main objective and managing Community Hubs will be their focus.

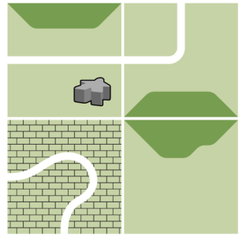


Step 1:
Find a tile with the icon shown on the Obective card.



Step 2:
Place a Community Member within the Community Hub that contains the icon.

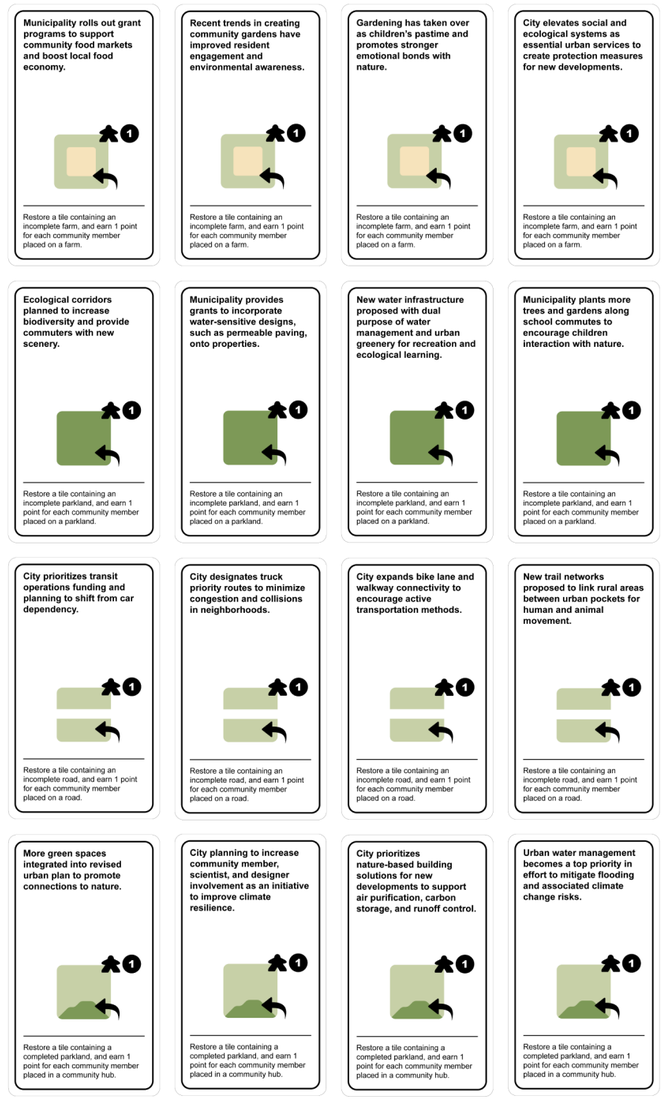
Note: You do not need to be the player that placed the tile with the icon. You simply need to occupy a Community Hub connected to the tile with the icon. If there is already a Community Member in the feature, some strategic tile placements may be necessary.



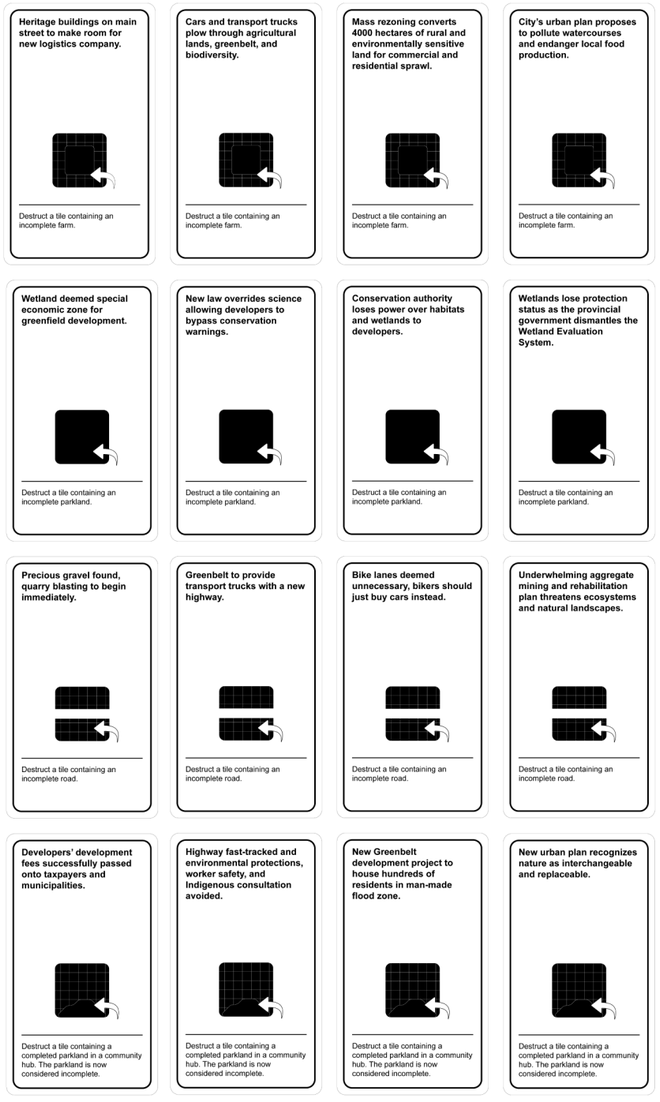
Step 3:
Complete Parklands within the Community Hub to earn more points!

Note: You will earn the 2 Objective card points as soon as you place a Community Member within a Community Hub containing the icon. Completing Parklands in the Community Hub is not necessary to achieve the objective.

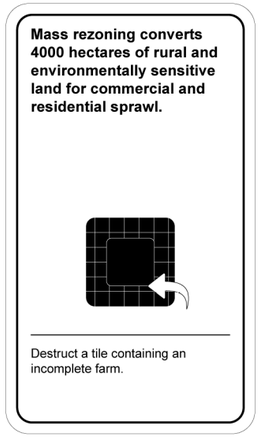
All 32 Information Cards Included 1/2



All 32 Information Cards Included 2/2



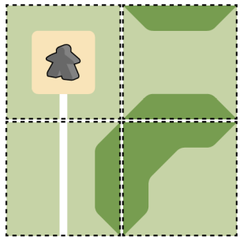
Example: Fulfilling Information Card (Farm based)



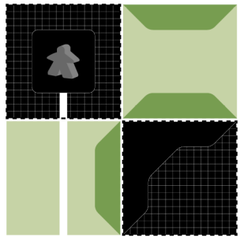
Example where a tile containing a section of an incomplete Farm must be flipped over and destructed.



Example where a tile containing a section of an incomplete Farm that has previously been flipped over, can now be resotred.

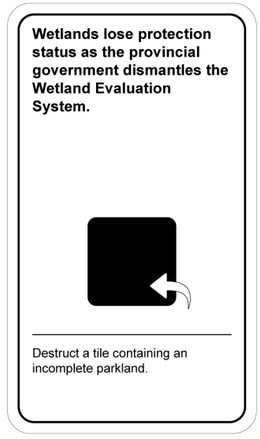


In this example, any one of these tiles can be flipped over and destructed. (Any of the adjacent tiles to the Farm and the farm tile itself can be flipped)

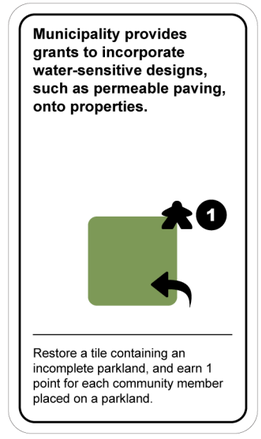


In this example, either of these tiles can be flipped back and restored.

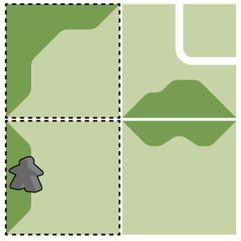
Example: Fulfilling Information Card (Parkland based)



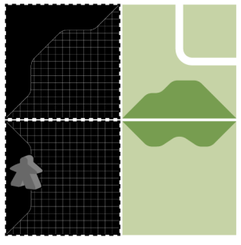
Example where a tile containing a section of an incomplete Parkland must be flipped over and destructed.



Example where a tile containing a section of an incomplete Parkland that has previously been flipped over, can now be resotred.

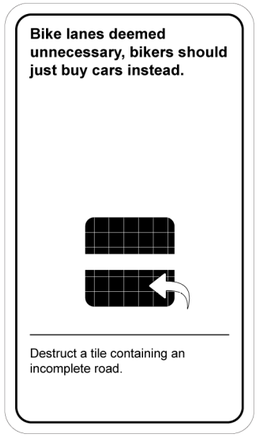


In this example, these tiles can be flipped over and destructed.

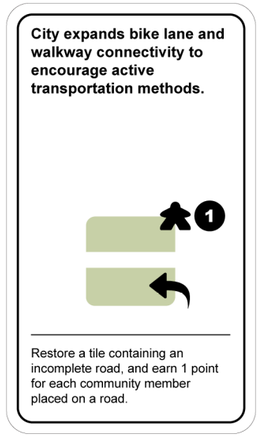


In this example, these tiles can be flipped back and restored.

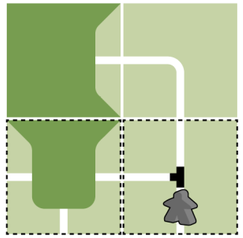
Example: Fulfilling Information Card (Road based)



Example where a tile containing a section of an incomplete Road must be flipped over and destructed.



Example where a tile containing a section of an incomplete Road that has previously been flipped over, can now be resotred.

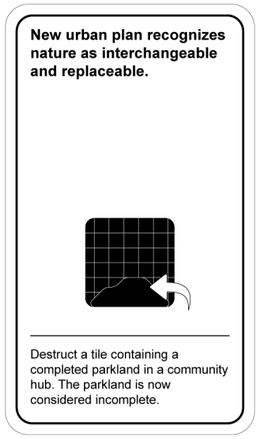


In this example, these tiles can be flipped over and destructed.

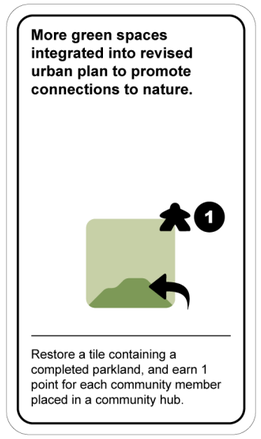


In this example, these tiles can be flipped back and restored.

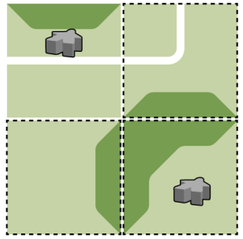
Example: Fulfilling Information Card (Community Hub based)



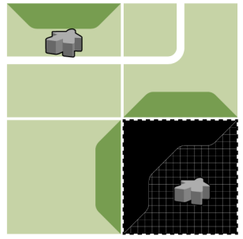
Example where a tile containing a section of a completed Parkland must be flipped over and destructed.



Example where a tile containing a section of a completed Parkland that has previously been flipped over, can now be resotred.



In this example, any one of these tiles can be flipped over and destructed.



In this example, this tile can be flipped back and restored.

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Appendices

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A. Playtest Guide

	AT THIS STAGE*	OBJECTIVES	DISCUSSION**	FOCUS GROUP INTERVIEW QUESTIONS
ROUND ONE	**Game mechanics and narratives are flexible** **+** Game to be taught verbally to allow rules to change and develop as the players play through the first time **+** Limited graphic consideration	**Is it playable?** **[ ]** Test new game mechanics and integration into Carcassonne **[ ]** Do objective and information cards work mechanically? Are they too easy or difficult to achieve? **[ ]** Does flipping over tiles work? Does it disrupt the flow of the game? **[ ]** Documentation of the questions players asked while learning and playing the game	**N/A**	**N/A**
ROUND TWO	**Game mechanics are functional** **+** Game to be taught verbally to allow rules to change and develop as the players play through the first time **+** Limited graphic consideration	**Is it engaging/fun?** **[ ]** Document player experience and overall enjoyment **[ ]** Documentation of player thinking times, strategic decisions made, and emotional responses **[ ]** Are objective and information cards legible and easy to understand? **[ ]** Consideration for how graphics can begin to aid player experience and comprehension **[ ]** Documentation of group discussions to finalize the game narrative, themes, and mechanics	**Discussion questions:** **[ ]** How was the playing experience? **[ ]** How did you find learning the game? **[ ]** What worked well? **[ ]** What didn't work? **[ ]** Was any aspect of the game too easy or too difficult? **[ ]** Did the event and objective cards contribute to you experience of the game? **[ ]** Were you ever bored? **[ ]** Final thoughts and suggestions?	**N/A**
ROUND THREE	**Game mechanics are functionally complete** **+** Game to be taught verbally to allow minor changes to game mechanics **+** Preliminary graphic and construction consideration	**Is it legible and intuitive?** **[ ]** Do graphics align with overall game theme? **[ ]** Do graphics align with objective and information card prompts? **[ ]** Do graphics supplement the game mechanics? **[ ]** Are the graphics legible and intuitive to general audiences?	**Informal group discussion questions:** **[ ]** How would you describe the game? **[ ]** What aspect of the game did you find most challenging? **[ ]** What aspect of the game did you find most fun? **[ ]** Final thoughts and suggestions?	**N/A**
FINAL ROUND	**Game mechanics, narrative, graphics, and construction are finalized** **+** Preliminary rulebook is created and referenced	**Is it engaging and educational?** **[ ]** How can the rulebook better support player learning and experience? **[ ]** Documentation of any questions asked while reading the rulebook and playing the final game **[ ]** Documentation on player engagement with the graphics and constructed game components **[ ]** Are the themes within the game engaging and educational? **[ ]** Audio recording and documentation of focus group interview discussion	**N/A**	**Formal focus group interview questions:** **[ ]** What was the outcome of the game, and what decision(s) made during the game do you think lead to this outcome? **[ ]** Were any decisions made during the game influenced by, or intended to influence, the other players of the game? **[ ]** Is there anything you would do differently, or attempt alternative strategies, if you were to play again? **[ ]** How did you find negotiating and collaborating with your teammates **[ ]** What was your objective card? And did it influence your game strategy or playing experience? **[ ]** The information cards are based on recent policies, were you aware of how policy can influence urban development and positively or negatively impact access to social and/or ecological services? If so, did playing through this game add to your existing knowledge? If not, has playing through this game introduced you to any new ideas? **[ ]** Final thoughts and suggestions? Do you have any key takeaways from the game in relation to policy, urban development, and/or social and ecological services you'd like to share?

* Participants will be the same during all playtesting rounds. The facilitator (author of this thesis) will not be a participant; Playtesting guide inspired by: West, "How Do You Playtest Board Games."

** Discussion questions are explored throughout playtesting to inform future iterations and will not be recorded within the contents of this thesis.

B. Printable Board Game

To create your own version of *Paving Paradise*, print the pages included in Appendix Part B. Feel free to remix or adapt any of the content to suit your preferences.

Materials needed:

- 20 sheets of 11” × 17” paper
- Colour printer
- Scissors
- Glue stick

Instructions:

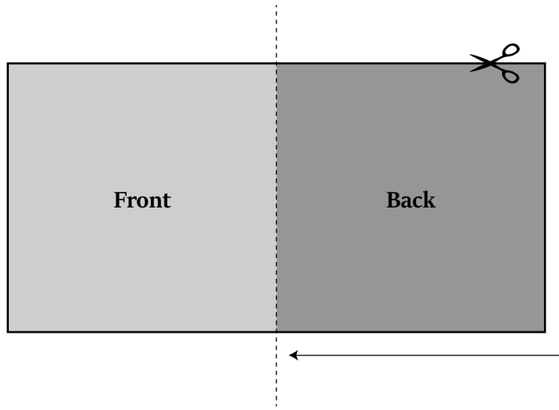
1. Print all pages in Appendix Part B single-sided, in colour, on 11” × 17” blank paper.
2. Check each page for printing notes. Some pages must be printed multiple times. Follow the instructions written on each page.
3. Read the construction notes on every sheet. Each page includes specific steps for assembling the game component shown.
4. Cut out the pieces using scissors or your preferred cutting tool, following the guidelines provided.
5. Assemble each component using the instructions on the page. Use a glue stick to attach pieces where indicated.
6. Once all components are assembled, your game is ready to play!

40	30	20	10	0
41	31	21	11	1
42	32	22	12	2
43	33	23	13	3
44	34	24	14	4
45	35	25	15	5
46	36	26	16	6
47	37	27	17	7
48	38	28	18	8
49	39	29	19	9

Cut around the boarder of the scoreboard.



Land tiles



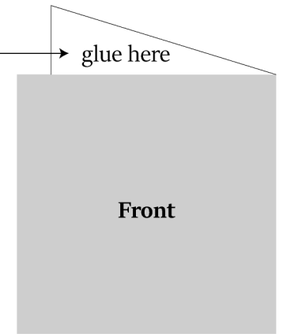
Cut along the outer border of two connected tile faces.

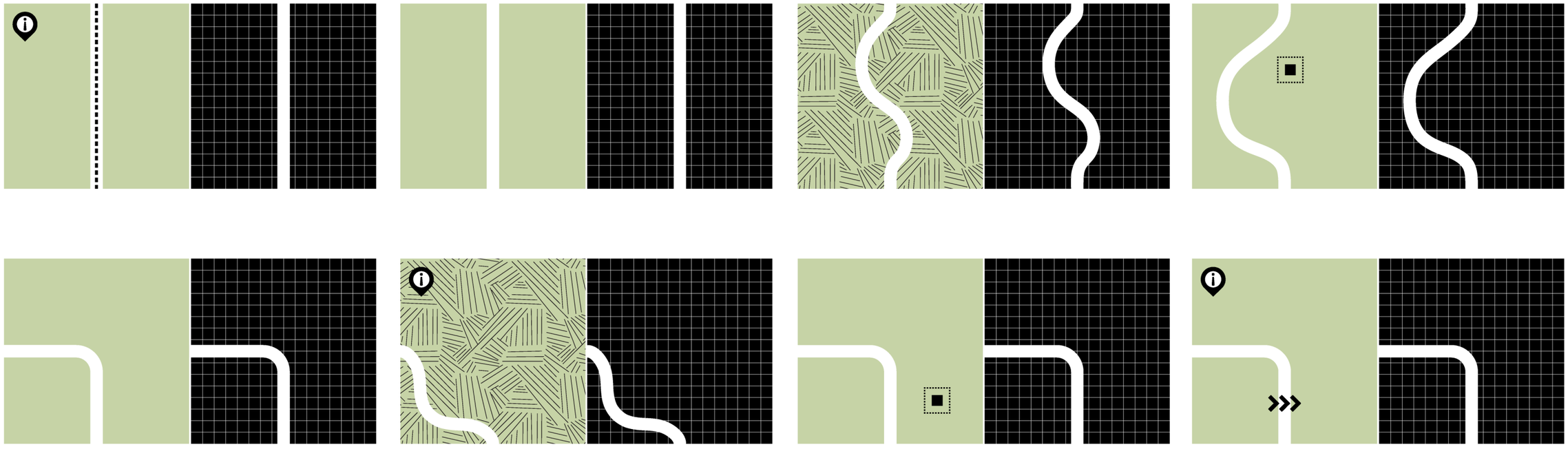
One face is the front, and one face is the back of the same tile.

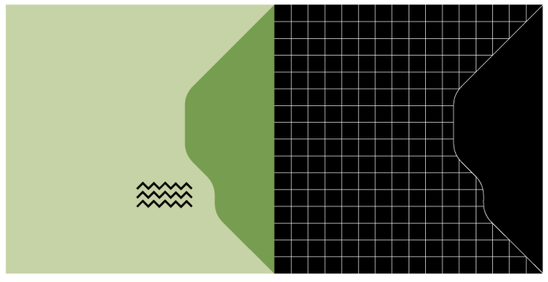
Fold the cut out along the connecting edge of both tile faces, ensuring the side with the illustrations are on the outside.

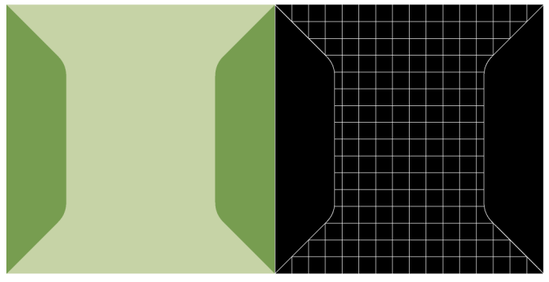
Glue the two faces together, forming one complete tile.

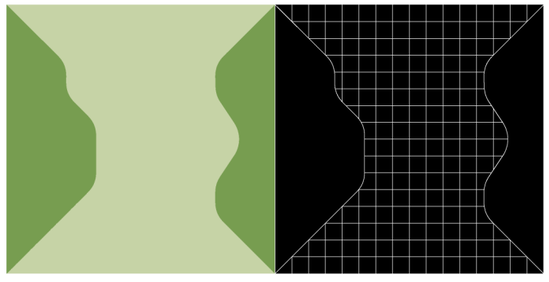
Repeat these steps for each tile.
This is an example and not a component in the game.

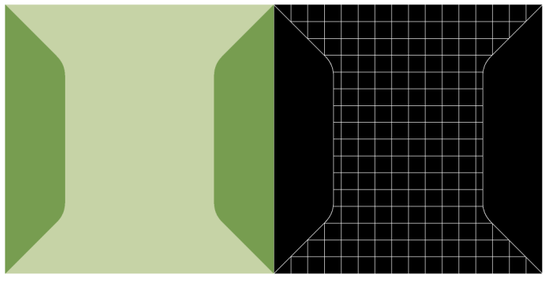


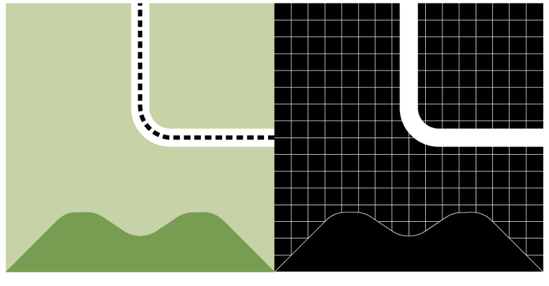


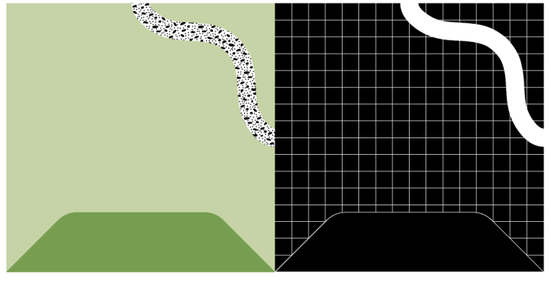


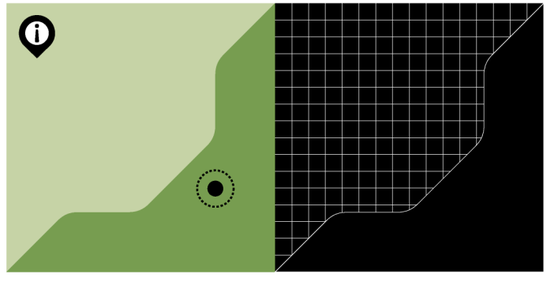


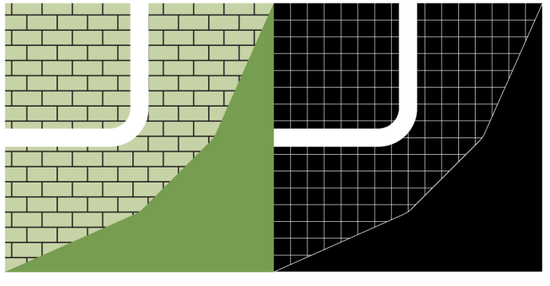


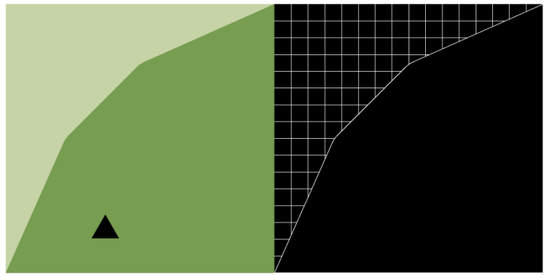


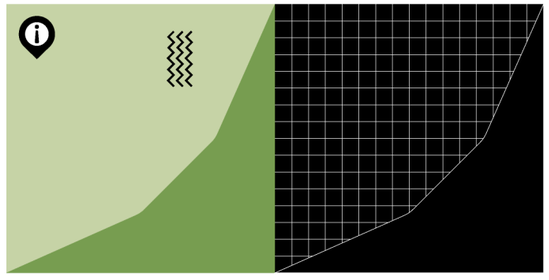


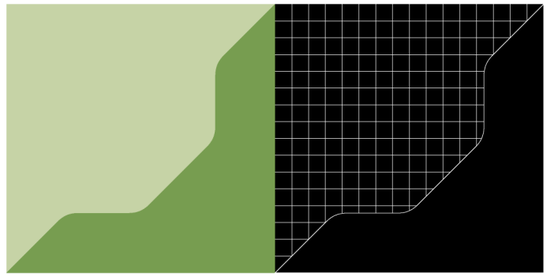


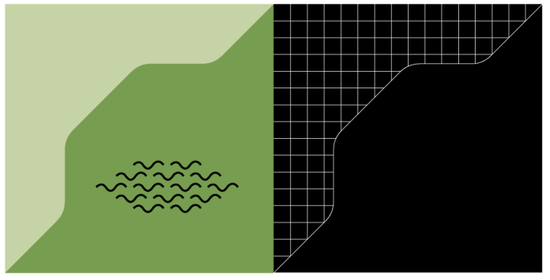


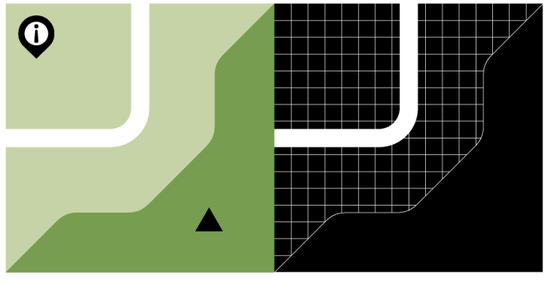


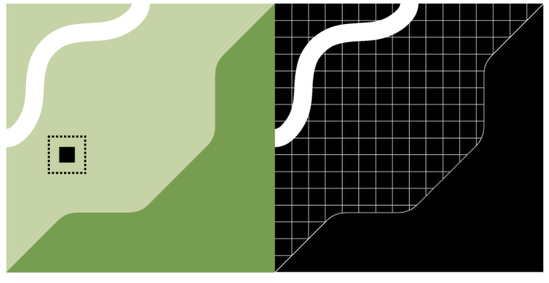


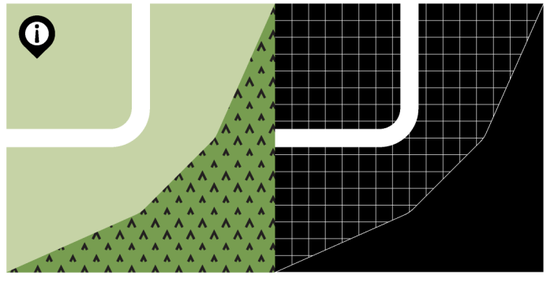


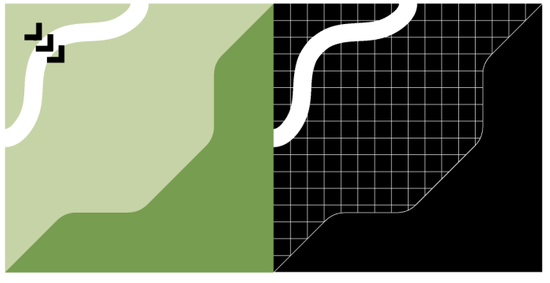


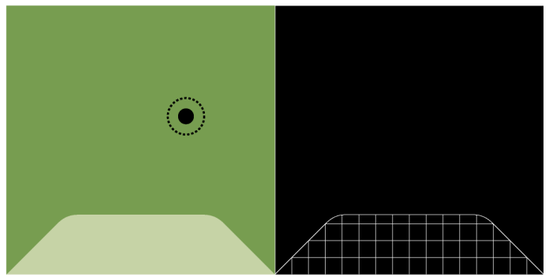


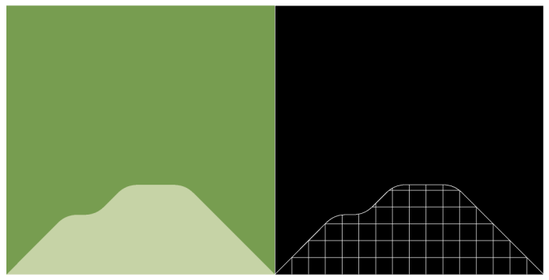


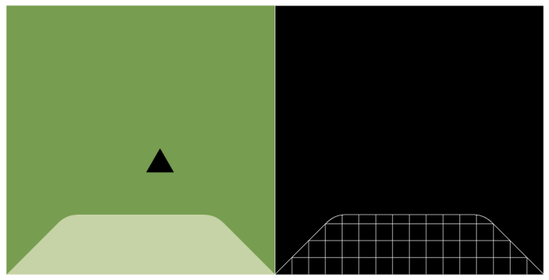


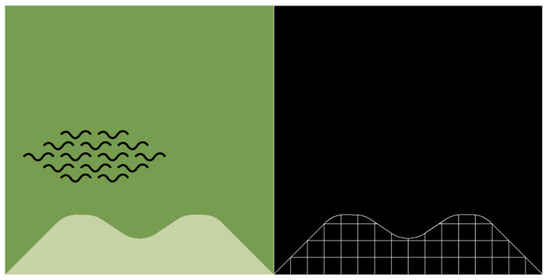


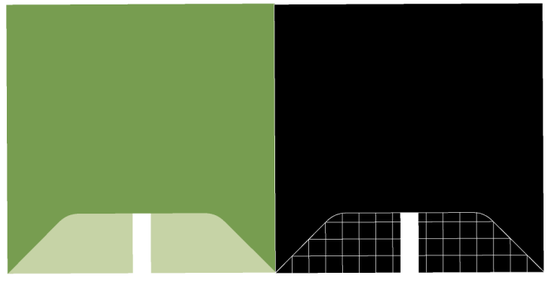




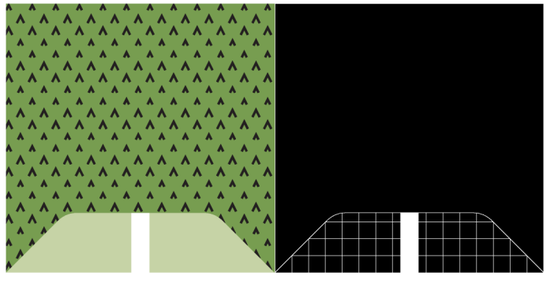


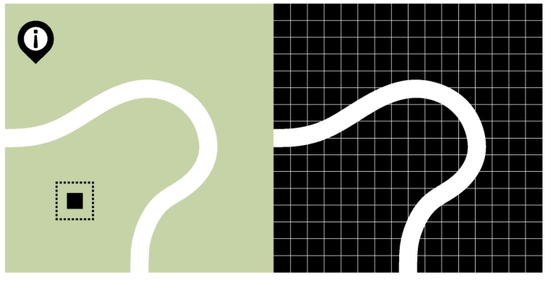


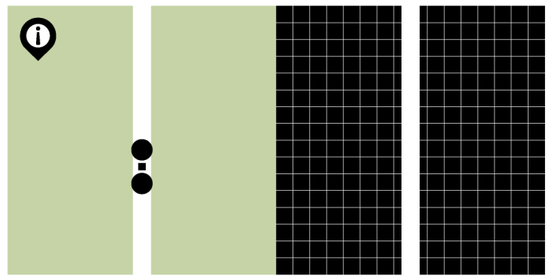


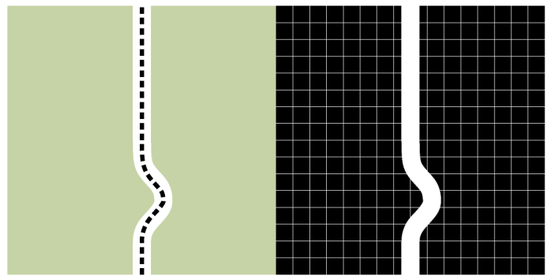


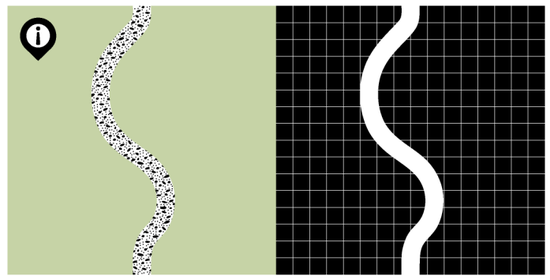


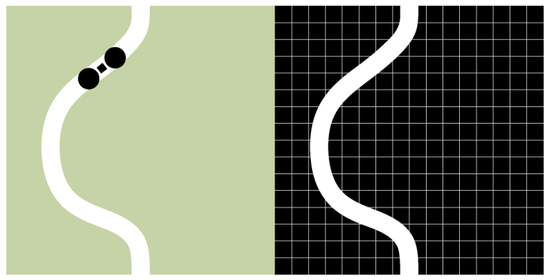


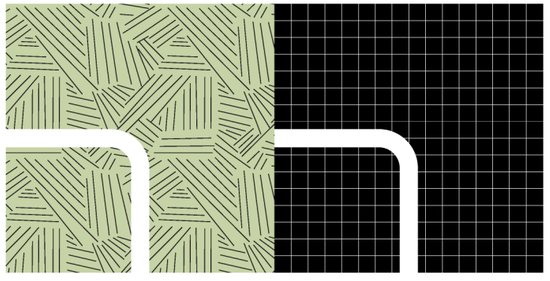


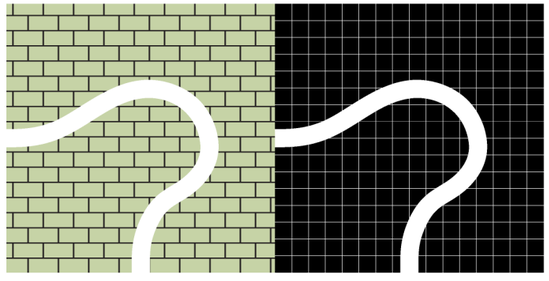


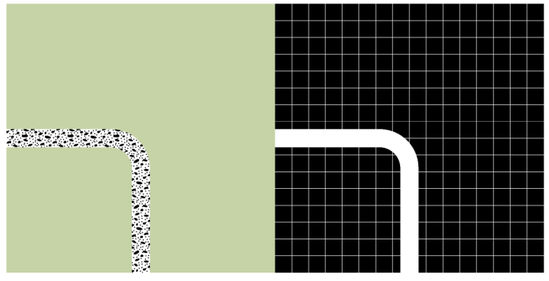


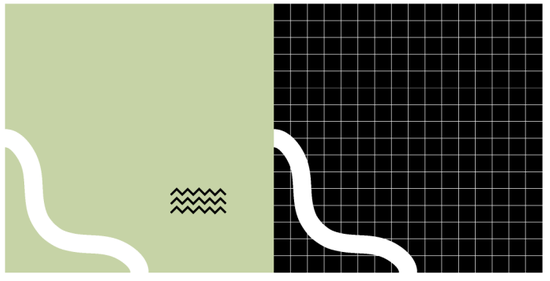


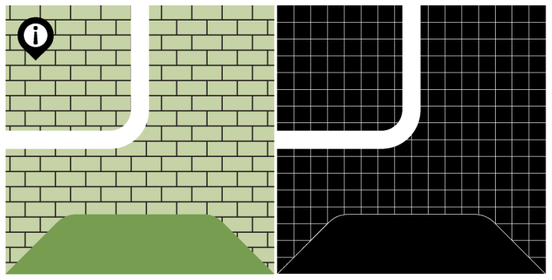


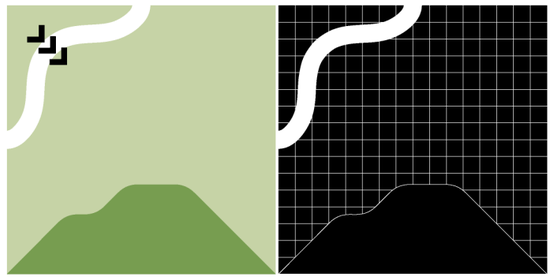




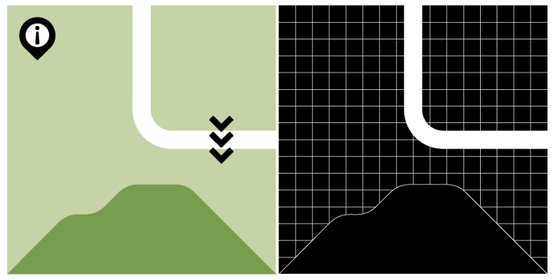


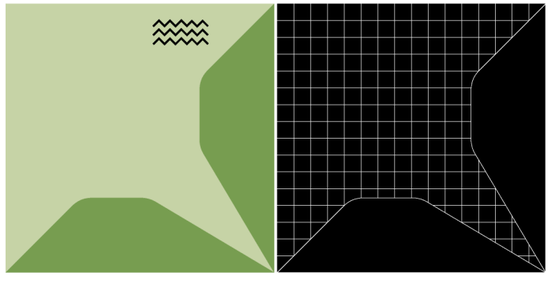


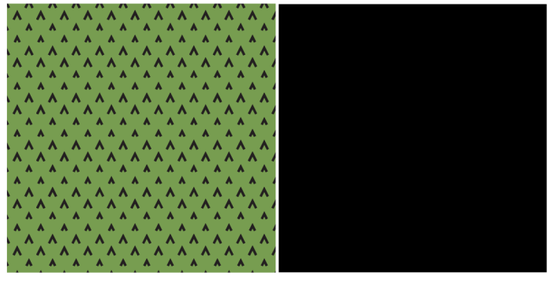


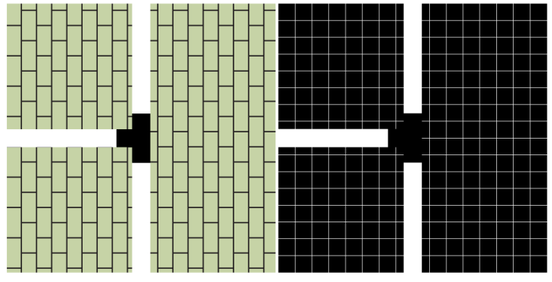


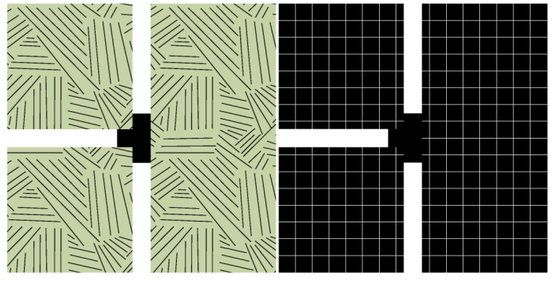


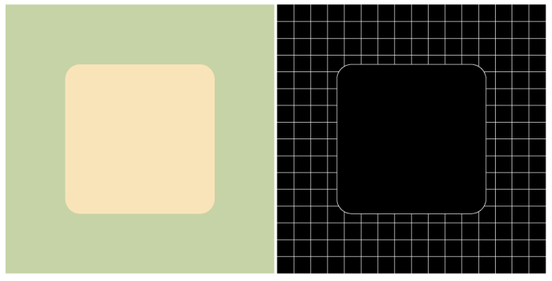


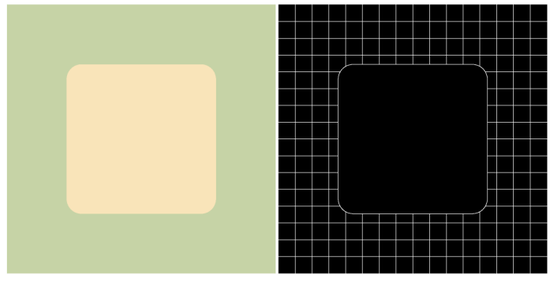


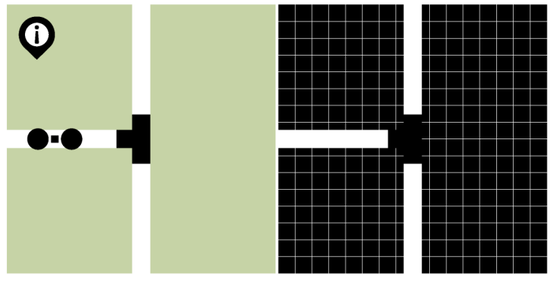


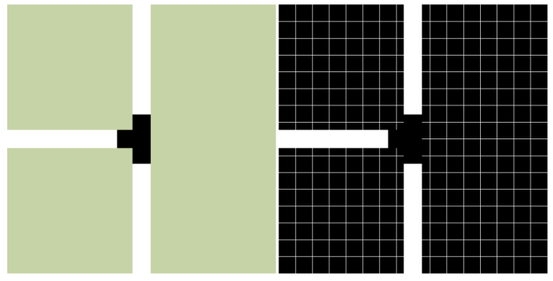


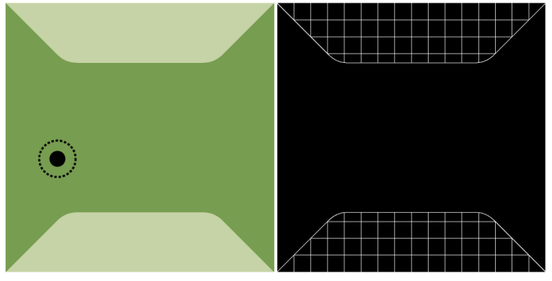


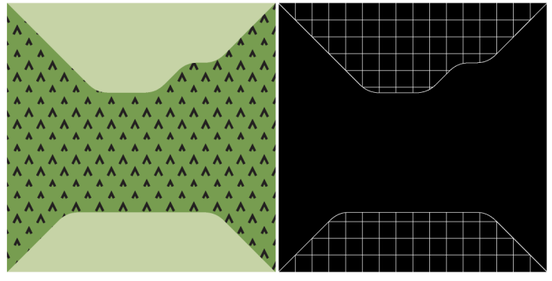


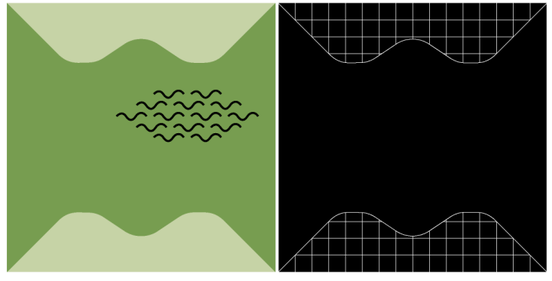


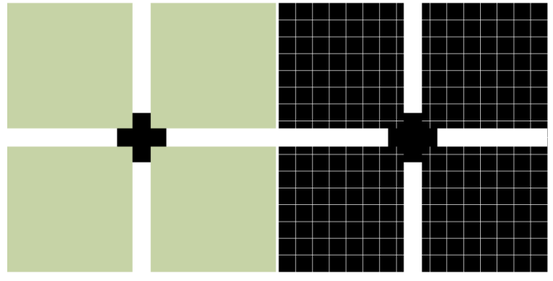




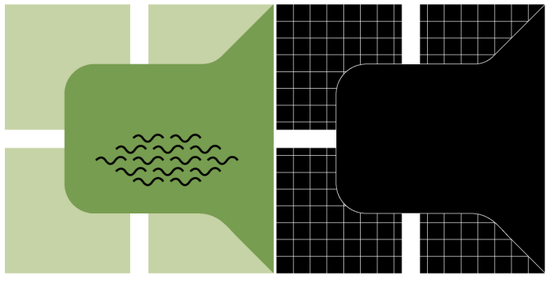


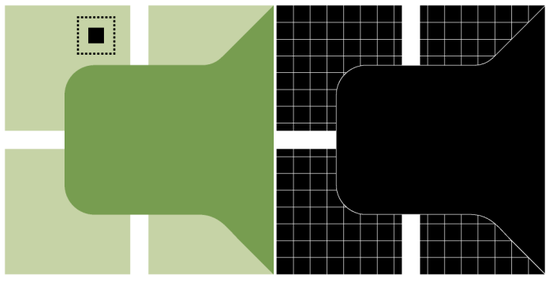


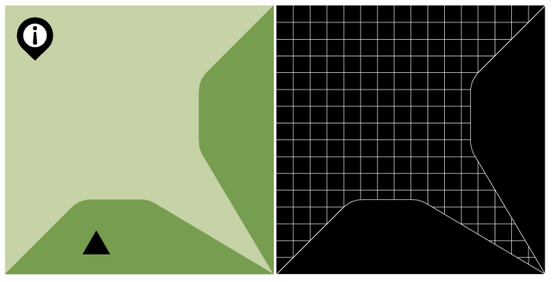




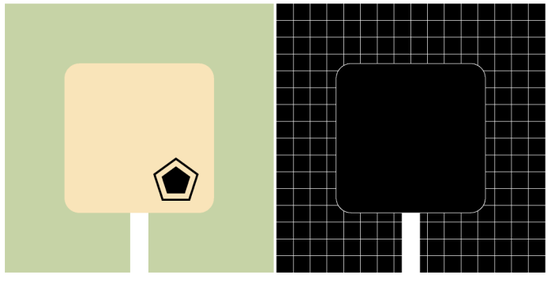


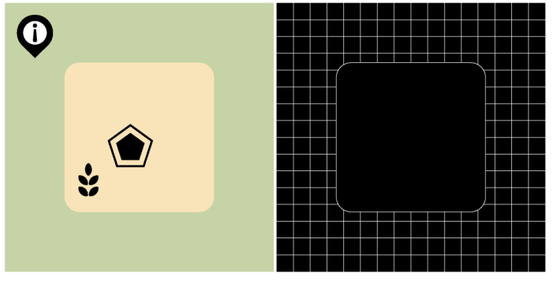


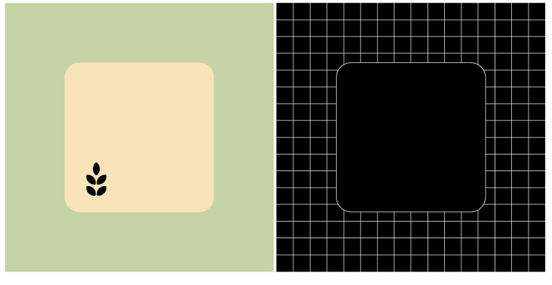


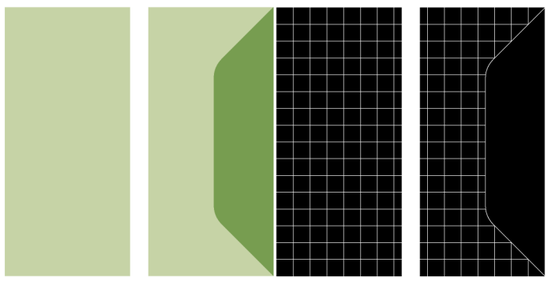


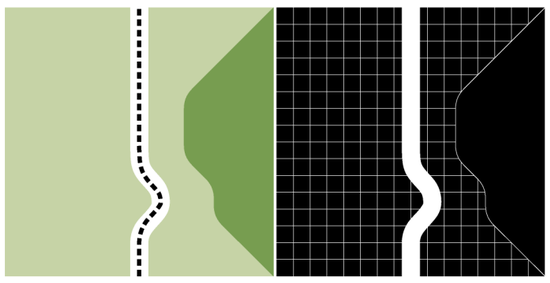


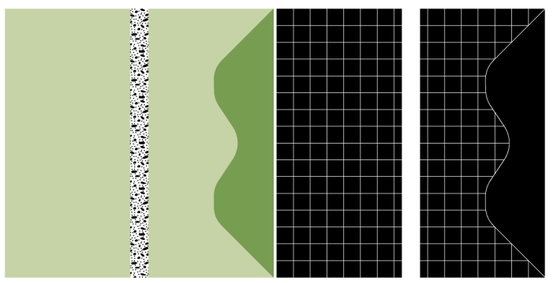


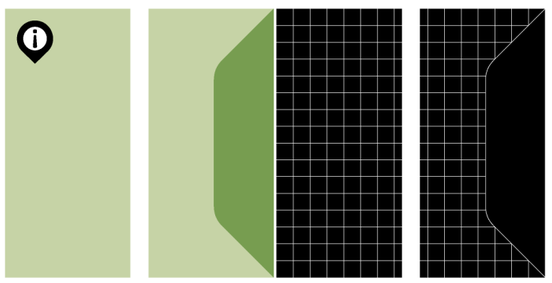


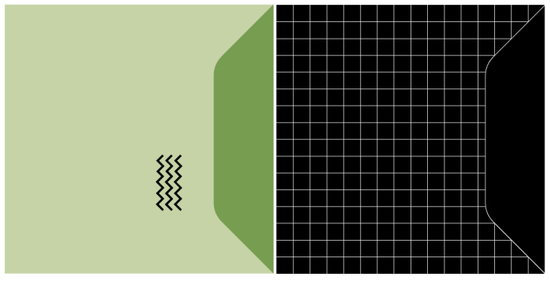


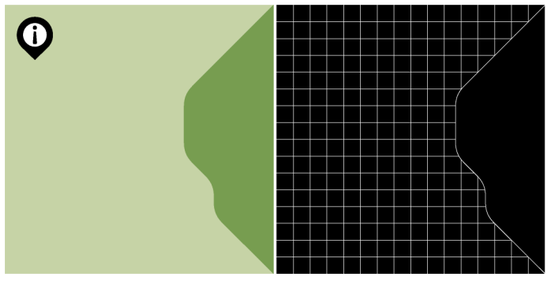


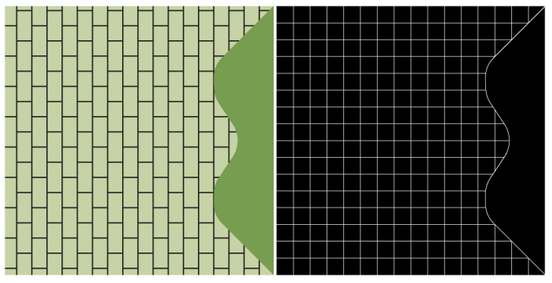


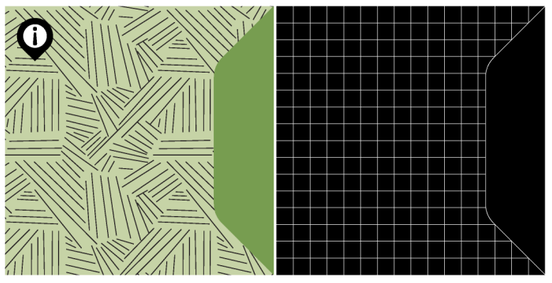












OBJECTIVES

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Cut along solid black outline for each card.
This is an example and not a component in the game.

Print two (2) copies of this sheet and glue each cut-out onto the back of each Objective card.

Objective cards (back)
Print two (2) copies

Endangered Redside Dace

1. Locate - found in slow streams with gravel, adults have a red and yellow stripe.
Locate parkland tile with an animal icon

2. Analyze - primary threat is habitat loss from urban and agricultural development.
Place parkland tile and a community member

3. Implement - stream side vegetation and stream shape protection to maintain cover, food, and temperature.
Complete parkland including tile with an animal icon

4 Earn an additional 4 points

Growing Field Crops

1. Locate - Canada Land Inventory classifies soil on their capability to produce crops.
Locate farm tile with a crop icon

2. Analyze - soil classes 1-3 are prime with optimal moisture, nutrients, structure, and minimal limitations.
Place farm tile and a community member

3. Implement - the agri-food sector contributes $50 billion to Ontario's GDP, and supports over 871,000 jobs.
Complete farm including tile with a crop icon

5 Earn an additional 5 points

Growing Livestock

1. Locate - With 19,000 beef farmers, 6% of Canada's beef cow population is in Ontario.
Locate farm tile with a barn icon

2. Analyze - cattle are classified as ruminants with digestive systems allowing hay and grass to be major sources of nutrients.
Place farm tile and a community member

3. Implement - the National Farm building Code is the primary regulation governing farm building construction in Ontario.
Complete farm including tile with a barn icon

5 Earn an additional 5 points

Wetland Protection

1. Locate - transition area between land and water, like swaps, bogs, and marshes.
Locate parkland tile with a water icon

2. Analyze - maintains ecosystem and human utility values, like biodiversity and flood prevention.
Place parkland tile and a community member

3. Implement - protect water quality by planting trees and shrubs, and manage waste.
Complete parkland including tile with a water icon

4 Earn an additional 4 points

Agritourism Awareness

1. Locate - Grown in Peel provides a map of farms to help source products and services.
Locate farm tile with a crop icon

2. Analyze - create opportunity for nature interactions and awareness for local businesses.
Place farm tile and a community member

3. Implement - Growing Agritourism Act, 2024 ensures visitors are aware of inherent agritourism risks.
Complete farm including tile with a crop icon

5 Earn an additional 5 points

Support Farmers' Market

1. Locate - Farmers' Market Ontario catalogues all in season produce to buy fresh.
Locate farm tile with a barn icon

2. Analyze - local farmers directly support Ontario's economy and food security.
Place farm tile and a community member

3. Implement - farmers' markets help preserve local operations and heritage against large agriculture corporations.
Complete farm including tile with a barn icon

5 Earn an additional 5 points

Objective cards

Cut along solid black outline for each card.
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Nature Tourism Awareness

1. Locate - local natural areas and features to spend time in, relax, learn, and enjoy.
Locate parkland tile with a triangle icon

2. Analyze - see animals, ecosystems, and unique landscapes at a safe distance.
Place parkland tile and a community member

3. Implement - preserve natural areas by properly disposing of waste and respecting wildlife.
Complete parkland including tile with a triangle icon

4 Earn an additional 4 points

Endangered Butternut Tree

1. Locate - found in deciduous forests, has compound leaves in feather-like pattern.
Locate parkland tile with a tree icon

2. Analyze - primary threat is Butternut Canker, a fungal disease killing trees.
Place parkland tile and a community member

3. Implement - contact designated butternut health assessor for proper assessment and removal of infected branches.
Complete parkland including tile with a tree icon

4 Earn an additional 4 points

Community Garden

1. Locate - accessible land with water infrastructure, sun exposure, and community interest and support.
Locate community hub tile with a garden icon 

2. Analyze - citizen-led urban agriculture promotes social-ecological learning and community place-making.
Place community member within community hub 

3. Implement - potential plants include basil, garlic, kale, onions, peppers, tomatoes.
Maintain community hub with adjacent parklands 

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2 Earn an additional 2 points after placing a community member.

Build Wildlife Crossings

1. Locate - roads through green corridors intersect habitats and interrupt wildlife movement.
Locate road tile with an arrow icon 

2. Analyze - monitor local habitats, roadkill statistics, and speed limits.
Place road tile and a community member 

3. Implement - landscape bridges, wildlife overpasses, and fences can help reduce collisions, injury, and death.
Complete road including tile with an arrow icon 

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3 Earn an additional 3 points

Improve Active Transport

1. Locate - routes connecting downtown cores, schools, public spaces, and commercial zones.
Locate road tile with a bike icon 

2. Analyze - support bike lanes in major cities to improve rider safety and traffic congestion.
Place road tile and a community member 

3. Implement - Repeal Acts like Bill 212 that allows removal of bike lanes.
Complete road including tile with a bike icon 

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3 Earn an additional 3 points

Permeable Paving

1. Locate - impermeable surfaces on roads and parking lots prevent rainwater from draining.
Locate community hub tile with a paving icon 

2. Analyze - permeable surfaces prevents flooding and erosion, and improves water quality by reducing stormwater runoff and filtering it naturally.
Place community member within community hub 

3. Implement - options including permeable asphalt or concrete, aggregates, or grass pavers.
Maintain community hub with adjacent parklands 

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2 Earn an additional 2 points after placing a community member.

Maintain the Bruce Trail

1. Locate - with over 900 km the Bruce Trail extends from the Niagara River to Tobermory.
Locate road tile with a gravel icon 

2. Analyze - continuous stretch of wilderness and access to the Niagara Escarpment, a UNESCO World Biosphere.
Place road tile and a community member 

3. Implement - volunteers and members of the Bruce Trail Conservancy maintain the trail and protect critical ecosystems.
Complete road including tile with a gravel icon 

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3 Earn an additional 3 points

Increase Public Transit

1. Locate - inclusion of transit funding in rural, remote, and Indigenous communities.
Locate road tile with a bus icon 

2. Analyze - more drivers and workers required for service frequency and reliability.
Place road tile and a community member 

3. Implement - Canada Public Transit Fund must include operations funding to influence public transit use.
Complete road including tile with a bus icon 

---

3 Earn an additional 3 points

Objective cards

Cut along solid black outline for each card.
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Urban Greening

1. Locate - urban areas with no access to nature, biodiversity, and connective green spaces.
Locate community hub tile with a hatched icon 

2. Analyze - more human-nature interactions and green habitats are essential to support social-ecological services.
Place community member within community hub 

3. Implement - nature-based solutions like green roofs, urban gardens, green infrastructure to support ecosystems and wildlife.
Maintain community hub with adjacent parklands 

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2 Earn an additional 2 points after placing a community member.

Pollinator Garden

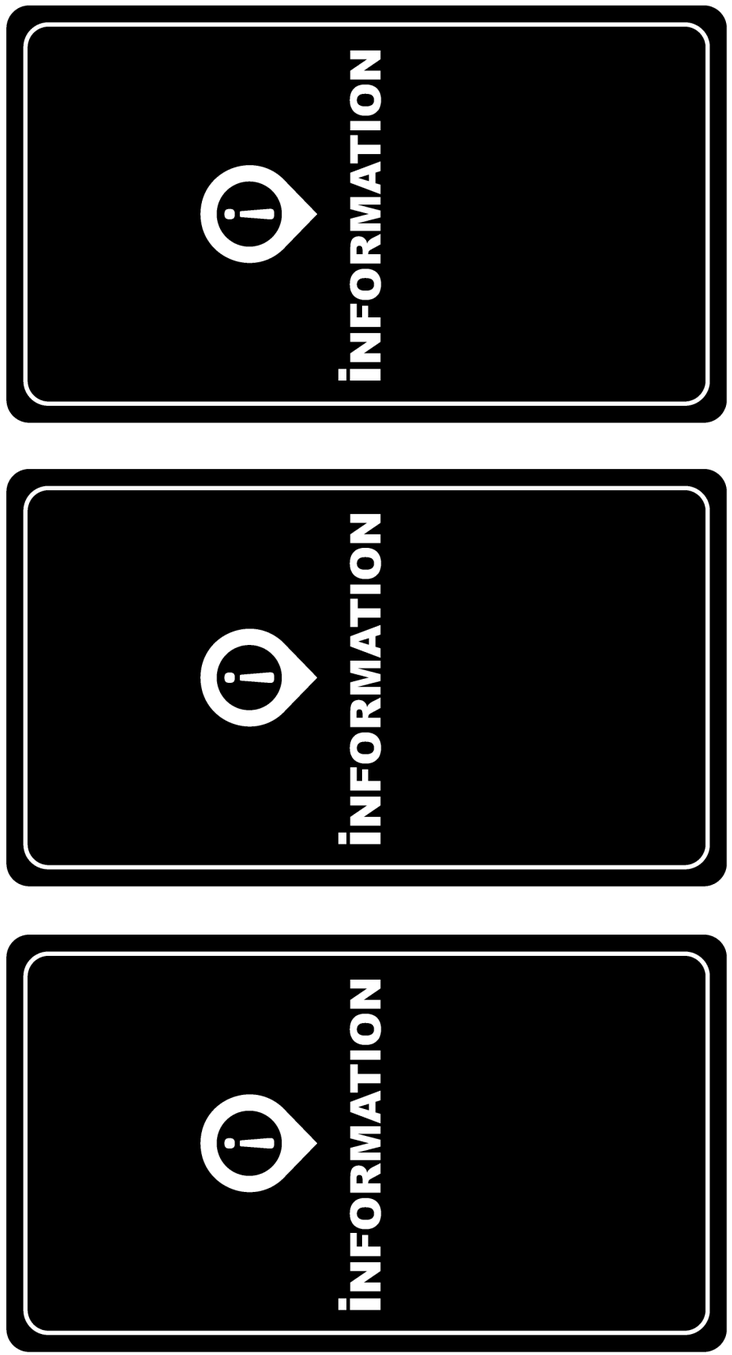
1. Locate - butterflies, bees, birds, and bats are all essential pollinators.
Locate community hub tile with a square icon 

2. Analyze - the majority of flowering plants rely on pollinators, and gardens help support pollinator ecosystems.
Place community member within community hub 

3. Implement - ideal native Ontario plants include wild bergamot, swamp milkweed, black-eyed susan.
Maintain community hub with adjacent parklands 

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2 Earn an additional 2 points after placing a community member.



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Print four (4) copies of this sheet and glue each cut-out onto the back of each Information card.

Information cards (back)
Print four (4) copies

Municipality rolls out grant programs to support community food markets and boost local food economy.

Restore a tile containing an incomplete farm, and earn 1 point for each community member placed on a farm.

City elevates social and ecological systems as essential urban services to create protection measures for new developments.

Restore a tile containing an incomplete farm, and earn 1 point for each community member placed on a farm.

City prioritizes transit operations funding and planning to shift from car dependency.

Restore a tile containing an incomplete road, and earn 1 point for each community member placed on a road.

Gardening has taken over as children's pastime and promotes stronger emotional bonds with nature.

Restore a tile containing an incomplete farm, and earn 1 point for each community member placed on a farm.

Recent trends in creating community gardens have improved resident engagement and environmental awareness.

Restore a tile containing an incomplete farm, and earn 1 point for each community member placed on a farm.

New trail networks proposed to link rural areas between urban pockets for human and animal movement.

Restore a tile containing an incomplete road, and earn 1 point for each community member placed on a road.

City expands bike lane and walkway connectivity to encourage active transportation methods.

Restore a tile containing an incomplete road, and earn 1 point for each community member placed on a road.

City designates truck priority routes to minimize congestion and collisions in neighborhoods.

Restore a tile containing an incomplete road, and earn 1 point for each community member placed on a road.

Cut along solid black outline for each card.
This is an example and not a component in the game.

Information cards

New water infrastructure proposed with dual purpose of water management and urban greenery for recreation and ecological learning.

Restore a tile containing an incomplete parkland, and earn 1 point for each community member placed on a parkland.

Ecological corridors planned to increase biodiversity and provide commuters with new scenery.

Restore a tile containing an incomplete parkland, and earn 1 point for each community member placed on a parkland.

City prioritizes nature-based building solutions for new developments to support air purification, carbon storage, and runoff control.

Restore a tile containing a completed parkland, and earn 1 point for each community member placed in a community hub.

Municipality p trees and gar school comm encourage ch interaction wi

Restore a tile con incomplete parkla point for each cor placed on a parkla

Municipality p grants to inco water-sensitiv such as perm onto propertie

Restore a tile con incomplete parkla point for each cor placed on a parkla

Urban water m becomes a to effort to mitig and associate change risks.

Restore a tile containing a completed parkland, and earn 1 point for each community member placed in a community hub.

More green spaces integrated into revised urban plan to promote connections to nature.

Restore a tile containing a completed parkland, and earn 1 point for each community member placed in a community hub.

City planning to increase community member, scientist, and designer involvement as an initiative to improve climate resilience.

Restore a tile containing a completed parkland, and earn 1 point for each community member placed in a community hub.

Cut along solid black outline for each card.
This is an example and not a component in the game.

Information cards

City's urban plan proposes to pollute watercourses and endanger local food production.

Destruct a tile containing an incomplete farm.

Mass rezoning converts 4000 hectares of rural and environmentally sensitive land for commercial and residential sprawl.

Destruct a tile containing an incomplete farm.

Bike lanes deemed unnecessary, bikers should just buy cars instead.

Destruct a tile containing an incomplete road.

Heritage buildings on main street to make room for new logistics company.

Destruct a tile containing an incomplete farm.

Cars and transport trucks plow through agricultural lands, greenbelt, and biodiversity.

Destruct a tile containing an incomplete farm.

Underwhelming aggregate mining and rehabilitation plan threatens ecosystems and natural landscapes.

Destruct a tile containing an incomplete road.

Precious gravel found, quarry blasting to begin immediately.

Destruct a tile containing an incomplete road.

Greenbelt to provide transport trucks with a new highway.

Destruct a tile containing an incomplete road.

Cut along solid black outline for each card.
This is an example and not a component in the game.

Information cards

Wetland deemed special economic zone for greenfield development.

Destruct a tile containing an incomplete parkland.

New law overrides science allowing developers to bypass conservation warnings.

Destruct a tile containing an incomplete parkland.

Developers' development fees successfully passed onto taxpayers and municipalities.

Destruct a tile containing a completed parkland in a community hub. The parkland is now considered incomplete.

Wetlands lose protection status as the provincial government dismantles the Wetland Evaluation System.

Destruct a tile containing an incomplete parkland.

Conservation authority loses power over habitats and wetlands to developers.

Destruct a tile containing an incomplete parkland.

New Greenbelt development project to house hundreds of residents in man-made flood zone.

Destruct a tile containing a completed parkland in a community hub. The parkland is now considered incomplete.

Highway fast-tracked and environmental protections, worker safety, and Indigenous consultation avoided.

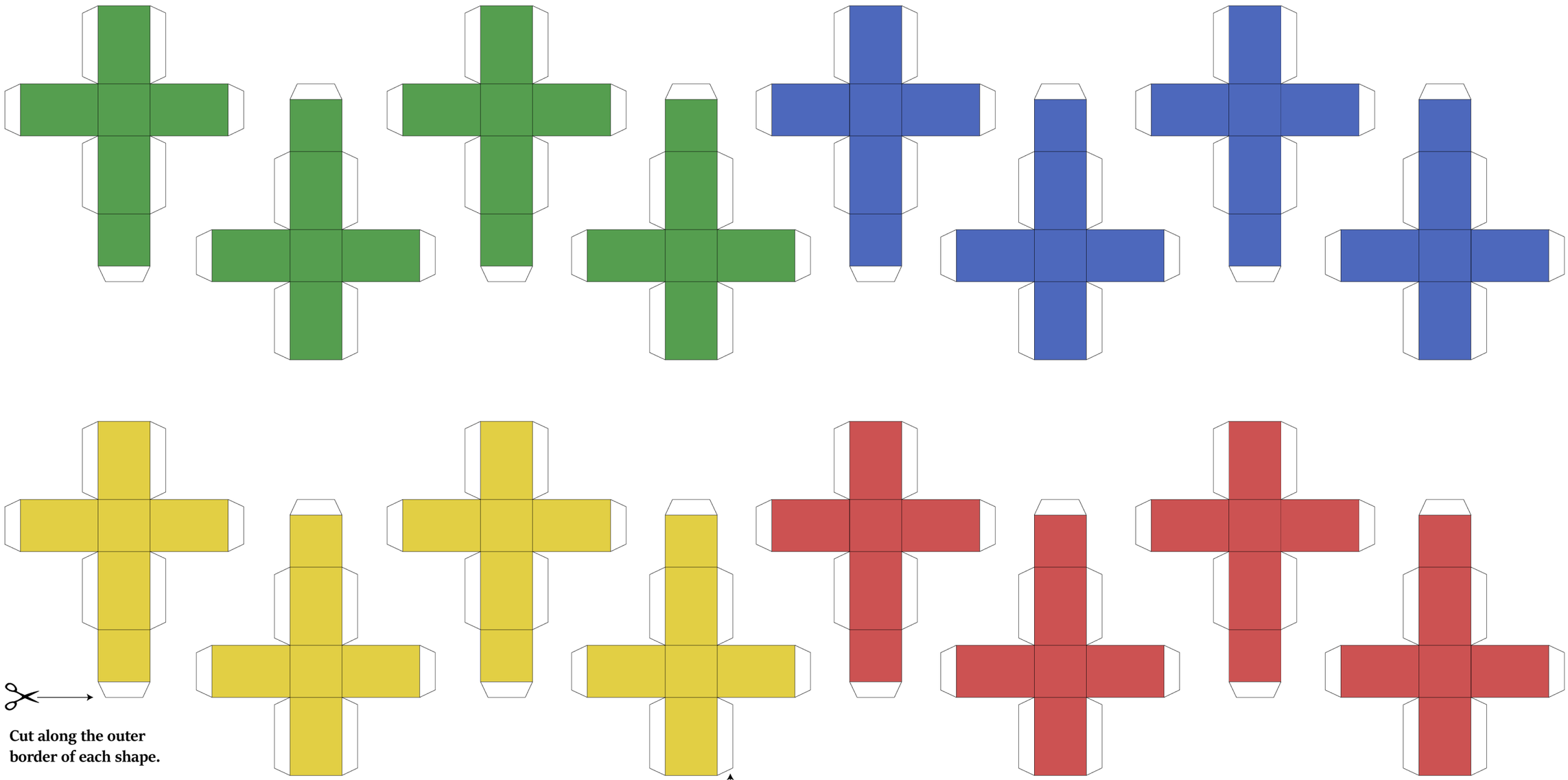
Destruct a tile containing a completed parkland in a community hub. The parkland is now considered incomplete.

New urban plan recognizes nature as interchangeable and replaceable.

Destruct a tile containing a completed parkland in a community hub. The parkland is now considered incomplete.

Cut along solid black outline for each card.
This is an example and not a component in the game.

Information cards



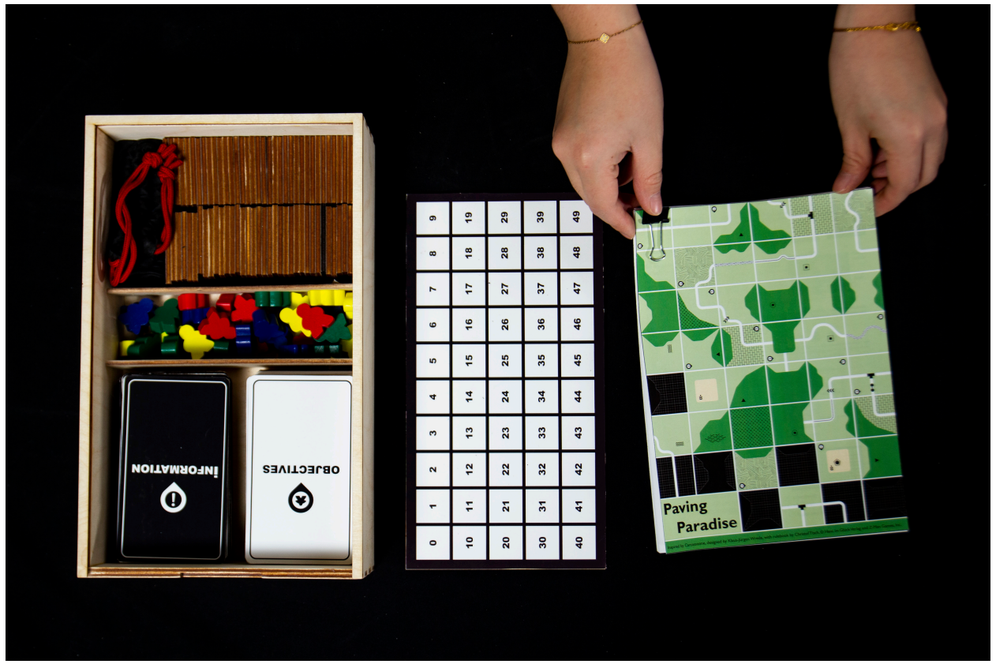
Cut along the outer border of each shape.

Fold along the solid black lines within each shape, ensuring the coloured side is on the outside

Glue the white tabs onto the coloured rectangles forming a rectangular prism.

Community Members
Print two (2) copies

C. Final Board Game Photographs



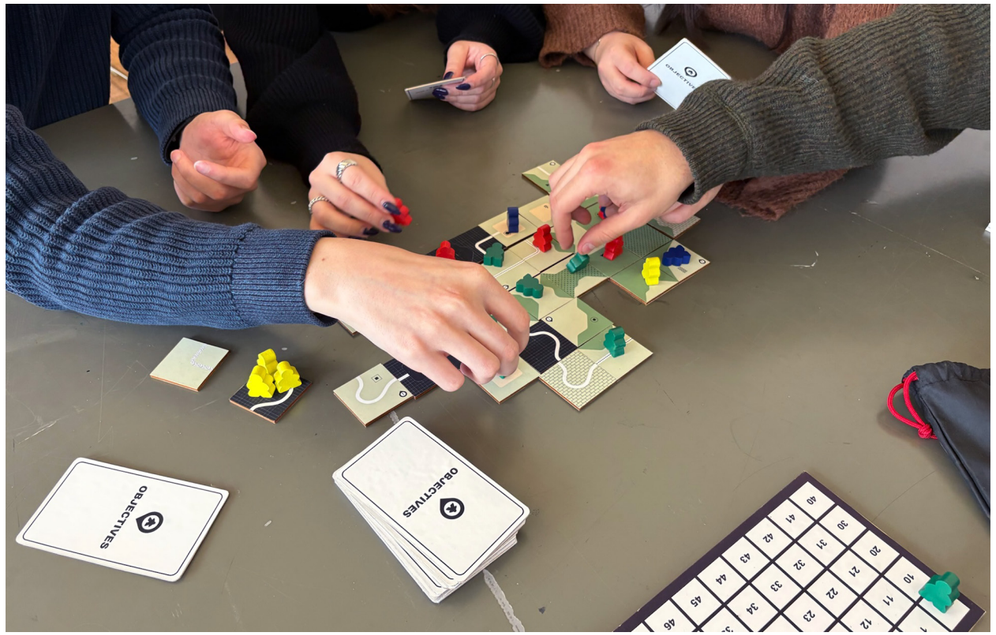



INTERVENTION
OBJECTIVES
Wetland Protection


INTERVENTION
OBJECTIVES
Increase Public Transit

D. Final Presentation Photographs








A Game of Urban Resilience // Introduction
Georgian Bay
Lake Huron
Lake Simcoe
Lake Ontario
The Town of Caledon


PAVING PARADISE
Game Goal
Final Scoring