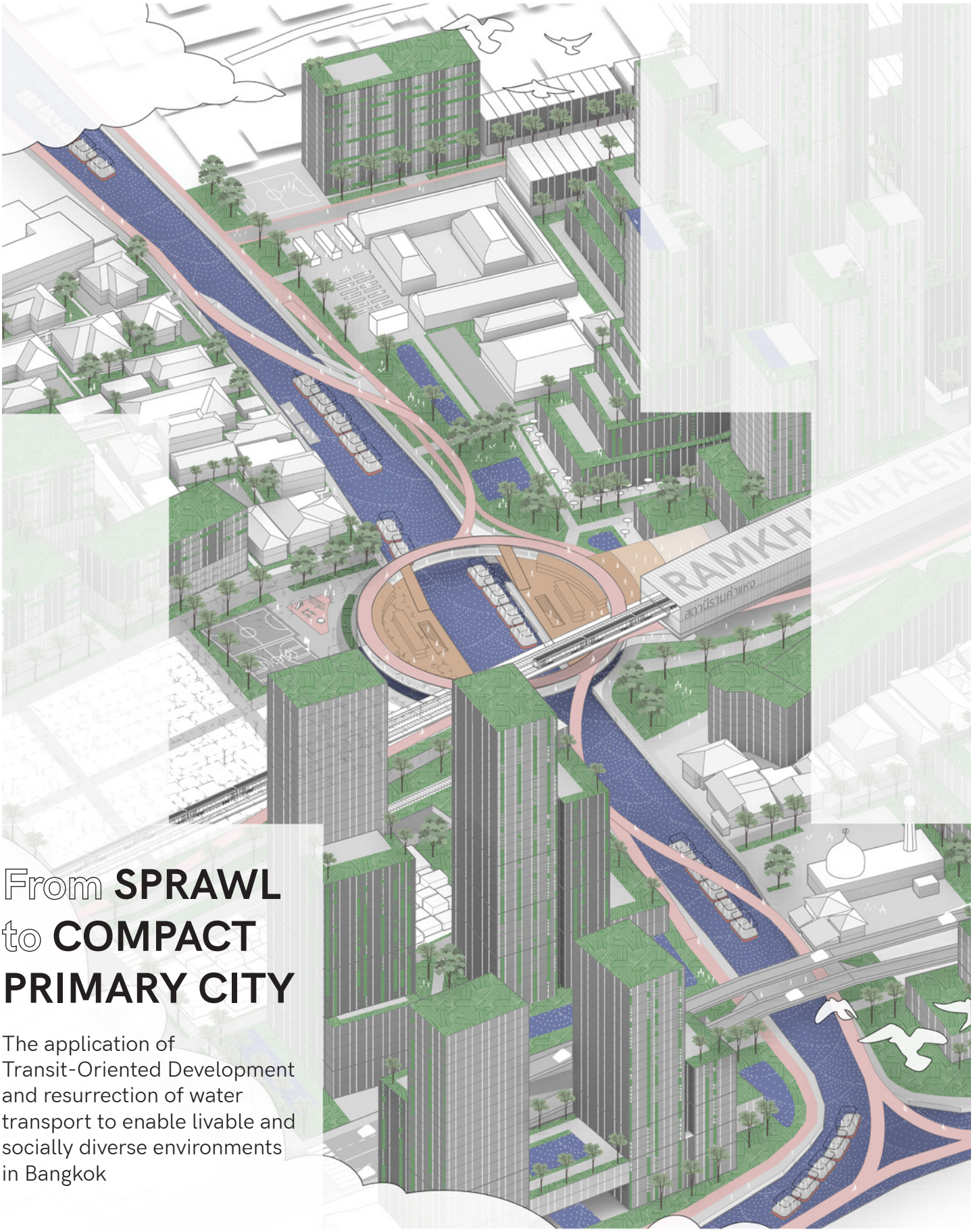

From **SPRAWL** to **COMPACT PRIMARY CITY**

The application of Transit-Oriented Development and resurrection of water transport to enable livable and socially diverse environments in Bangkok

Sorawit Pattarasumunt 5001595 P5 Report

Acknowledgement

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Colophon

From Sprawl to Compact Primary City

The application of Transit-Oriented Development and resurrection of water transport to enable livable and socially diverse environments in Bangkok

MSc Graduation Thesis P5 Report
MSc 4 Urbanism Track
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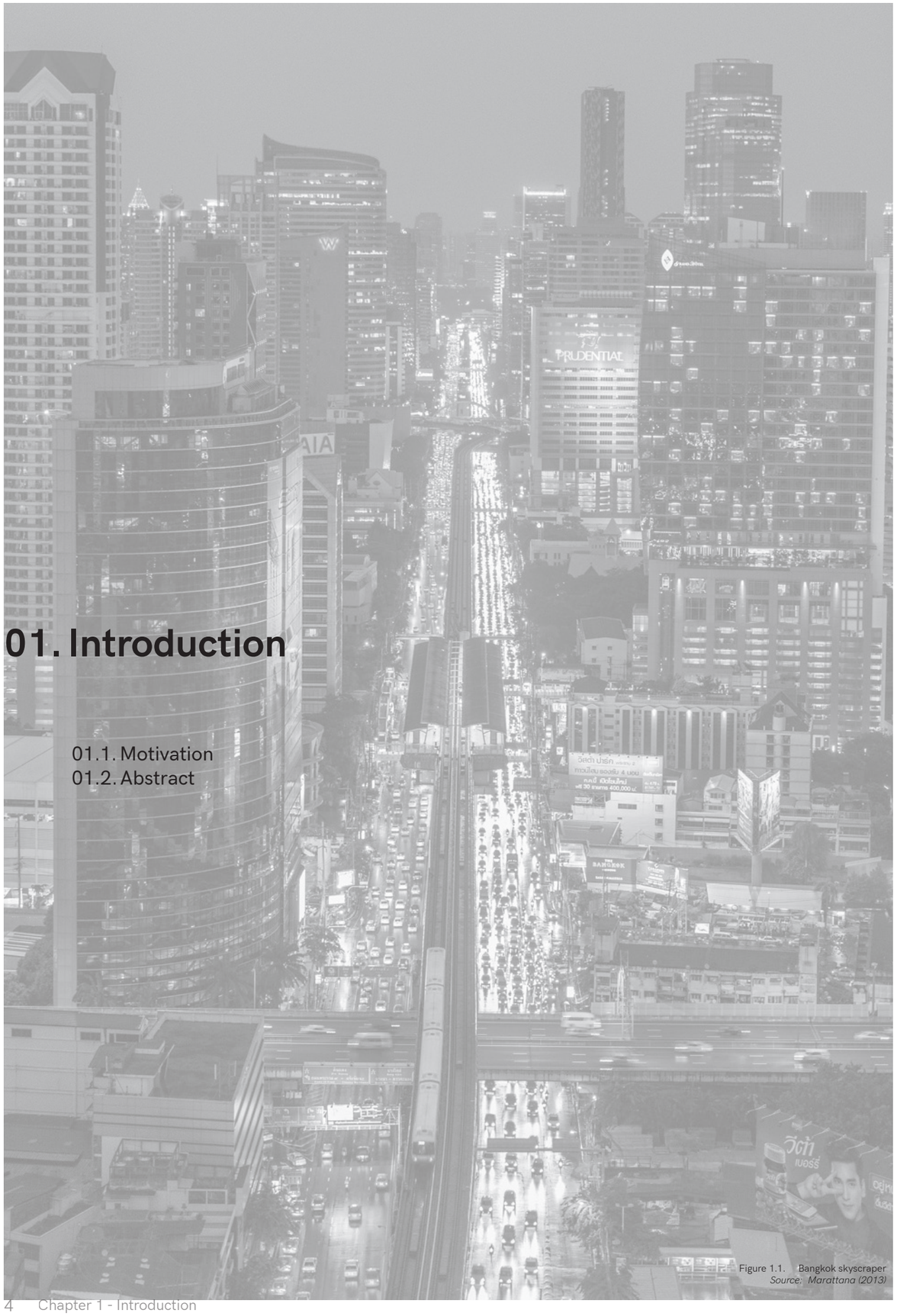
Back Cover Image: Bangkok from above, by author

Delft, The Netherlands, 1st July, 2021

Content



01. Introduction

Figure 1.1. Bangkok skyscraper
Source: Marattana (2013)

01.1. Motivation

The project has been created from the author's strong motivation, who has resided in a developing country in Southeast Asia. Specifically, in Bangkok, Thailand, there has been a lack of urban planning in the city's development, which results in unplanned urban sprawl. The city's current situation has triggered the author to explore how urban planning and design can contribute to the development of Bangkok. Therefore, there is a necessity to propose a holistic approach embedded in urban development to enhance urban quality.

01.2. Abstract

Bangkok, the primary mega-city of Thailand, had once been driven by water-based development until car mobility was introduced. Since then, the development has been gradually shifted to land-based. The dispersed roads and highways stimulated the urban sprawl where suburban gated communities are built in the outskirts, inaccessible by public transportation, and encourage private motorization. To cope with the congestion, the government is developing public rail transport throughout the metropolitan area. However, the current market-driven development triggers the proliferation of urban gated communities around the emerging stations, resulting in transit-induced gentrification and leaving insufficient spaces for the public. Social segregation and unlivable environments posed by these unplanned phenomena need to be responded. Simultaneously, the water network is disregarded and home to the impoverished citizens, which hinders the performance of stormwater management in this flood-prone metropolis. Regardless of how extensive the network is, only a few waterways are used for public transport. Bangkok Metropolitan Administration (BMA) is readjusting the land-use plan to align with the expansion of mobility networks, considering the Transit-Oriented Development (TOD) and Compact City. Since the concepts have been predominantly applied in the Global North, they need to be comprehensively studied to be adapted to Bangkok properly. This project investigates Bangkok's current spatial, social, and institutional conditions on multiple scales to seek the development potentialities. On the macro-scale, it proposes potential canals to be utilized for waterborne transport and prospective TOD locations. Ramkhamhaeng is selected as the pilot project to apply patterns translated from the metropolitan-scale vision and strategy in four layers; enhancing collective and public space, integrated urban mobility, density configuration, and revitalizing water systems. On the micro-scale, design intervention showcases the contextualization of the principles and explores the built forms compromising to the surroundings. Lastly, to realize the project, it suggests the planning systems that engage all stakeholders to ensure the inclusive and efficient operation and implementation, which resulting in the aimed livable and socially diverse environments.

Keywords: Transit-oriented development, Compact City, Urban transformation, Urban mobility, Livability, Social diversity

02. Problem Focus

Figure 2.1. Hua Lamphong Top View
Source: Teekayu (2014)

02.1. Introduction

The problem field is defined by the existing situation of Bangkok, where the rapid urban growth has occurred, as well as the concentration of socio-economic happens and attracts agglomeration of population. The problem analyses look back to the historical transformation of the city from water-based to land-based society and how the city developed through the sprawling road network. Consequently, it sets the issues of car-oriented city and the disregarded water networks in contrast to the land-based development. The analyses conclude with the problem statement, which addresses four main aspects and challenges: the opportunities for Transit-Oriented Development (TOD) and more integrated mobility networks, urban flood vulnerability, social and spatial segregation, and unlivable environments.

02.2. Problem Field

Country's Primary City

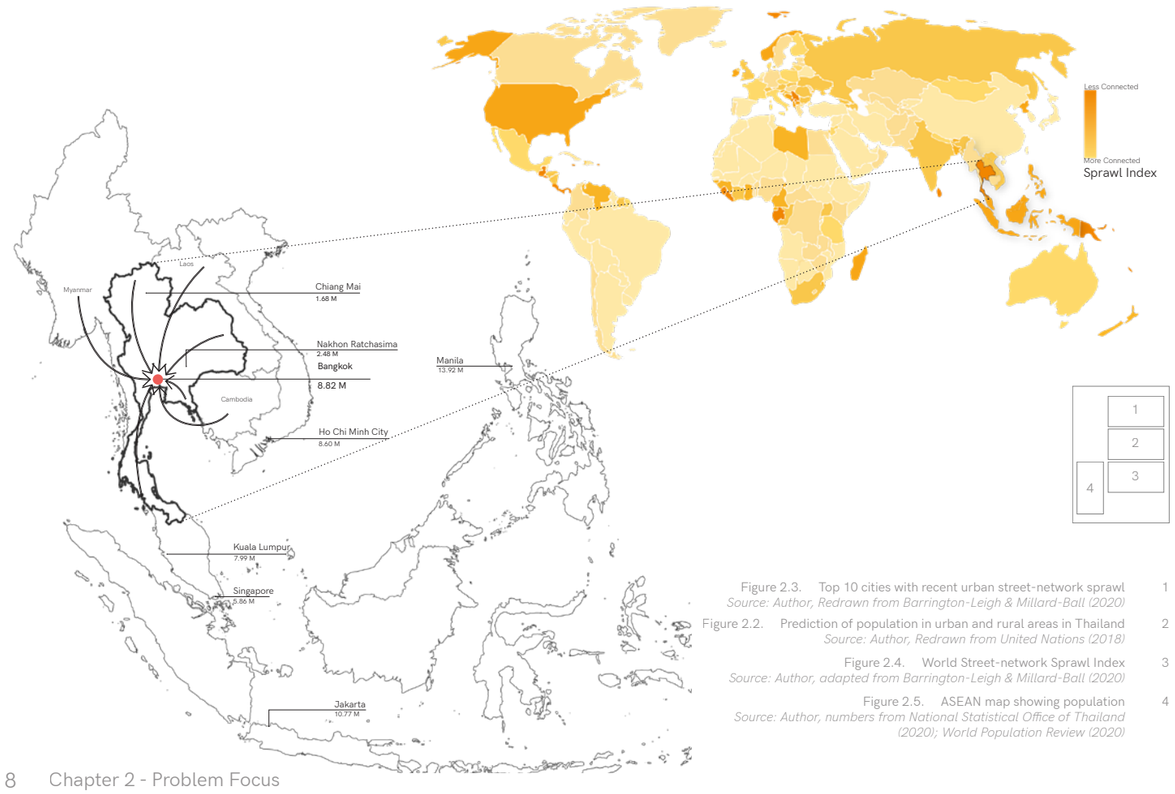
Sternstein claimed in 1982 that Bangkok is the primary city - disproportionately larger in terms of the population size than other cities in the country. Thus far, this capital megacity is the largest metropolitan area attracting rural populations and immigrants from neighboring countries (Figure 2.5). The city offers various benefits to the newcomers, particularly, better job opportunities and qualified education, which leads to how Bangkok is at least ten times larger than Chiang Mai, the city in the North of Thailand (Rojanaphruk, 2019).

Regarding the projection of total population in Thailand (Figure 2.2), there will be an increase in the urban population. In contrast, rural population will decrease, which means that there will be an influx of rural immigrants to Bangkok in the future.

Rapid Urbanization

Urban sprawl resulted from the unplanned development of street networks has been the problem in many cities globally, and remarkably, especially in Southeast Asia (SEA). According to Barrington-Leigh & Millard-Ball (2020), Thailand has the least connectivity of road networks amongst Southeast Asian Countries (Figure 2.4). At the city level, Bangkok stands out with the urban street-network sprawl index of 8.1, which is the highest globally (Figure 2.3).

	Sprawl Index (SNDi)			
	<1990	1990 to 1999	2000 to 2013	Stock
Bangkok, Thailand	**6.8**	**7.6**	**8.1**	**7.3**
Guatemala City, Guatemala	3.8	5.6	7.5	4.5
Cebu City, Philippines	6.1	6.9	7.3	6.6
Los Angeles, CA, USA	3.6	6.2	6.3	3.9
Raleigh, NC, USA	4.8	5.4	6.3	5.6
Palembang, Indonesia	4.7	5.6	6.3	5.2
New York, NY, USA	2.9	5.2	6.3	3.1
San Salvador, El Salvador	4.4	7.1	6.1	5.0
Belgrade, Serbia	2.9	6.6	6.0	4.2
Tijuana, Mexico	4.3	3.6	6.0	4.4



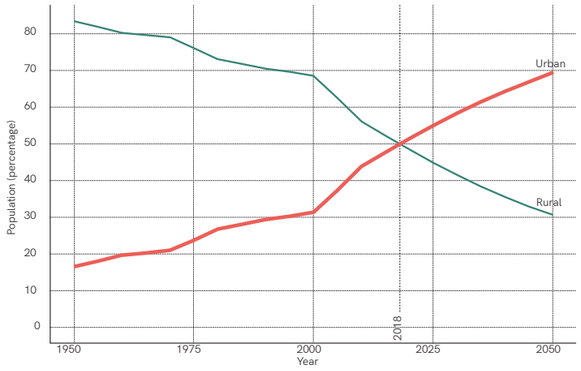


Figure 2.3. Top 10 cities with recent urban street-network sprawl 1
Source: Author, Redrawn from Barrington-Leigh & Millard-Ball (2020)

Figure 2.2. Prediction of population in urban and rural areas in Thailand 2
Source: Author, Redrawn from United Nations (2018)

Figure 2.4. World Street-network Sprawl Index 3
Source: Author, adapted from Barrington-Leigh & Millard-Ball (2020)

Figure 2.5. ASEAN map showing population 4
Source: Author, numbers from National Statistical Office of Thailand (2020); World Population Review (2020)

02.3. Problem Analysis

02.3.1. Urban cohesion

Fast urbanization in Bangkok brings about new characteristics and dynamics, especially the scattered city where peri-urban areas are formed, and urban growth by real estate development occurs. This rapid transformation creates ambivalent new urban realities that directly impact urban life and causes some issues, such as lack of connectivity, fragmentation, segregation, marginalization, scarcity of functions, and loss of social and economic dynamics. These problems associate with the lack of cohesion in the urban fabric and the improperly structured planning stages in urban territories (Pinto & Remesar, 2012). Bangkok is confronting these mentioned problems. It is significant to understand the factors of these fragilities to define strategies that can enhance the coherence.

Pinto & Remesar (2012) introduced the urban cohesion concept to understand the mentioned phenomena through a set of factors in which urban development is directly influenced. Urban cohesion can be comprehended through a layer-based approach that comprises the physical structure of territory and social and economic cohesion problems. The way to understand the urban cohesion issues is through the perspective of multi-scalar integration. It starts from the larger scale where territorial cohesion is defined to the local scale in which the specific measures enable intervention in the territory. However, it is possible if the cohesion is analyzed and defined on the urban scale.

In the Bangkok context, the analysis of problems is conducted through multiple scales, ranging from the metropolitan scale of Bangkok Metropolitan Administration (BMA), district-scale where one area with severe problems is chosen, the neighborhood scale in the existing station area (Figure 2.6). According to the concept, physical structure and social and economic cohesion are concerned in the investigation. Moreover, since Bangkok has been transformed from a water-oriented society to land-based urban development, the analysis starts from the historical study of the urban network morphology, posing the importance to land-based development. While the problems associated with water-based development will be discussed at last.

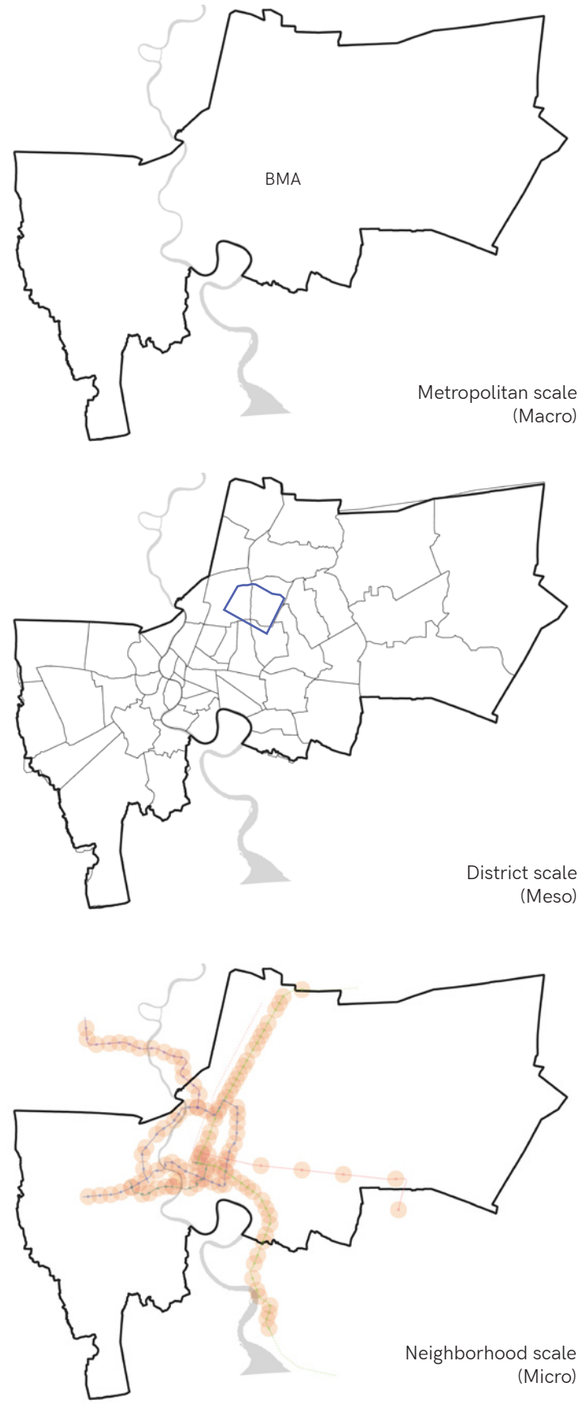


Figure 2.6. Multiplicity of scales
Source: Author

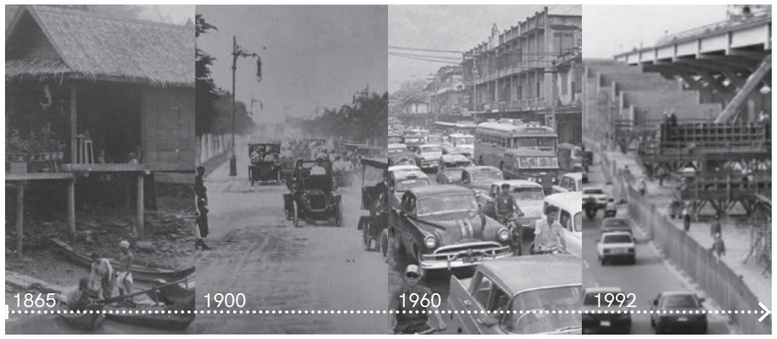
02.3. Problem Analysis

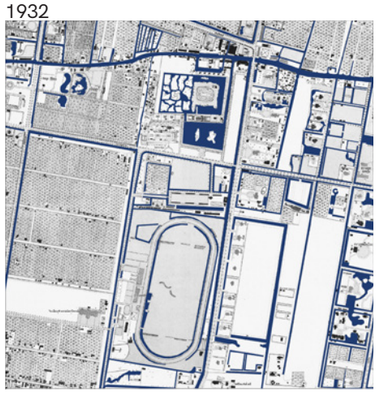
02.3.2. From water-based to land-based development

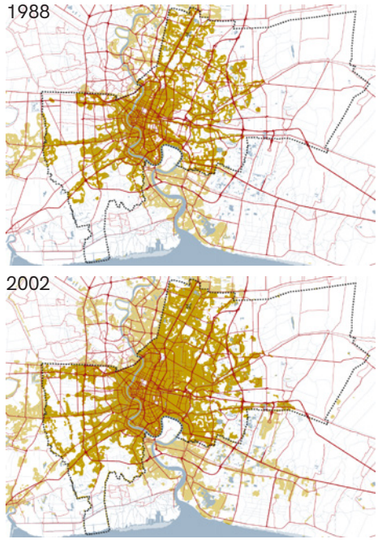
Bangkok was established in 1782 on the Eastern bank of Chao Phraya River, close to the Gulf of Thailand. What indicates how the water-based Bangkok was the fact that "Venice of the East" was once its alias due to its extensive waterways network. Chao Phraya River, natural and dug canals were-fully integrated into the city fabric, and people were dependant on these aquatic systems (Sintusingha, 2011). The majority of residences was situated along the canals, amphibious, and built on stilts, or floating on rafts (Figure 2.7). Waterways played a crucial role in how indigenous inhabitants live since they were used for commuting and trading. Although the lifestyle had vanished after the Second World War when the rapid urbanization began, the population started to increase in the central city (Thaitakoo et al., 2012). And the new land-based era was introduced to Bangkok with the advent of roads in 1857 (Jumsai, 1997).

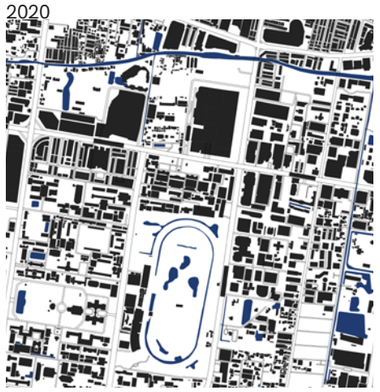
Urban sprawl along road network

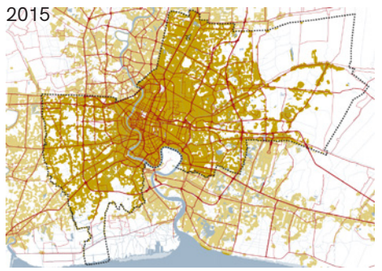
Within the transition from water-based to land-based era, between 1857 and 1887, people still relied on canals to travel and commute due to the road and rail network not being extensive enough. However, when more roads started to be developed and dispersed, the waterways had been deprioritized. In fact, earlier roads were built along-side canals, and the patterns of settlement altered to land-based, resulting in the filling of waterways for road construction (Thaitakoo et al., 2012). The new types of land-based architecture were introduced, shophouses by the Chinese and the European colonial mansions. Since then, the traditional aquatic counterparts began to be deprioritized (Jumsai, 1997). After 1945, the modern form of highways and concrete buildings started to be built, assisted by American know-how and financial help during the Second Indo-China War (1959-1975) (Sintusingha, 2011). The development of roads acted as a catalyst for the real estate market, which was pushed out to the agricultural lands. Eventually, the urban area grew and merged with the surrounding satellite provinces (Figure 2.11). The example can be seen on a smaller scale. Figure 2.12 and Figure 2.13 show the comparison between the condition in 1932 and 2020 of the Siam area (central shopping district of Bangkok). The area was taken by agrarian landscapes, connected with the waterways for irrigation. However, roads built next to the canals before have been widened and ultimately filled the waterways. Urban development started to happen along the roads, making the area denser and more commercialized.











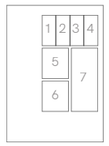


Figure 2.7. Saen Saeb Canal in 1865 (King Rama the 5th reign) 1
Source: ประวัติศาสตร์ชาติไทยและบ้านสาร Facebook (2020)

Figure 2.8. The parade of cars on public road in the reign of King Rama the 5th around 1907-1908 2
Source: ประวัติศาสตร์ชาติไทยและบ้านสาร Facebook (2020)

Figure 2.9. Traffic jam on Chareon Krung Road in 1962 3
Source: ประวัติศาสตร์ชาติไทยและบ้านสาร Facebook (2019)

Figure 2.10. The construction of Don Mueang tollway 4
Source: ประวัติศาสตร์ชาติไทยและบ้านสาร Facebook (2020)

Figure 2.12. Bangkok map 1932AD [แผนที่กรุงเทพฯ พ.ศ. 2475] 5
Source: Author, adapted from Chulalongkorn University Research Unit: Historical Maps and Documents for Urban and Architectural Study (2006)

Figure 2.13. Siam area in 2020 6
Source: Author, derived information from Department of City Planning, Bangkok Metropolitan Administration (n.d.)

Figure 2.11. Bangkok's rapid urbanization 7
Source: Author, adapted from Atlas of Urban Expansion (2016)

02.3.3. Land-based development - *Metropolitan scale*

Suburban gated communities

Road network development has stimulated the sprawl of the peri-urban areas. Out in Bangkok's fringes, laissez-faire has led to the flourishing gated communities or "*mu-banchatsan*" taking over large patches of agricultural field (Figure 2.15). Each gated community accommodates inhabitants with a particular income range. An enormous mansion and specious lawn characterize the enclaves for affluent residents. In contrast, others for the lower-income group is seen with a smaller homogenous detached house. All of them are fenced and secured by the guard, which spatially and socially segregate the inside and outside worlds. Moreover, segregation obscures these privileges since the affluent citizens are not encountering and aware of the situation of the less well-offs (Young, 2000).

However, what identical in every "bedroom suburb" is a parking garage, which is essential since there is no accessibility by public transport to these enclaves, as referred as "shadow" by Pinto & Remesar (2012). Thus the only way to travel is by car. Consequently, this situation contributed to the overflowed traffic on the roads in rush hours.

Figure 2.15. Suburban gated community *(mubanchansan)*
Source: AP Thai (n.d.)

Scarcity of public space

Due to the fact that most plots are privately-owned, public spaces are hard to find in Bangkok. According to The Urbanis (2020), green public space area per capita in Bangkok is only 5.23 m^2, which is relatively low compared to that of Singapore and Paris or even the standard by WHO (Figure 2.14). The map also shows the uneven distribution of public parks, and the average distance to these parks is 4.5 km, which is too far to walk. Moreover, when comparing the distribution of public parks and amenities (Figure 2.16), there are more malls and markets than parks in Bangkok. This condition contributes to the unlivability and social segregation as the fundamental places to spend leisure time are inadequate.

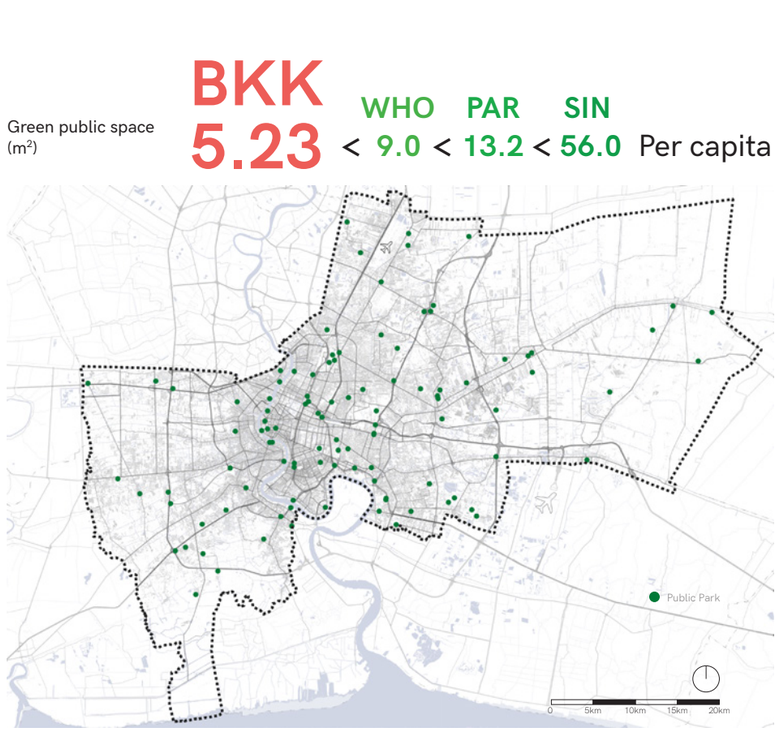


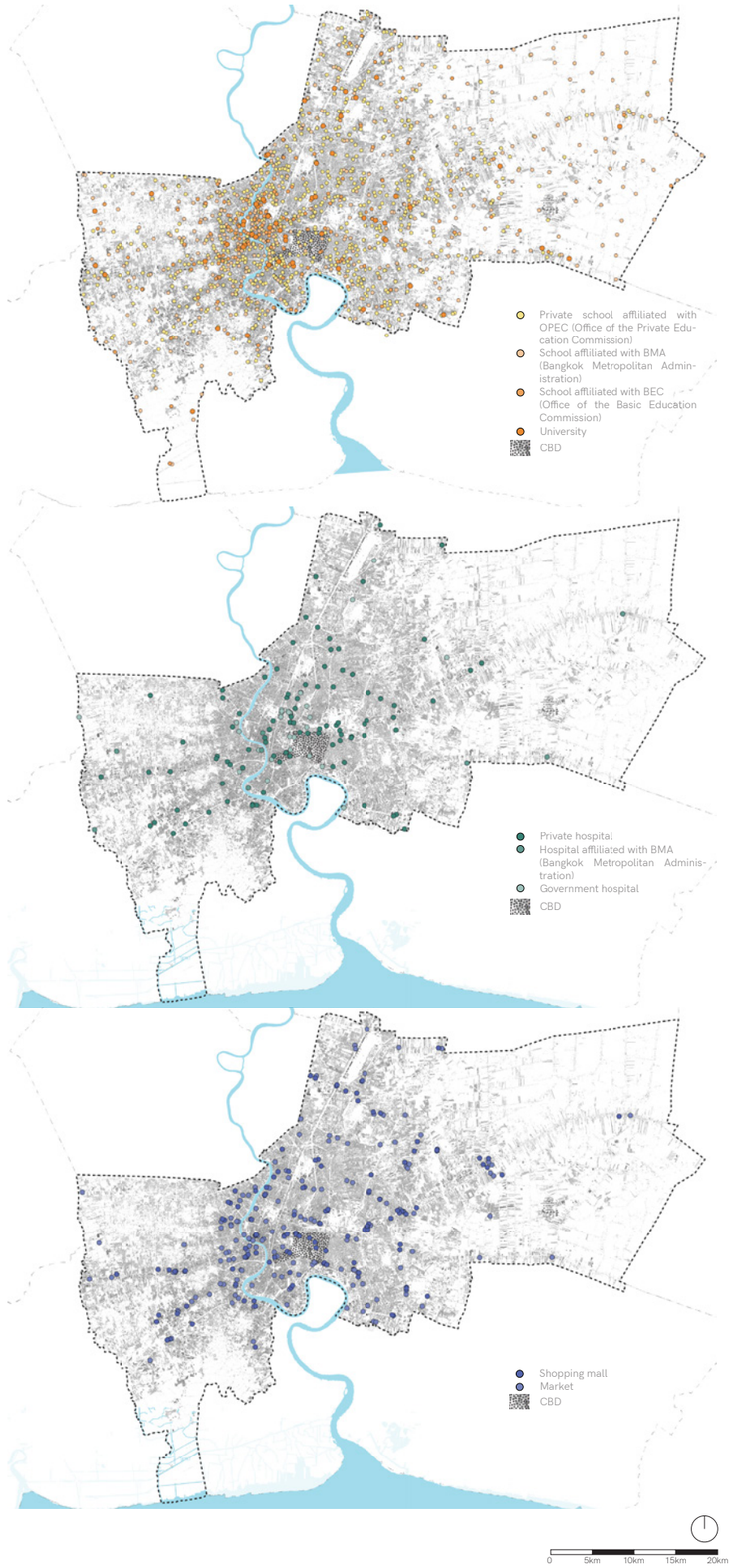
Figure 2.14. Public park in Bangkok
Source: Author, derived form The Urbanis (2020)

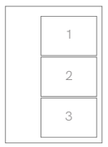
02.3. Problem Analysis

02.3.3. Land-based development - *Metropolitan scale*

Concentration of services

The distribution of services and amenities is uneven and clusters in the city center. For example, healthcare institutes are the most essential service, unevenly located and concentrated in the inner city (Figure 2.17). The amenities, including shopping malls and markets, which are the places where Bangkok people choose to go for spending leisure time, are predominantly situated in the city center (Figure 2.16). Whereas the educational institutes seem to be distributed consistently with diverse levels and types of school (Figure 2.18). However, in Thai culture, people still symbolize the institutes with a more prestigious reputation, which tend to be located remotely from their homes. However, parents are willing to drive a distance to drop off and pick up their children. These concentrations of services force people to travel a long distance from their accommodation to access these services and subsequently leads to traffic congestion.





1 Figure 2.18. Educational institutes in Bangkok
Source: Author, derived information from BMA GIS Center (2020)

2 Figure 2.17. Hospitals in Bangkok
Source: Author, derived information from BMA GIS Center (2020)

3 Figure 2.16. Shopping malls and markets in Bangkok
Source: Author, derived information from BMA GIS Center (2020)

Car-oriented city

Despite the extensive road network developed throughout the city, it is not enough compared to the excessive number of private cars on the road. According to Pujinda and Yupho (2017), out of the total area under BMA, the cumulative road length measures approximately 8%. Whereas, "a flow city" as defined by the Executive Director of UN-Habitat, is a city where 30% of the land area is dedicated to the road surface. Figure 2.20 shows that in 2019 Bangkok has approximately 10.7 million registered vehicles that take one-fourth of the whole country's. However, road networks in Bangkok can handle around 1.5 million vehicles, meaning that the number of automobiles in Bangkok exceeds by almost seven-fold of road surfaces' full capability.

According to Tomtom (2020), Bangkok is ranked eleventh in the world's worst traffic congestion in 2019. The externalities created by the heavy reliance on private cars are pollutions. According to Uber and the Boston Consulting Group's "Unlocking Bangkok" project (Thaipublica, 2017), air pollution from the exhaust fumes per year can fill up 23,000 Mahanakhon buildings, the tallest skyscraper in Bangkok (Figure 2.20); this could indicate why Bangkok is ranked seventh globally with the lowest air quality (Figure 2.22) (NationThailand, 2020). Moreover, Bangkokians spend around 24 days per year in traffic congestion and finding parking spots (Figure 2.20). This wasted time people are taking for granted can contribute to the loss of individual opportunities, physical and mental health, and economic development on the national scale.

As mentioned, *mubanchatsan* dwellers live in the shadows where public transport does not reach; on working days, they tend to waste 4-5 hours in the car, traveling back and forth to work in the city center. Figure 2.19 demonstrates the traffic flows on Friday at 6 pm when usually the roads are congested. Moreover, it also shows that people who dwell in Samut Prakarn and Nonthaburi, where most gated communities are located, traverse daily to Bangkok at around 2.40% and 2.05%, respectively, meaning that people still have to travel a long distance every day. These mentioned impacts show how Bangkok could be an unlivable city to live in.


Bangkok traffic jams among world's worst

Figure 2.21. Traffic jams are a part of living in Bangkok
Source: Bangkok Post Public Company Limites, (2017)


Smog-choked Bangkok struggles to improve air quality

Measures include restrictions on trucks, tighter inspections of factories, possible car ban

Figure 2.22. A thick layer of smog cloaks central Bangkok on Jan 2020
Source: Nikkei Asia, (2020

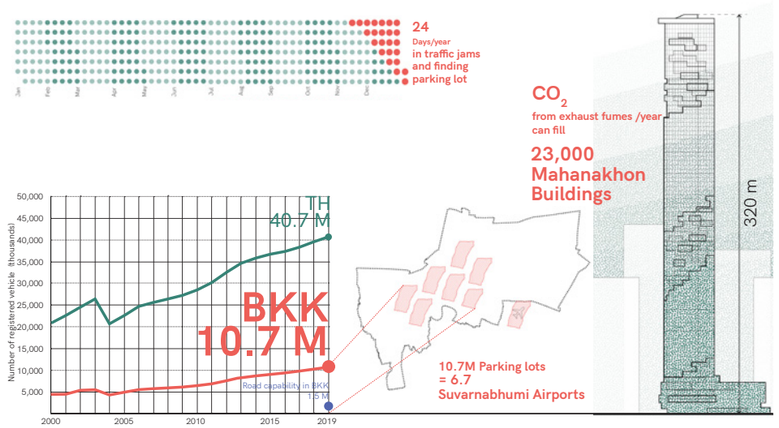


Figure 2.20. Car-oriented city
Source: Author, adapted from Thaipublica (2017), Department of Land Transport (2019), and road capacity from Longtunman (2018)

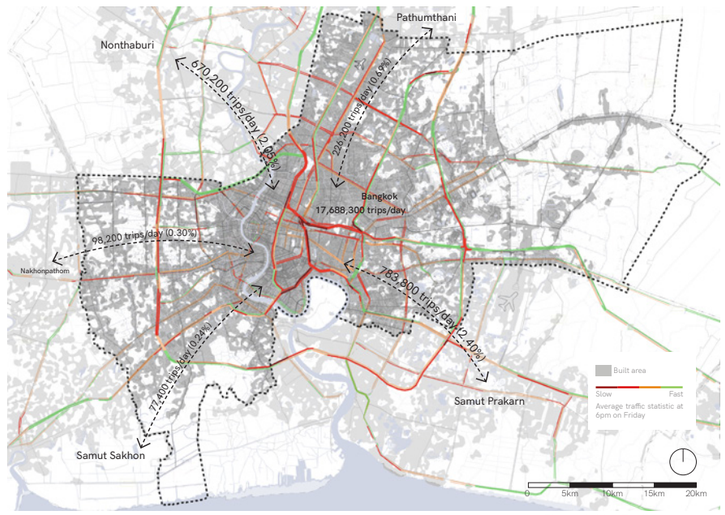


Figure 2.19. Traffic congestion map
Source: Author, derived information of typical traffic from Google, (n.d.); number of trip per day from The Office of Transport and Traffic Policy and planning, (2018)

02.3. Problem Analysis

02.3.3. Land-based development - *Metropolitan scale*

Development of rail public transport

One of the implementations that BMA has been doing to tackle the problem of traffic congestion is rail public transportation development, operated two decades ago. Initiated with two lines in the city center in 1999, elevated rails and stations characterized the inner city and brought about many new developments (Figure 2.27). Five years after, the underground metro was first operated interconnected with the existing Skytrain lines. There are five lines currently, and in the future, 2030 as planned, there will be 14 lines with around 300 stations (Figure 2.23). Nevertheless, infrastructure development can affect urban growth in detrimental ways if there is no appropriate acts that determine urban development.

Notwithstanding, the current metro and sky train network does not serve *mubanchatsan* dwellers. Instead, they have to uses other modes of transport, for example, a motorcycle taxi and taxi for the last-mile connection (Figure 2.26). Moreover, high fares that they pay for many transport modes, the long duration, and the thermal discomfort they experience discourage them from using public transport.

Readjustment of the City Comprehensive Land-use Plan

Together with the transit infrastructure developments, BMA is working on the city comprehensive land-use plan readjustment, which will be enacted in the coming year (Figure 2.24). This revision promotes the development that integrates with the future public transportation plan and allow for Transit-Oriented Development (TOD). The policy will include the increase of Floor Area Ratio (FAR) around interchange stations and incentives that encourage real estate developers to provide more public benefits in their projects (Figure 2.25). However, is this enough for TOD that gives more livability to the residents? This reorganization of density should be implemented in the holistic approaches to enhance livable environments.

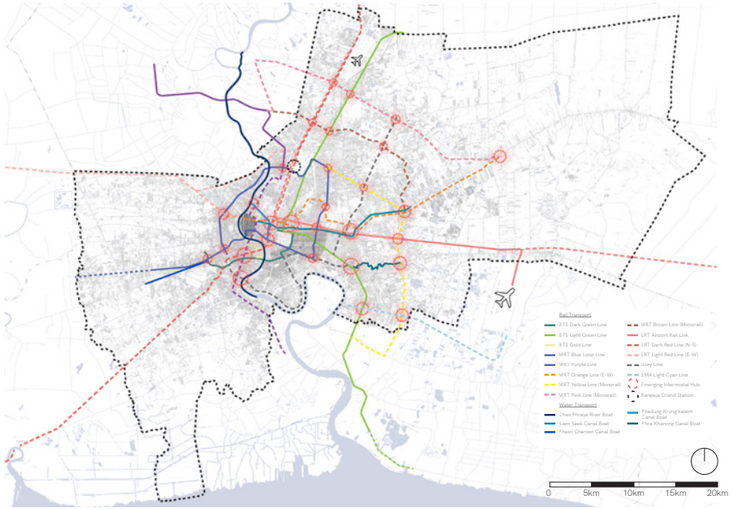


Figure 2.23. Current and future public transport map
Source: Author, derived information from OpenStreetMap (n.d.)

Figure 2.27. BTS train
Source: The Bangkok Insight (2020)

Figure 2.26. Motorcycle taxi
Source: Matichon (2019)

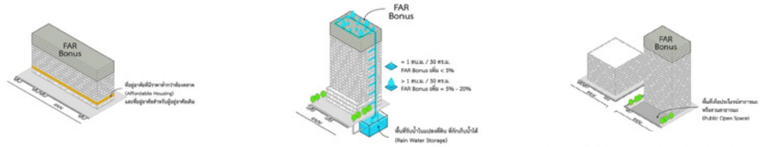


Figure 2.25. Incentives for developers
Source: Plan4Bangkok, (2020)

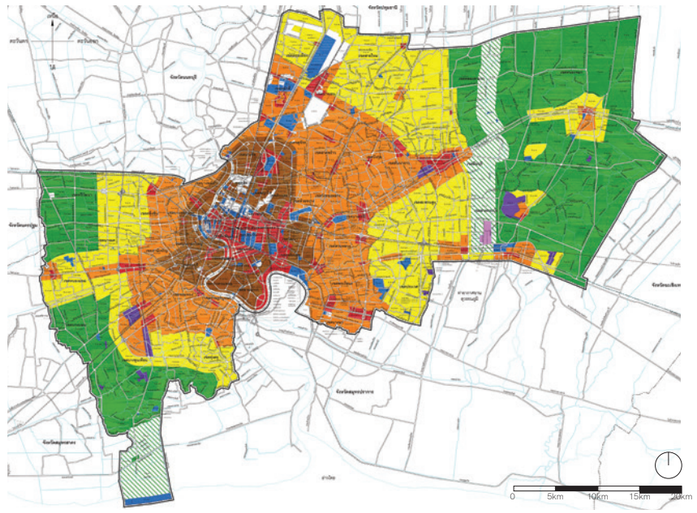


Figure 2.24. The revision of Bangkok land-use plan
Source: Plan4Bangkok, (2020)

02.3.3. Land-based development - *Meso scale*

Superblock

As distinct from the concept applied in Barcelona to reduce car use, the Bangkok version of the "superblock" is the outcome of how most side roads (*sois*) are cul-de-sac within large rectangular patches bounded by a few main roads (Sintusingha, 2011).

An example of a superblock can be seen in Ladprao district, where the massive residential patch covers around 5 km. by 6.2 km. This results in the circumstance when people living within the area have to traverse via deep *sois* before they reach the major roads. According to Figure 2.31, the area in the middle of superblock is not covered by the 1-kilometer catchments of metro station and 500-meter catchments of bus stop, making such area inaccessible by public transport and the only way to reach major roads is by private cars, taxis and motorcycle taxis which increase the transit costs. Moreover, this area consists of a predominantly mono-functional low- to medium-density residential area, forcing residents to travel out to work in other zones. This situation contributes to how *sois* and main roads are congested during rush hours and marked Ladprao Road as one of Bangkok's most congested roads in 2018 (Figure 2.28) (JS100, 2018).

Furthermore, this area and other superblocks are overflowed with traffic because most *sois* are dead-end (Figure 2.29). According to Yupho (2018), over 37.19% of Bangkok roads are blind alleys, which is considerably high compared to other cities. For example, London's dead-end streets make up about 18%, while Singapore and Tokyo have around 7% of blind alleys, and lastly, New York exists only 3%. This in-continuity of traffic routes results in the immobility in Bangkok.

Figure 2.28. Lad Prao Road in the rush hours
Source: The Standard, (2018)

Figure 2.29. Blind alleys in Lad Prao superblock
Source: Google, (n.d.)

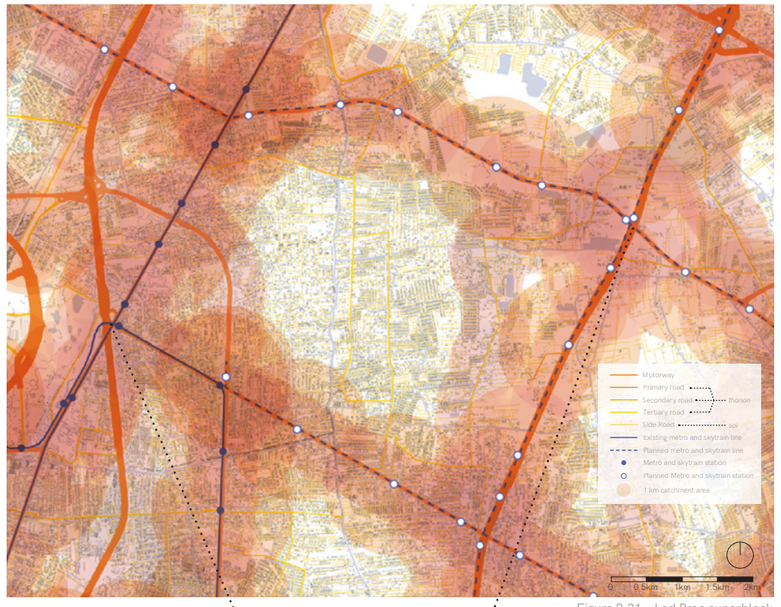


Figure 2.31. Lad Prao superblock
Source: Author, information derived from OpenStreetMap (n.d.), BMA GIS Center (2020)

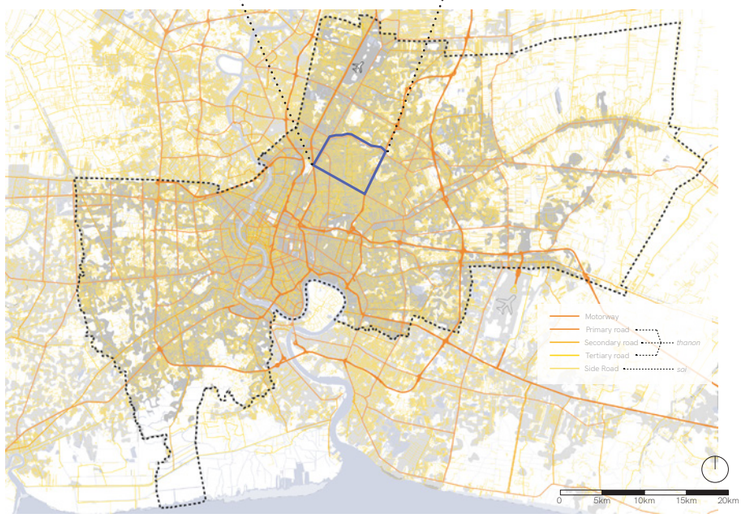


Figure 2.30. Bangkok's rapid urbanization
Source: Author, adapted from Atlas of Urban Expansion, (2016)

02.3. Problem Analysis

02.3.3. Land-based development - *Micro scale*

Market-led development

Since private sectors can own most plots, large real-estate developers have acquired parcels and developed projects, such as shopping malls, condominiums, and hotels. The prime locations are around the metro and Skytrain stations (Figure 2.33).

Urban high-rise gated communities

In the past 20 years, since Skytrain's first lines were opened, there has been a trend of condominium developments around transit stations. The city began to grow vertically, overwhelming by these high-rise gated communities. Likewise, in the suburban enclaves, the residences are secured by fence and guard, segregating the inner and outer societies (Figure 2.32). Besides, within the condominium itself, social contact between neighbors is mitigated. Wissink and Hazelzet (2016) argue that high-rise living is detrimental to social engagement. The results show that condominium residents have fewest contacts with neighbors, even fewer than high-end *mubanchatsan*.

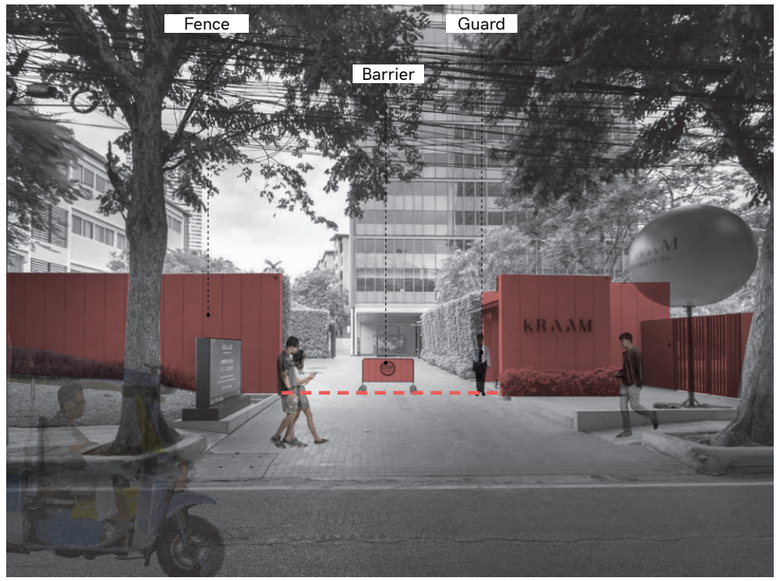


Figure 2.32. Spatial segregation between condominium and street
Source: Author, adapted from Propholic (2019)

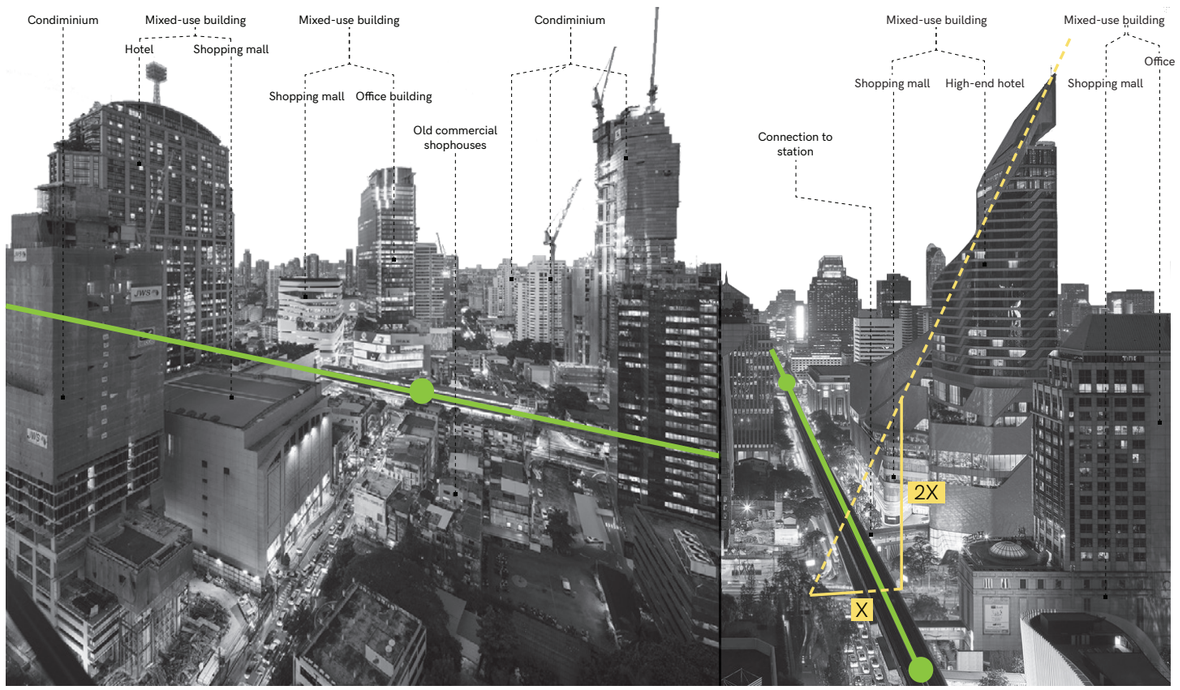


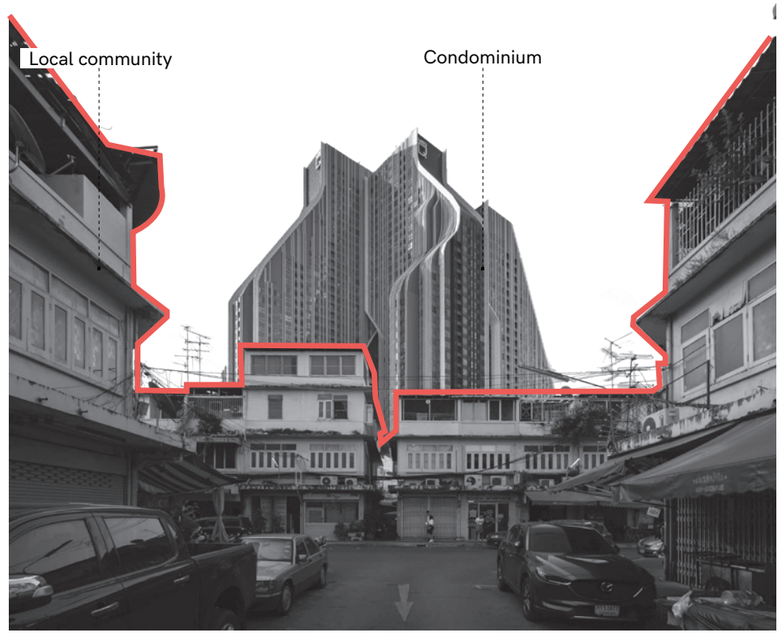
Figure 2.33. Market-led urban development around BTS stations
Source: Author, adapted from Architonic (n.d.), and Boiffils (n.d.)

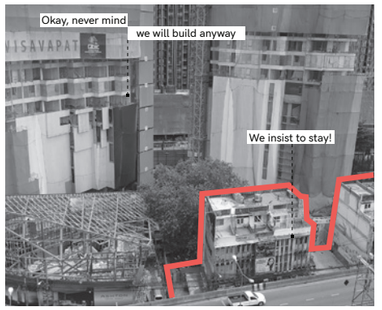
Transit-induced gentrification

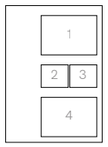
The development of transit infrastructure led to the gentrification, which has occurred around the existing Skytrain and metro stations in Bangkok, where high-rise condominiums are built and attract middle- to high-class residents. While local low-income residents who have lived there are pushed away to the outskirts, or even local wealthier residents who insist to stay might experience the externalities created by new developments and newcomers. Figure 2.37 and Figure 2.35 show the contrast between the futuristic-look condominium and the local neighborhood with old shophouses that could describe how Bangkok has been developed. Some local communities are strong enough to oppose to these invasive developments through the process of Environmental Impact Assessment (EIA) (Figure 2.36). However, this only succeeds in harmonious and educated communities, which are rare in this city.

Pedestrian-unfriendly street

In contrast to the prosperous and picturesque skyline, at a nanoscale, Bangkok streets are not attractive for people to walk. Various obstacles discourage walkabilities, such as too narrow footpath with street signs, electric wires, and the footbridge's staircase. Some footpaths are disorganized and filled with street vendors (Figure 2.34). These hindrances have made the street of Bangkok unwalkable for ordinary pedestrians and disabled people.







1 Figure 2.37. Gentrification in Bangkok
Source: Author, adapted from A49 (n.d.)

2 Figure 2.36. Local communities against the new condominium
Source: Author, adapted from Limjittrakorn (2019)

3 Figure 2.35. Gentrification in Bangkok
Source: Author, adapted from Pantip (n.d.)

4 Figure 2.34. Bangkok, Thailand - February 21, 2017: Street food vendor is selling food to her customers on the footpath nearby Silom Road in Bangkok, Thailand.
Source: Christopher PB / Shutterstock.com (2017)

02.3. Problem Analysis

02.3.4. Water-based development *- Metropolitan, meso, and micro scales*

Another valuable network that seems to be disregarded is the water system. Since land-based mobility was introduced to Bangkok in 1857 and the first street was opened to public use in 1864, waterways' importance has been diminished. Some canals were filled in for new road development, while others became stagnant and non-navigable, devalued to drainage ditches and open sewers (Thaitakoo et al., 2012). Consequently, the neglected canals are home to impoverished citizens.

Figure 2.38. Bangkok major flood in 2011
Source: The Standard (2017)

Geographical context of floodplain

Bangkok is located on the low-lying flat terrain of the Chao Phraya Delta. The monsoon climatic conditions and coastal tidal dynamics dictate and put Bangkok's land-based development prone to flood. During the rainy season, the city is flooded caused by the accumulation of rainfall in the Northern part of watershed and flow excessively through Bangkok, also the inundated monsoon rainfall which always puts some thoroughfares in the city underwater (Thaitakoo et al., 2012).

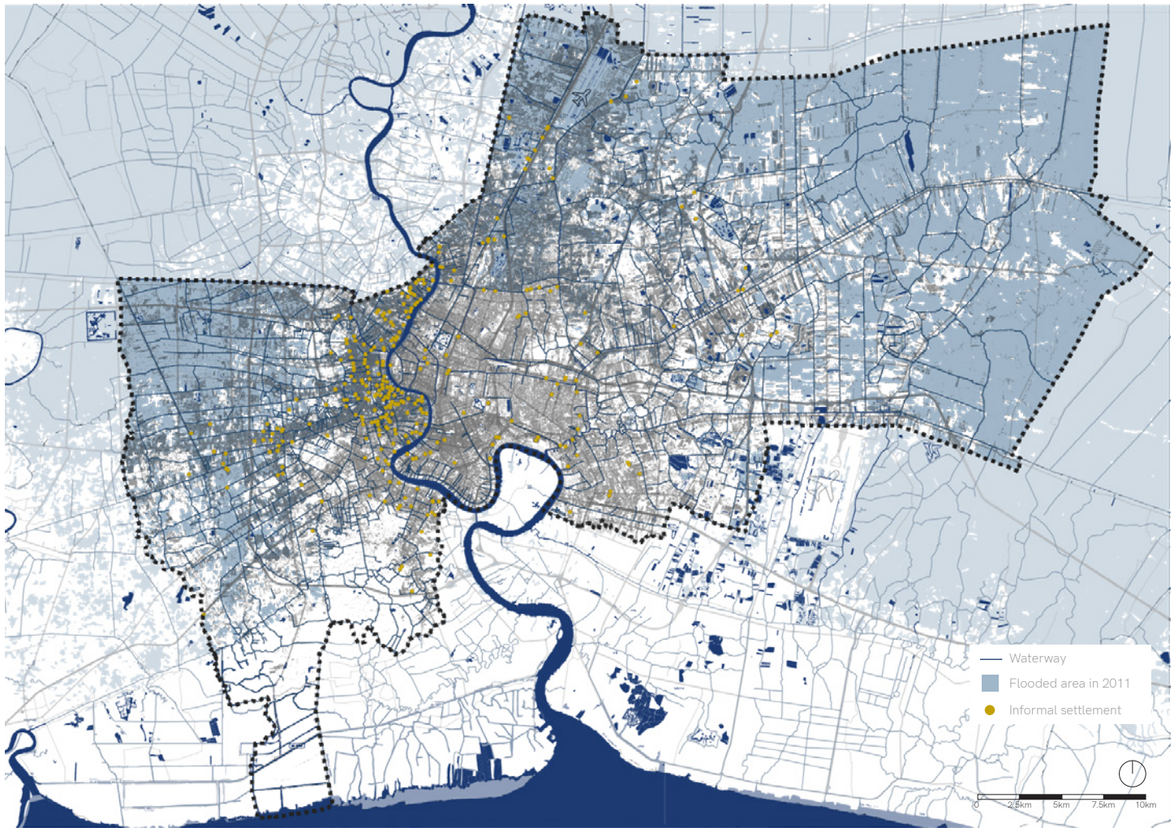


Figure 2.39. Water network, 2011 flood, and informal settlements map
Source: Author, derived information of flood from Gistda (n.d.); Informal settlements from BMA GIS Center (2020)

In the past decade, this vulnerability to the unpredictable climate change has been proved by the disaster in 2011 when the Chao Phraya Delta, which includes the majority areas of Bangkok, was flooded for months (Figure 2.38 and Figure 2.39).

Partially used for public transport

Despite the fact that the majority of canals are stagnant and non-navigable, some canals are used for public transport. There are five water transport routes in Bangkok Metropolitan Area (Figure 2.41). However, they still share only 0.28% of all the daily trips made in Bangkok (The Office of Transport and Traffic Policy and Planning, 2018).

According to the existing research on Bangkok's canals, Iamtrakul et al. (2018) suggest that out of over 1,161 waterways in Bangkok Metropolitan Region (BMR), routes with navigable potentials are found, and they could be integrated with the existing and future rail transit system. Bangkok is already characterized by this asset. There are opportunities to make use of it to the fullest potential to enhance urban mobility and alleviate traffic congestion towards society's more sustainable well-being.

Figure 2.41. Saen Saeb Canal boat
Source: ThaiHealth (2018)

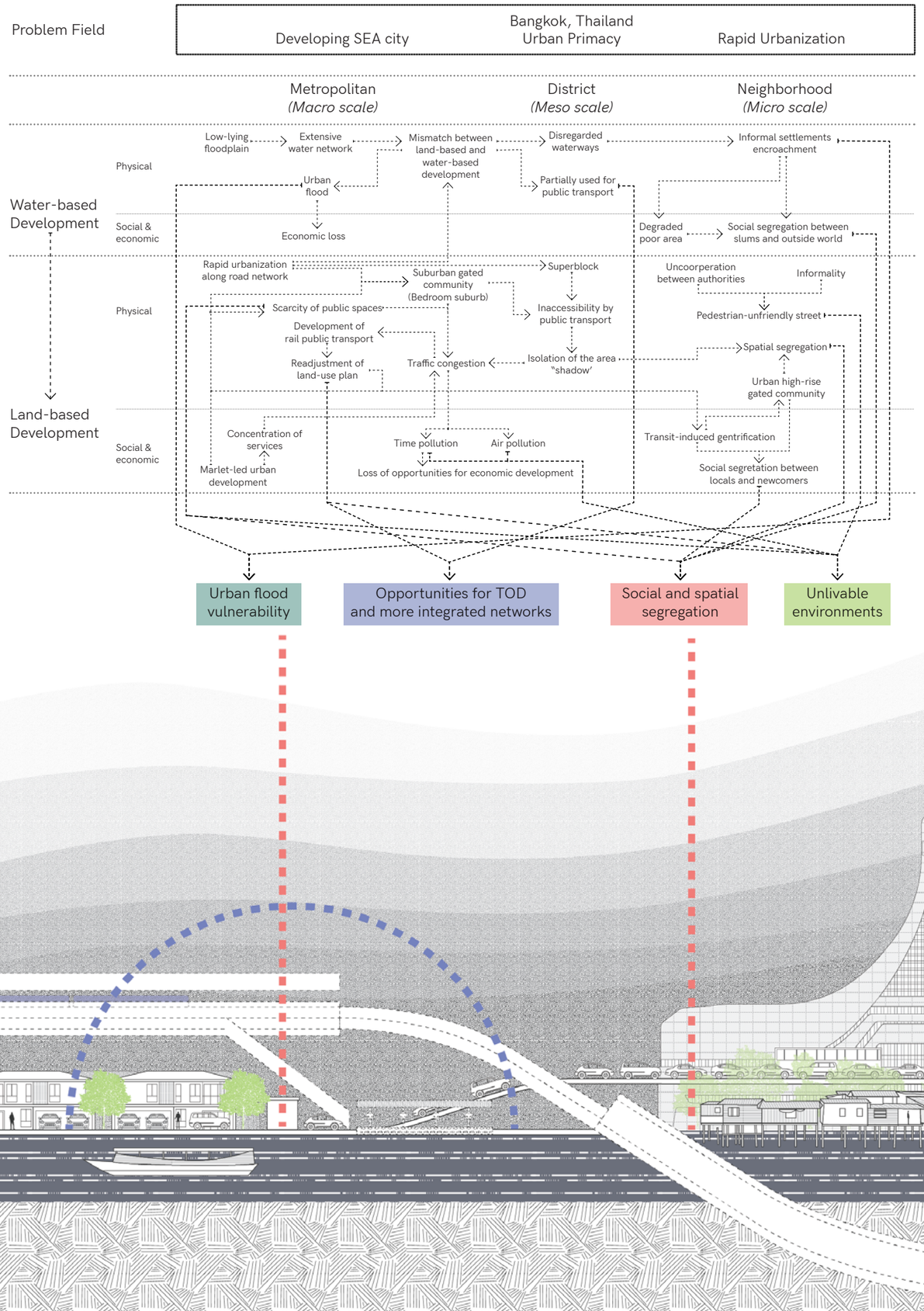
Encroachment by informal settlements

Currently, along-side some canals are taken by informal settlements (Figure 2.40). The row of shanties is built above waterways. Since these structures do not connect to the sewer system, dwellers have to dispose waste into the water, resulting in water contamination. Consequently, the water is not suitable for consumption and can be an origin of vermin and disease (Ramkisor, 2016). Moreover, the structure can trap all the solid waste and the waste from the slum itself, hindering the water flow and subsequently leading to less water management performance.

Regarding the social segregation issue, it is apparent that the slum is not attractive to outsiders. In fact, wealthier citizens do not have any reason to visit slums; they also do not know their unlivable housing situation and visualize these undisclosed parts of the city with insecurity. However, informal settlers have more contact with neighbors within the neighborhood than other richer enclaves (Wissink & Hazelzet, 2016). Therefore, it appears that lower-income groups within the informal settlements in Bangkok have more social involvement and could make the community more harmonious.

These informal settlements pose how unlivable their dwellers are living in and social segregation between low-income dwellers and wealthier citizens outside.

Figure 2.40. Slums along Lad Prao Canal
Source: Urban Creature (2019)



02.4. Problem Statement

Bangkok is the primary mega-city of Thailand with the agglomeration of the urban population that results in the metropolitan area's rapid growth. The advent of car mobility led to how car-oriented the city has been. The development of roads and highways took place to serve citizens accommodating in the suburban gated communities, forcing them to drive long distances from the outskirts to work in the city center. The excessive number of cars exceed road networks' capacity and results in heavy rush-hour traffic congestion, where people lost their valuable time. Moreover, the exhaust from these vehicles has polluted the city and adversely affected people's well-being. The government's action to tackle these problems was developing rail public transport projects. As a result, high-rise gated communities have invaded the surrounding area of stations and brought about gentrification. Besides, the majority of plots are owned by the private sector, which led to a lack of public space. The unlivable environments caused by the externalities of car dependency and social segregation resulted from gated communities, and the scarcity of public spaces need to be solved.

Bangkok Metropolitan Administration (BMA) is readjusting the city comprehensive land-use plan to align with mobility systems' expansion. However, this quantitative approach alone might not be sufficient to bring livability to the neighborhoods. Transit-Oriented Development (TOD) is the concept taken into this revision. Since the concept has been predominantly utilized in the Global North, it needs to be comprehensively studied to be adapted to the city properly. The existing guidelines and incentives might not work in Bangkok, especially integrating affordable housing in the development. Thus, a holistic approach to TOD design and implementation is required. Unless it is conducted in the appropriate way that fits Bangkok, it can contribute to the downsides and side effects, unlike other cities do.

On the other hand, the water network is disregarded, due to the shift from water-based to land-based society. The informal settlements encroach and pollute the waterways, hindering the water flow. Furthermore, the geographical location of the floodplain poses a risk to urban flood. Lastly, the minority of waterways are used for public transport, and there is an opportunity to revitalize and upgrade the water system to synergize with other land-based public transits. Since Bangkok is already equipped with this valuable, it has not been used to the fullest potentials. Therefore, its hidden performance needs to be rediscovered and made use of to enhance urban mobility towards the more sustainable well-being of society.

Figure 2.42. Problem statement
Source: Author

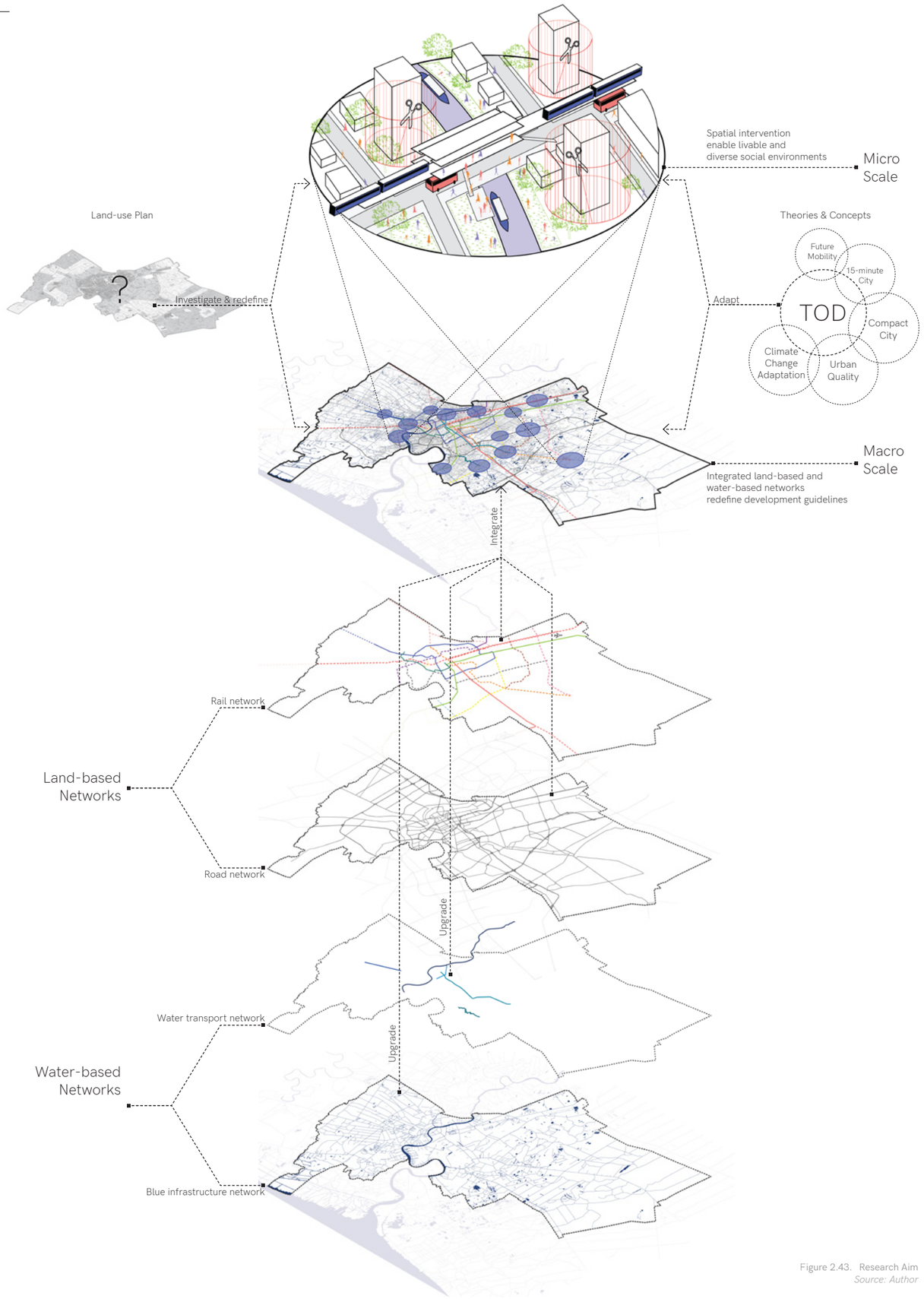


Figure 2.43. Research Aim
Source: Author

02.5. Research Aim

This research aims to explore how the developed concept of TOD could be transferable to implement in the context of Bangkok. To achieve this aim, the research will develop the theoretical framework on TOD and other relevant concepts, namely, the Compact City and 15-minute City, to seek the design principles applicable to Bangkok. Although to contextualize the concepts, a comprehensive study on the existing spatial organization, including density, road networks, and public transportation, needs to be conducted. Moreover, the city land-use and future infrastructure development plan will be investigated to see how the urban fabrics could be affected and how the policy and guidelines can be improved to enable urban livability on the macro scale and micro scale.

The project also aims to integrate waterways with public transport systems in the city scale since it will be the backbone of urban mobility. Consequently, the TOD concept can be applied in specific areas. The existing waterways will be analyzed on how they are utilized and which canals have the potential to be developed and synergize with other modes of transport. In the meantime, the climate change adaptation aspect needs to be concerned in the canal revitalization. Therefore the literature review of the developed strategy will be done to adapt it to the specific context. This public realm will be resurrected while enhancing urban mobility and resilience to flooding hazards and promote urban livability.

On the micro-scale, the project's objective is to propose the spatial intervention around the intermodal hubs derived from the analyses. This will be conducted by the research-by-design method. Density configurations will be investigated to see how the existing urban typology, streets, and public spaces could be transformed or added while seeking their qualities and enable more livable environments. Lastly, this spatial intervention aims to alleviate the gentrification that TOD could cause and mitigate social segregation between gated communities and the local communities by exploring the bottom-up approach to promote the socially diverse environment and enhance the inclusivity for the local residents and newcomers.

02.6. Research Question

SQ1 Which aspects of Transit-Oriented Development are specifically applicable to Bangkok?

SQ2 Which station area could serve as a pilot project?

SQ3 Which waterways have potential to be developed for daily commute transport?

SQ4 How to revitalize the neglected water systems to mitigate flood vulnerability and integrate them with the mobility?

How can Transit-Oriented Development transform the area surrounding emerging intermodal nodes in Bangkok and integrate with the water-based transport, in order to achieve the more compact city, where livable and socially diverse environments, are provided?

SQ5 What does the concept of compact city mean in the context of Bangkok?

SQ6 How can urban fabrics stimulate livable and diverse social environments in Bangkok? What are the main principles?

03. Methodology

Figure 3.1. Canal in captial
Source: Teekayu (2014)

03.1. Introduction

This chapter aims to structure how the research is approached and identify the appropriate methods for data acquisition, analysis, and design to achieve the desired research output. It explains the approach through frameworks, including the research framework that outlines the steps from motivation to conclusion. The methodology framework discusses the descriptive research and analytical research and introduces the suitable methods for the research. While theories are elaborated in the theoretical framework and underpinning, they are integrated into the conceptual framework that depicts the projects' main layers. Lastly, the analytical framework positions all methods concerning the steps towards the answers to the research question.

03.2. Research Framework

Structure of the research

The methodology chapter outlines how this graduation project is conducted and identifies the methods included in the process. The research framework (Figure 3.2) shows the general structure of this project.

As concluded in chapter 2, the problem statement puts forward four issues and challenges that this project will tackle: urban flood vulnerability, opportunities for TOD and more integrated networks, social and spatial segregation, and unlivable environments. While research aim and research question address the need to contextualize the TOD concept in Bangkok and integrating water transport and synergize with other transport modes. Simultaneously, the climate change adaptation approach will alleviate urban flood hazards. The ultimate goal of this project is to enable social diversity and urban livability through interventions in both the metropolitan scale and micro scale.

In alignment with the problems, research aim, research questions are formulated to be answered by various methods to achieve the outcomes. The expected outcomes are the strategic integrated model on the macro scale and design interventions in the micro-scale. However, before the formulation of these outputs, a set of plausible guidelines has to be derived from the developed concept and case studies. Since TOD and its integration with water networks have rarely been applied in the developing cities, this project will be an exploratory research. Moreover, it criticizes the existing policy and explored how it can be improved to enable urban livability on the macro and micro scale. This aligns with the transformative worldview, which intertwines with politics and places significance on the qualitative research of socio-economic, social diversity, and stakeholders to understand who is involved in the development. Besides, quantitative research is needed as building, and population density can determine livable and socially diverse environment.

This chapter includes the methodology framework, which outlines the methods used in this project. They are categorized into two types, descriptive and analytical research. Following this, the theoretical framework presents the contribution of relevant theories and concepts, which are divided into five categories, within two scales according to the mentioned outcomes. It demonstrates the roles of each theory in the project and the relation between them. These theories are reviewed and elaborated in the underpinning part. The conceptual framework depicts the integration of the main concepts and the relation with the theoretical framework. Lastly, the analytical framework demonstrates the analysis approach on how each research question is responded through the steps where methods are applied.

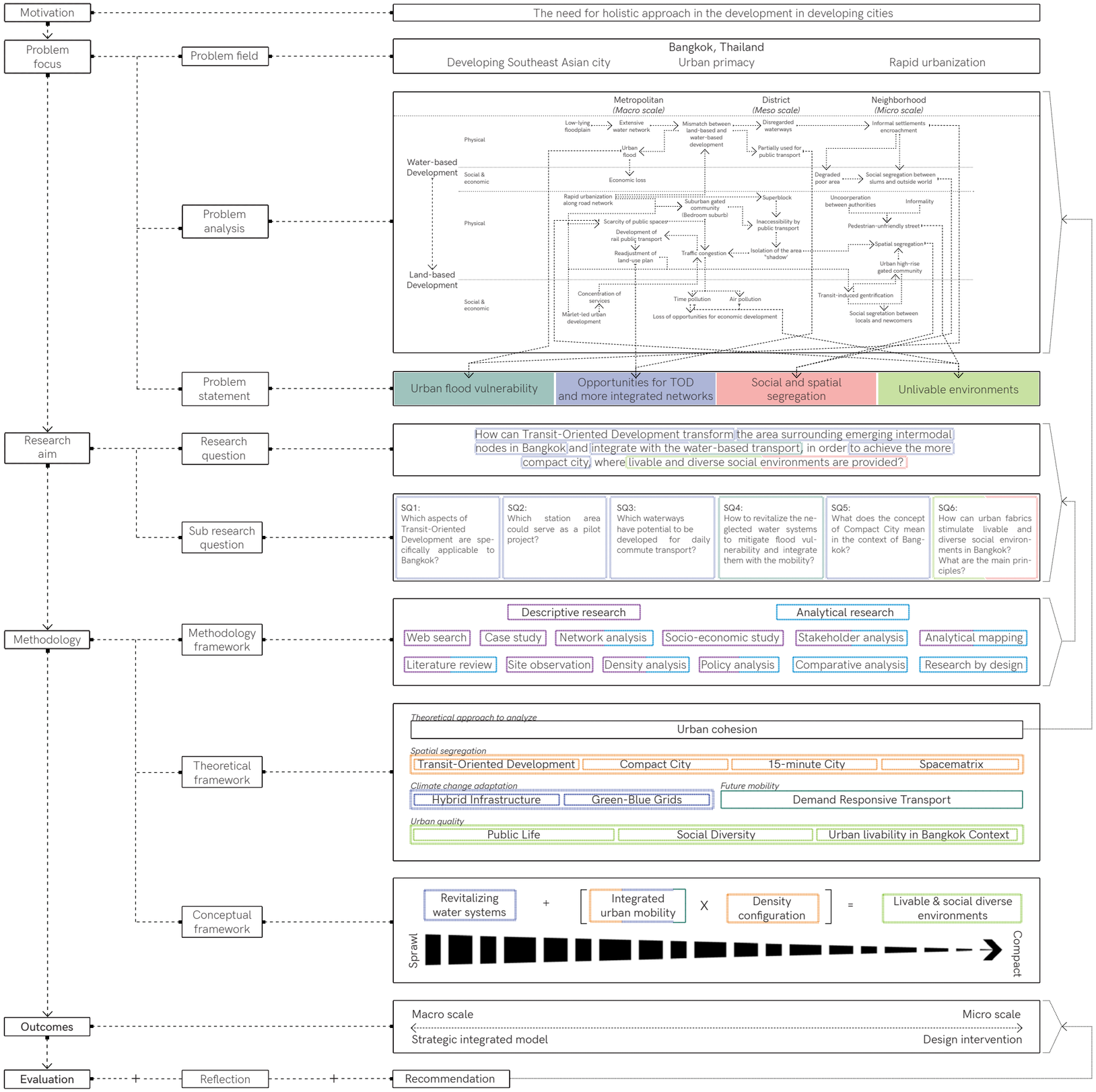


Figure 3.2. Research Framework
Source: Author

03.3. Research Questions, Methods, and Outcomes

Main research question

How can Transit-Oriented Development transform the area surrounding emerging intermodal nodes in Bangkok and integrate with the water-based transport, in order to achieve the more compact city, where livable and socially diverse environments, are provided?

Sub research questions	Methods		Outcomes
SQ1 Which aspects of Transit-Oriented Development are specifically applicable to Bangkok?	(L) Literature review	TOD, Compact City, (Output from AR3U023 theory paper)	A set of TOD design principles that can be used for the strategic model in the macro scale and for design intervention in the local scale Input from SQ2 to conduct the design scenarios in local scale
	(C) Case study	TOD implementation in European and Asian cities (Output from AR3U023 theory paper)	
	(CA) Comparative analysis	Make comparison between case studies and create a set of principles that applicable in Bangkok (Output from AR3U023 theory paper)	
	(N) Network analysis	Accessibility, Mobility, and walkability in existing conditions and design scenarios on micro scale	
	(D) Density analysis	Existing built density of station areas and proposing the transformation	
	(P) Policy analysis	Existing land-use policy of Bangkok and deliver the plausible strategy	
	(SA) Stakeholder analysis	Analysis on who are involved in the development and what they do and how they collaborate	
	(RD) Research by design	Design intervention in local scale, incorporating density configurations and future mobility scenarios	
	(M) Analytical mapping	Present all the aboved analyses and design intervention	
SQ2 Which station area could serve as a pilot project?	(W) Web search	Information of the existing rail public transport and future plan, bus routes, road networks	Potential stations in macro-scale strategic model and to be designed in local scale to answer SQ1 and SQ6
	(S) Site observation	Inspecting the existing physical environments of the potential areas	
	(N) Network analysis	Existing and future rail public transport lines and current bus routes	
	(D) Density analysis	Priliminary analysis of the existing urban fabrics,	
	(P) Policy analysis	Existing land-use policy of Bangkok	
	(CA) Comparative analysis	Make comparison between station areas	
	(M) Analytical mapping	Mapping the potential station areas [City scale]	
SQ3 Which waterways have potential to be developed for daily commute transport?	(W) Web search	Information of physical aspects of waterways: width; depth; functions	Potential waterways in macro-scale strategic model and to be designed in local scale to answer SQ1, SQ4, and SQ6
	(S) Site observation	Inspect the existing physical conditions of the canals	
	(N) Network analysis	Heirachy, functions, and water management systems of waterways	
	(SS) Socio-economic study	The distribution of anchor functions, along potential waterways to undersatnd who they serve	
	(CA) Comparative analysis	Make comparison between waterways	
	(M) Analytical mapping	Mapping the potential waterways [City scale]	
SQ4 How to revitalize the neglected water systems to mitigate flood vulnerability and integrate them with the mobility?	(L) Literature review	Climate change adaptation: Hybrid infrastructure, Green-blue grids	A set of indicators, design principles Input from SQ3 to conduct design scenarios
	(C) Case study	Examples of canal revitalisation and water-transit station project	
	(RD) Research by design	Design intervention in local scale	
	(M) Analytical mapping	Present all the aboved analyses and design intervention	
SQ5 What does the concept of Compact City mean in the context of Bangkok?	(L) Literature review	Compact City, 15-minute City	A set of principles and guidelines that can be used in the macro and micro scale
	(D) Density analysis	Existing built density of station areas and proposing the transformation	
	(P) Policy analysis	Existing land-use policy of Bangkok and deliver the plausible strategy	
	(SA) Stakeholder analysis	Analysis on who are involved in the development and what they do and how they collaborate	
	(RD) Research by design	Design intervention in local scale	
	(M) Analytical mapping	Present all the aboved analyses, strategy, and design intervention	
SQ6 How can urban fabrics stimulate livable and socially diverse environments in Bangkok? What are the main principles?	(L) Literature review	Literature studies which focus on the qualitative approaches - Livability in the context of Bangkok, social diversity, public life	A set of indicators that assess the livability in the context of Bangkok and principles that activate diverse social environments Input from SQ2 and SQ3 to conduct design intervention in local scale
	(SS) Socio-economic study	Demographic analysis, income group, etc.	
	(DA) Density analysis	Built forms, open spaces	
	(RD) Research by design	Design intervention in local scale	
	(M) Analytical mapping	Present all the aboved analyses and design intervention	

Aims

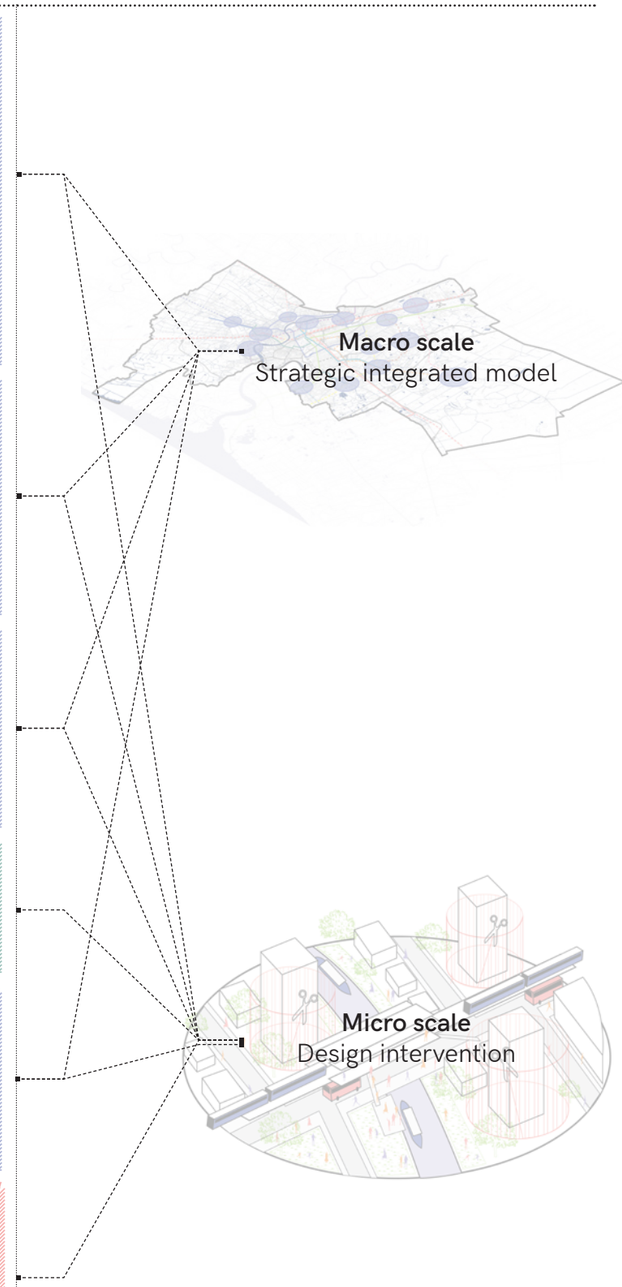


Figure 3.3. Methodological Framework
Source: Author

03.4. Methodology Framework

Descriptive Research

Descriptive research consists of surveys and fact-finding inquiries of various kinds. Its primary purpose is to describe the state of affairs as it exists at present. Also, the researchers have no control over the variables, only that has happened and what is occurring can be reported. The methods within descriptive research also include comparative and correlational methods (Kothari, 2004).

In this project, the main objectives are to adopt TOD to Bangkok and integrating waterways with the transport network, while tackling the flood hazard issues. Moreover, the aims are also to enable socially diverse and livable environments. Thus, the goal of descriptive in this project is to comprehend the existing conditions in spatial, socio-economic, and governance structures. Besides, the developed concepts are reviewed to understand their keystone, together with the case studies for the example of how TOD has been implemented.

To understand the urban cohesion, a layer-based approach will be used in descriptive and analytical research (Pinto & Remesar, 2012). In descriptive research, each layer of information and data will be mapped in multiple scales. The methods included in the descriptive are as follows:

1. Web search (W)
Existing research about Bangkok and scholarly literature of relevant theory can be derived from Google Scholar and other scholarly search engines. Most useful information and data about Bangkok can also be found through search engines.

2. Literature review (L)
Theories are chosen based on relation to the concepts of the project. TOD is the central concept that is elaborated and adapted, while others support it as a tool and framework for assessment. A more in-depth explanation of the role and contribution of theories will be discussed in the theoretical framework.

3. Case study (C)
In order to understand the policy and governance perspectives of TOD, two case studies are selected, namely *Stedenbaan* and Singapore, and elaborated in the theory paper (appendix 10.3.1.). While design aspects of the case are studied and conducted as a group in the atlas of references of the Urban Fabrics studio.

4. Site observation (virtual) (S)
Site observation helps to understand the physical conditions of the site. It complements the network and density analysis as GIS data of built form and water network in Bangkok is insufficient. Thus, site observation offers a way to inspect the existing volume of buildings and the profile of the waterways. However, as the current situation does not allow the fieldwork at the site, Google Street View is viable for this method.

5. Network analysis (N)
In the metropolitan scale, the street networks, and public transport are analyzed to find potential waterways and locations. On the local scale, the existing network and accessibility density are analyzed aided by the GIS simulation.

6. Density analysis (D)
The current built density will be analyzed in the critical project area with Spacematrix (Berghauser and Pont, 2010). This method allows for the comprehension of the volume of buildings and the number of open spaces compared to the aimed floor area ratio and open space ratio in the land-use plan, which will complement the policy analysis.

7. Socio-economic study (SS)
The socio-economic analysis includes a broad demographic study such as population density and in-come range of people to understand the residents' current status, as it is essential to consider them to achieve the project's goal of enabling a socially diverse.

8. Policy analysis (P)
Policy analysis reviews governance planning policies, particularly the land-use plans. The existing plan is studied to understand how the current urban fabrics have been influenced by its application. Whereas the latest plan that will be enacted in the coming year is investigated to see how the government envisions Bangkok's future scenarios.

9. Stakeholder analysis (SA)
To identify and prioritize actors involved in the urban development process, stakeholder analysis is conducted. Since the organizational structures and territories in Bangkok are complex and hierarchical, this method is significant for the planning perspective of this thesis.

10. Analytical mapping (M)
Mapping within descriptive research visualizes the findings and creates the base, ready for superimposition in the analytical research.

Analytical Research

Once the descriptive research has been conducted, analytical research plays a crucial role in the thesis. It uses facts or information already available and analyzes them to formulate a critical evaluation of the material (Kothari, 2004). This project's analytical research includes the analyses using the information gathered from the descriptive research to formulate the guidelines and strategy applied in metropolitan-scale and local-scale interventions. The methods used for analytical research are as follows:

1. Literature review (L)
After the theories have been reviewed, the next step is to elaborate on what principles could be adapted in the project. In the scope of governance and policy, specific guidelines derived from theories and case studies have been discussed in the theory paper (appendix 10.3.1.).

2. Network analysis (N)
The base layers of mobility networks derived from the descriptive research are superimposed to find potential TOD nodes. Besides, in the micro-scale intervention, the same method conducted for the existing condition is done for the design to test and evaluate the scenarios.

3. Density analysis (D)
The qualitative approach plays a crucial role in density analysis. Density configurations at the key locations are explored considering the quality that the right amount of built volume and the open space can deliver and enable a livable environment.

4. Policy analysis (P)
The policy analysis explores the possible change in policy appropriate in Bangkok. Moreover, the land-use plans and incentives that have been analyzed are criticized and propose the possible changes. This analysis's output is integrated into the large-scale model as a strategy and tested n the local-scale interventions.

5. Stakeholder analysis (SA)
After the stakeholders are analyzed, the problems in the organization of urban development in Bangkok is manifest. Thus, in the planning process, they are strategically shuffled through phasing to enhance the effective implementation at the metropolitan and local levels.

6. Comparative analysis (CA)
The comparative analysis is applied to compare potential station areas and waterways to be utilized for public transport. Moreover, in the theory paper (appendix 10.3.1.), two case studies of Stedenbaan and Singapore are compared to seek the applicable policies and guidelines for Bangkok.

7. Analytical mapping (M)
Mapping assists other methods; for example, comparative analysis of case studies where physical elements of two case studies are mapped and compared. Besides, it helps to explain in visualizing the interventions and transformations.

8. Research by design (RD)
According to Jong & Voordt (2002), research by design generates knowledge and new insights by investigating the transformations of a design, design interventions in a current situation, and the effects they will cause.

The method used in this project is scenario design since such method does not only consists of the extension of empirically established possible developments perspective but also the policy interventions and feasible spatial interventions (Jong & Voordt, 2002).

In order to propose the holistic plans for TOD design and implementation in Bangkok, a multi-scalar approach will be used, comprising mainly two scales as follows:

8.1 Strategic integrated model
In the metropolitan scale, this integrated model will set main goals and objectives for the future development of Bangkok, while TOD will be used as the major strategy for the desired transformations and respond to the main research question of the thesis. It will determine the key locations for the local scale interventions, including the pilot project and the toolbox of TOD design that will be applied in station areas.

8.2 Key projects
The urban design of three key projects in Bangkok will allow exploring the implications of the TOD at the local levels. These interventions will serve as a prototype whose guidelines can be applied in other areas. The interventions will cover the scope of catchment area around potential interchange stations with the multi-modal node of land-based and water-based public transport. Moreover, public spaces and streets are essential elements to be designed as they are the agents that further cohesion (Pinto & Remesar, 2012) and enable socially diverse and livable environments. Besides, the micro-scale interventions will ensure how they will support the metropolitan-scale strategy.

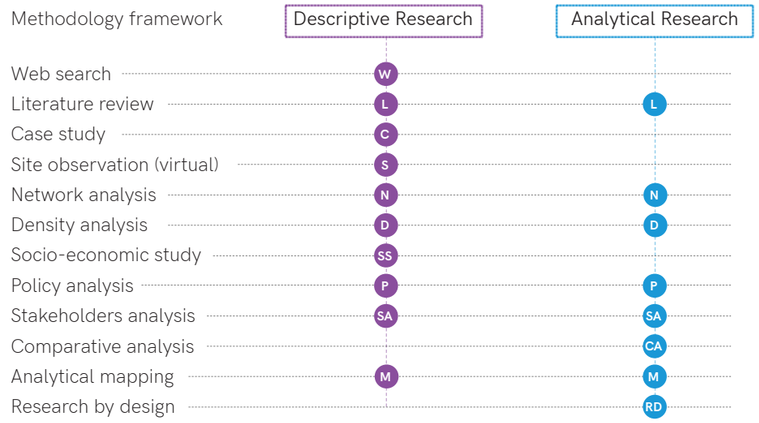


Figure 3.4. Classification of descriptive research and analytical research
Source: Author

03.5. Theoretical Framework

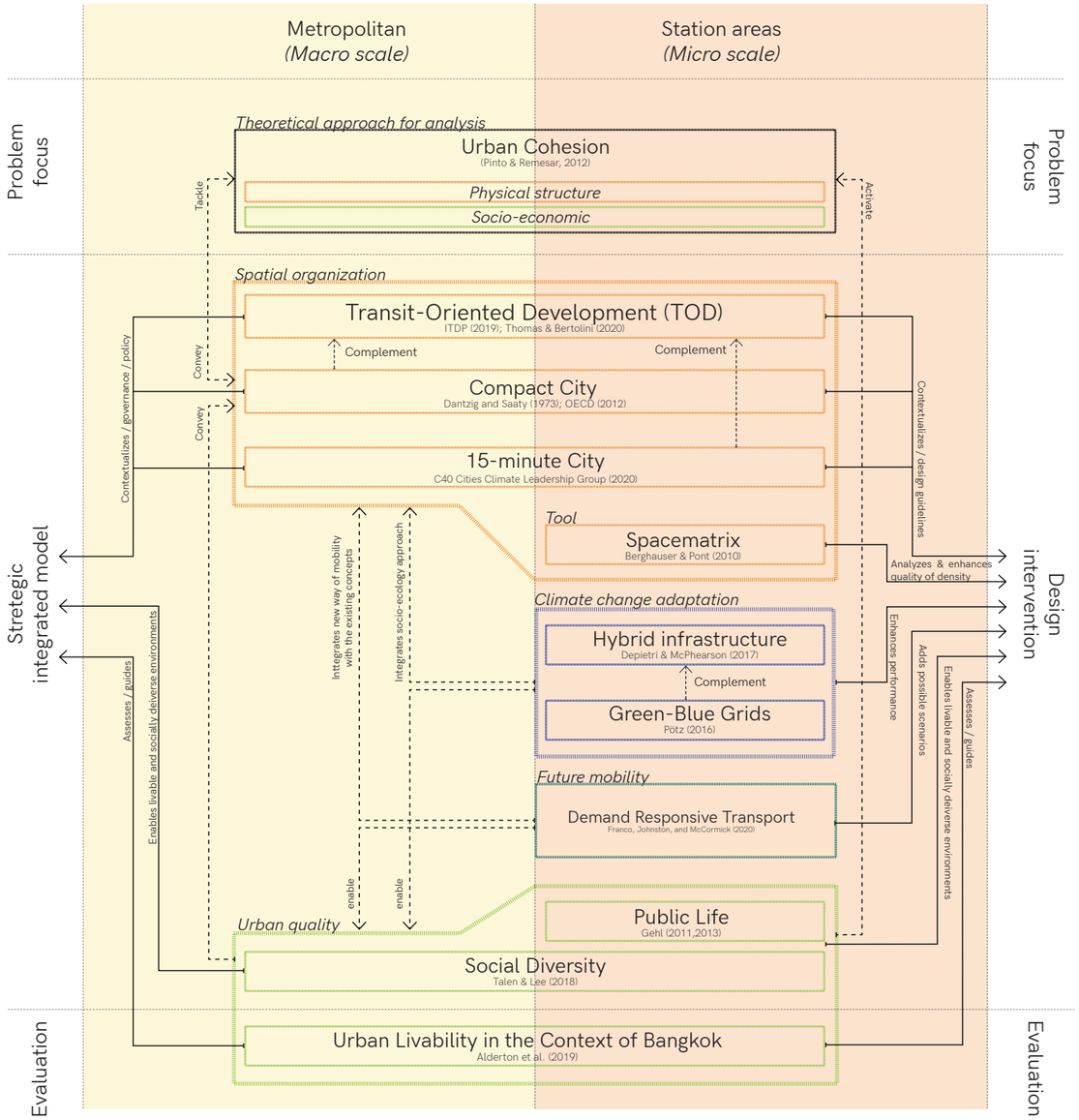


Figure 3.5. Theoretical Framework
Source: Author

The theories chosen for this graduation project are divided into five categories based on their purposes and themes. While another dimension is the scale (Figure 3.5).

In the problem focus, Urban Cohesion is used as a framework to analyze problems. It puts forward the problems in the emerging cities that perfectly align with the conditions in Bangkok.

The spatial organization covers the TOD, Compact City, and 15-minute City, which complement each other, as there are some overlapped principles. They play a crucial role in macro-scale and micro-scale interventions. Spacematrix is utilized as a tool to calculate density and find the balance of the built and unbuilt spaces. The urban quality body includes Public Life, Social Diversity, whose role is to enable a socially diverse and livable environment. Whereas, for the evaluation, urban livability in the context of Bangkok is reviewed for the indicators to assess the livability in design interventions. While climate change adaptation and future mobility act as a supportive layer for the mentioned two categories and the outcomes in the micro-scale.

03.6. Theoretical Underpinning

03.6.1. Theoretical approach for the analysis

03.6.1.1. Urban Cohesion

(Pinto & Remesar, 2012)

Urban Cohesion was developed by Ana Júlia Pinto and Antoni Remesar (2012) to analyze the factors that directly affect urban development process. The vital points of this concept are the territorial balance that integrates into the city's physical structures and its connections, and social and economic balance, which ensures the accessibility to goods and services, and that different areas of the city have the diversity of functions and cultures.

The authors assume that this concept is reasonable only from the aspect of multi-scale integration. The planning coordination at multiple territorial scales ranging from the broader scales to local ones might promote cohesive urban territories, urban form, and social and economic structures.

Nowadays, the problems of urban cohesion in Bangkok are related to: (1) morphologic fragmentation; (2) lack of functional diversity; (3) social exclusion and marginalization; (4) isolation (lack of connections/ lack of access); (5) absence of singular/ unique functions, able to attract users. These issues result in severe consequences at the urban structure cohesion level. Also, public space is the agent that can further cohesion since it ensures citizens' mobility and benefits the identitary processes, structuring the entire city, while creating and maintaining places. Urban Cohesion is the fundamental concept that conveys the interventions in urban realities. To enhance cohesion in urban space, the existing urban structure has to respond to values such as inclusiveness, accessibility, and attractiveness.

Five essential values are defined to promote cohesion in urban space regarding the statement that public space is the catalyst for cohesion (Figure 3.6).

Not only is this concept used as a framework for the problem analysis, but also it conveys the spatial organization since it poses elements that align with TOD, Compact City, and 15-minute City, such as the continuity and equality of accessibility to places. Moreover, it addresses the significance of the public space as the agent for urban cohesion. Therefore, the interventions that include the design of public space will be enlightened by this theory to activate the more cohesive urban space.

	Regional Scale (Region / Metropolitan)	Urban Scale (City)	Urban Inner Scale (Neighborhood / Street)
Continuity	Great transport infrastructures, mainly roads and railroads, establishing, connections beyween different urban functions of higher hierarchy.	Primary urban axes, establishing connections between main urban functions. These spaces should bee shared between different transport modes (shared spaces)	Axes linking proximity, local urban functions. Active transportation (walking, cycling, etc.) is privileged.
	Ex.: highways; roads junctions; major public transport infrastructure; etc.	Ex.: main streets and avenues; large squares; public transport infrastructure; etc..	Ex.: secondary or local access streets; squares; local public transport infrastructure; etc..
Anchor Spaces	Urban functions of higher heirarchy, able to attract users from a large territorial scale (region, metropolitan area city). They are typically unique / differentiated functions		Local, proximity urban functions, able to generate dynamics of use at local, neighborhood scale.
	Ex.: beaches; shopping centers; great trasnport hubs; university campus; urban parks; monuments; etc..		Ex.: churches; sports / recreation clubs; local commerce / services; schools; parks / gardens; etc..
Multifunctionality	Mix of different typologies of uses, including unique / differentiated uses with influence at regional and metropolitan scale.	Mix including both urban functions of wider catchment area, offering differentiated uses, and local proximity functions.	Mix of proximity local urban functions, mainly associated to daily needs and activities.
	Ex.: mix of consolidated urban areas; natural / environment areas; great commercial and services areas; etc..	Ex.: mix of residential areas; cultural areas; sports facilities; commercial and services; educative facilities; etc..	Ex.. mix of residential areas; commerce and services; local scale / proximity facilities.
Diversity	Structures that shelter different typologies of functions, promoting different types of uses in urban space.	Different types of housing and urban functions that promote the existence of diffrent user profiles. Different types of public spaces that allow different ways of use / appropriation.	
	Ex.: consolidated urban areas; suburban and periurban areas; great commercial, services, industrial areas; great facility areas; etc..	Ex.: urban areas where coexist different social classes, age groups, cultures, etc.. Public spaces that allow different forms of use (leisure, movement, contemplation, etc.).. Areas that offer a multitude of functions, promoting the use of public space for diversified user profiles	
Identity	Elements, with direct impact in the territory, which have the ability to build a collective image / representation of oneness for a specific territory.	Elements, with direct inpact in the territory, which have the ability to build a collective image / representation of oneness for a specific territory. Spaces of expression of individual and collective identity, which is materialized by the way its users appropriate and experience space.	
	Ex.: Great landscape units, with specific characteristics.	Ex.: monuments; public art; specific physical characteristics of architecture or public space; public spaces that enable to different forms of collective or individual appropriate by its users.	

Figure 3.6. Elements for urban cohesion in different territorial scales of analysis
Source: Author, adapted from Pinto & Remesar (2012)

03.6. Theoretical Underpinning
03.6.2. Spatial organization
03.6.2.1. Transit-Oriented Development

ITDP (2019); Thomas and Bertolini (2020)

Transit-Oriented Development (TOD) is the concept that integrates high-density, mixed-use developments, including the mixture of housing, office, retail, and other commercial development and amenities, located within a half-mile of quality public transportation infrastructure (Thomas, Bertolini, 2020). Also, it integrates urban places designed to bring people, activities, buildings, and public space together, connecting and supporting them with the pedestrian- and bicycle-friendly thoroughfares (ITDP, 2017). The development surrounding the stations will maximize the efficiency of existing public transit services and promote other alternatives to private cars.

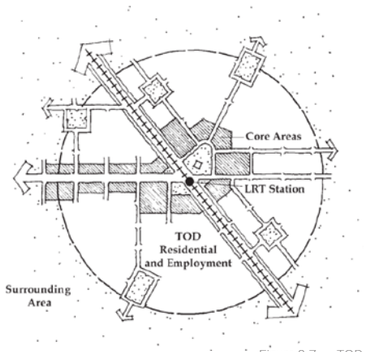


Figure 3.7. TOD
Source: Calthorpe Associates (2002)

TOD can be applied at the large-scale station; however, it can also be integrated at various scales across a region. For example, European cities' implementation has evolved into a regional or network, rather than focusing on the economic revitalization and redesign of individual railway station areas. Most cities want to apply this concept, as it promises to give advantages to the city and its inhabitant. The city government perceives rail transit as the solution to reduce congestion, restructure urban form, create a livable city, and attract economic development.

According to Thomas and Bertolini (2020), successful TOD is broadly considered dependent upon the five Ds: density, diversity, design, distance to transit, and destination accessibility.

1. Density
TOD provides potentials to the area, concentrating on new population and employment growth. Nevertheless, it could be problematic if the transit infrastructure location is in the car-oriented, low-density region or with a limited regional transport network. Quantifying the density can be measured in various aspects per unit of area, for example, population, dwelling, units, and employment.

2. Diversity
Diversity refers to the number of various land-uses in the designated area and the extent to which they are represented in the plot area, floor area, or employment.

3. Design
This refers to street network characteristics, significantly block size, proportion, and numbers of four-way intersections. What influences the walkability is the intersection density and the number of destinations within walking distance. These characteristics result in a decreased number of Vehicle Miles Travelled.

4. Distance to transit
In the US context, 800 meters is considered the maximum distance that people will walk to the metro and Light Rail Transit stations. 400 meters is the distance people willing to walk for the local stop service. However, walking preferences vary in many aspects, especially the geographic and cultural context.

5. Destination accessibility
The ease of access to regional and local trip attractions defines this component. The distance to the central business district, the accessibility to the number of jobs within a particular trip are included in the typical measures. Besides, how convenient the labor force could access the workplace is associated with increased population and job density in the region.

These five Ds could make TOD successful, but there can be difficulties, taking the difference in spatial and cultural aspects between the contexts that can be the barriers to the implementation while contextualizing the concept as follows.

1. Zoning and regulatory issues
Private automobile plays a crucial role in city planning. Suburb-to-city commute determines how cities are planned through the extensive land-use regulations favoring the car, such as the requirement of a certain number of parking spots per housing unit based on the assumption that every household owns one or more cars. Furthermore, the size and shape of plots are the hurdles. Medium-size parcels and broad corner plots are where most intensification occurred as they yield significantly higher densities.

2. Policy consistency and planning coordination
A lack of broader, regional-level approaches to decrease private motorization and coordination between transit investments and land use can obstruct TOD, as happened in many cities. TOD's application needs to be conducted beyond individual station areas in coordination with tools, policies, and plans that regulate urban growth, employment, and housing area development, to achieve regional aims.

3. Cost
Due to the high cost of constructing rail-based infrastructure and the time-consuming in built-up areas, mid-sized cities and regions cannot afford to implement it. In order to generate more revenues to support TOD, station areas need to be attractive to developers. Many financial tools have been used, such as tax increment financing, allowing the government to use the expected increase in tax revenues to fund development. Density bonuses allow the developer to build more areas that generate more profits.

4. Public opposition
Neighborhood residents can oppose transportation infrastructure. They may also object to changes. For example, an increased density, urban design characteristics, or decreased parking levels are associated with TOD.

5. Loss of affordable housing
The extensive implementation of TOD can be restraint by the loss of affordable housing. The issues usually happen in the cities where the private market supplies most housing, making the rent increases along transit corridors and around station areas.

03.6.2.2. Compact City

Dantzig and Saaty (1973); OECD (2012)

The term "Compact City" was initiated by George Dantzig and Thomas L. Saaty in 1973. They desired to explore more efficient use of resources within the city and a richer quality of life. This original proposal of Compact City started with a simple concept that aims to arrange out urban areas vertically to reduce travel time. The amount of land needed for the city is negligible to curtail urban sprawl and conserve the nature surrounding the urban form since the key idea is that it pays to 'built land' instead of robbing nature. Residents do not have to travel long distances for school or work, and they can reach every service by foot and bicycle. Besides, buildings are flexible to changing needs, in the sense that they can be remodeled, renewed, and rearranged easily. The plan is divided into five circular parts as showin in Figure 3.8.

The mentioned proposal is one of the examples from many Compact City initiatives. Many attempts have been made to define this concept concerning sustainable development since urban sustainability has emerged in the 2000s. Particularly in the developing city context, which contrasts with Western cities where this concept and policy have been applied. The Compact City policies in the emerging cities can be discussed in relation to various components: attempts to increase built area and residential population densities; to intensify urban economic, social and cultural activities and to control urban size, form and structure and settlement systems for the environmental, social and sustainability benefits obtained from the concentration or urban functions.

In developing countries, rapid urbanization absorbs peripheral agricultural land; doubts are raised whether the policies are effective for containment since it does not appear to improve agricultural productivity or result in better urban living conditions.
Organization for Economic Co-operation and Development (OECD) (2012) proposes Compact City policy strategies in their Green Growth Studies to achieve better outcomes and underline governance challenges. It defines three significant characteristics of a compact city as dense and proximate development patterns, urban areas linked by public transit networks, and accessibility to local services and jobs. Moreover, the Compact City policies help to achieve urban sustainability in various ways. One example of the environmental benefits is that energy consumption and CO2 emissions can be reduced by shorter intra-urban distances and less car dependency. Besides, economically, Compact Cities offer inhabitants easier access to diverse local services and jobs. While they also socially benefit people, the shorter travel distances and public transit networks result in the reduction of travel costs, facilitating the mobility of low-income citizens.

1. Set explicit Compact City goals	○ Establish a national urban policy framework ○ Encourage metropolitan-wide strategic planning
2. Encourage dense and contiguous development at urban fringes	○ Increase effectiveness of regulatory tools ○ Target compact urban development in green-field areas ○ Set minimum density requirements for new development ○ Stregthen urban-rural linkage
3. Retrofit existing built-up areas	○ Promote brown-field development ○ Harmonize industrial policies with compact city policies ○ Regenerate existing residential areas ○ Promote Transit-Oriented Development in built-up areas ○ Encourage "intensification" of existing urban assets
4. Enhance diversity and quality of life in urban centers	○ Promote mixed land use ○ Attract residents and local services to urban centers ○ Promote focused investment in public space and foster a "sense of place" ○ Promote a walking and cycling environment
5. Minimize adverse negative effects	○ Counteract traffic congestion ○ Encourage the provision of affordable housing ○ Promote high-quality urban design ○ Encourage greening of built-up areas

Figure 3.9. Five recommendations for Compact City policy strategies and 20 sub-strategies
Source: Author, adapted from OECD (2012)

Notwithstanding, different local circumstances address different policy responses. No fixed formula of comprehensive Compact City model is applicable to all cities and regions since the local context must be considered. For example, in rapid-growing regions with intense development pressures, regulations are essential to prevent uncontrolled urban growth. Complementary fiscal tools can steer market-based decisions where development will occur and how much intensity should be there. Moreover, OECD recommends five key policy strategies and 20 sub-strategies (Figure 3.9). It can be seen that the Compact City and TOD policies complement each other. There are many identical principles, for example, promoting a walking and cycling environment and encouraging the provision of affordable housing.

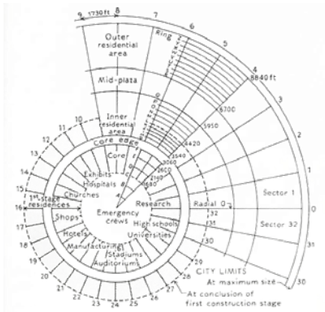


Figure 3.8. A typical plan for one level of Compact City
Source: Dantzig and Saaty (1973)

03.6. Theoretical Underpinning
03.6.2. Spatial organization
03.6.2.3. 15-Minute City

C40 Cities Climate Leadership Group (2020)

"15-minute city" is where everyone can fulfill their needs in proximity by walking or cycling from their residences. Neighborhoods are lived-in, people-friendly, 'complete,' and connected. While it also decentralizes city life and services. The reduction of an unnecessary trip across cities, the provision of more public space, lively high streets, a more robust sense of community, health and wellbeing promotion, climate shock resilience, and cities' sustainability and livability improvement are the objectives of this concept.

In 2020, COVID-19 has triggered this concept and made it gained momentum particularly in Paris (Figure 3.10). It will help cities to revive urban life safely and sustainably in the wake of COVID-19. Many cities have embraced it to support a recovery of the pandemic and foster the more local, healthy, and sustainable way of life that many of their citizens are demanding.

The core principles of a 15-minute city are; aasy accessibility to goods, and services within every neighborhood. Variety of housing types, different sizes and levels of affordability are provided in every neighborhood, accommodating wide range of households , therefore people could live closer to workplace. Clean air, and green spaces are available for everyone to enjoy.

As the main aim is to ensure everyone has access to everything they need in the neighborhood, services such as community-scale healthcare and education, groceries and pharmacies, and parks need to be equipped in each neighborhood. This will help alleviate the crowd in central shopping areas or malls.

Furthermore, the 15-minute city approaches compliment TOD. In a prosperous 15-minute city neighborhood, efficient and reliable public transport connections to other neighborhoods and working districts are essential to facilitate car-free access to jobs, friends and family, entertainment, and other parts of the city.

Figure 3.10. Paris en Commun's "15-minute city" concept sketch
Source: Here360 (2020)

03.6.2.4. Spacematrix

Berghauser & Pont (2021)

<u>Multivariable definition of density</u>
Three fundamental indicators that offer a specific method and allow for the definition of urban types and economic are Floor Space Index (FSI) used to express land-use intensity, Ground Space Index (GSI) used for measuring compactness, and network density (N).

Four variables are needed to calculate these basic indicators are: base land area (A); network lenght (l); gross floor area (F); and built up area, or footprint (B).

Basic indicators N, FSI, and GSI
Network density (N) refers to the concentration of networks in an area, defined as network lenght per square meter of base land area (m/m^2). It is calculated as the sum of the entire internal network and half of the lenght of the network used to demarcate the base land area.
$N_f=(\Sigma l_i+(\Sigma l_e)/2)/A_f$
l_i = lenght of the interior network (m)
l_e = lenght of the edge network (m)
A_f = area of fabric (m^2)

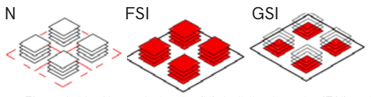


Figure 3.11. Network density (N), building intersity (FSI) and coverage (GSI)
Source: Berghauser & Pont (2021)

Building intensity (FSI) is calculated as follows:
$FSI_x=F_x/A_x$
F_x = gross floor area (m^2)
A_x = area of aggregation x (m^2)
x = aggregation

Coverage (GSI) indicates the relationship between built and non-built space, calculated as follows:
$GSI_x=B_x/A_x$
B_x = footprint of (m^2)
A_x = area of aggregation x (m^2)
x = aggregation

Spacematrix
To simultaneously assess the mentioned three main indicators, a three-dimentional diagram has been used (Figure 3.12). However, the ones that are productive in this research are FSI (GSI) and FSI (N). The Spacemate (Figure 3.13) comprises FSI on the y-axis, GSI on the x-axis. The spaciousness (OSR) and building height (L) are gradients that fan out over the diagram.

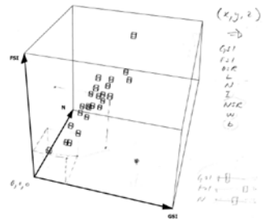


Figure 3.12. Spacematrix diagram
Source: Berghauser & Pont (2021)

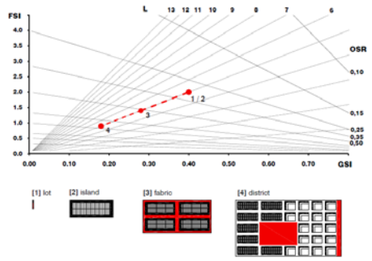


Figure 3.13. Spacemate diagram and scalar composition of sceme
Source: Berghauser & Pont (2021)

03.6.3. Climate change adaptation
03.6.3.1. Hybrid infrastructure

Depietri and McPhearson (2017)

Cities drive climate change and, simultaneously, put themselves at risk. Aligning with the vulnerability to flooding due to climate change, a surface flood at local and regional scale due to the rising sea level, and reduced water infiltration in highly paved urban areas are the urgent.

Grey infrastructures are engineered and physical structures, mostly made of concrete acting as mediators between the human, built-up system, and the variability of meteorological and climatic systems. Sprawling cities rely on grey infrastructures for protection, and slums are often situated in hazard-prone areas. The expansion of the population in unsafe areas led by these protective infrastructures exposes them to hazards and other aggravating risks. However, despite its detrimental effects, it is suitable for the urban context in a fast-changing climate.

Green infrastructures are constituted by well-functioning biophysical systems. Simultaneously, Blue infrastructures include all water bodies. Since water and land converge in various ways, integrating green and blue infrastructures could be the solution that requires minimal or no technological/infrastructure intervention. Moreover, Initial research indicates that well-organized ecosystems could reduce risk and cost-effective, multifunctional, and win-win solutions in the long term.

The approaches utilized integrated engineered grey and green infrastructures. The example can be seen when wetlands restoration is paired with engineering measures such as small levees for coastal flood protection. Other examples in urban areas are bioswales, rain gardens, green roofs, street trees. Hybrid approaches are suitable in the city context where exclusively dependence on green infrastructures hardly copes with the flood compared to built structures' efficiency. They are intended to decrease reliance on grey infrastructures and their side effects. Besides, their co-benefits will improve the sustainability of cities and the inhabitants' well-being.

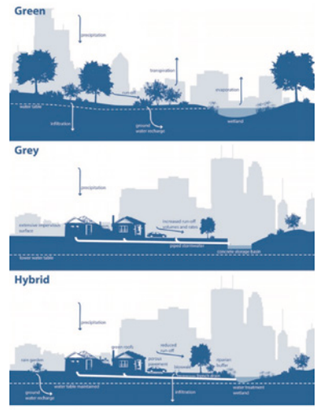


Figure 3.14. Three contrasting approaches, green and blue only, grey only, and hybrid for dealing with urban water
Source: Depietri and McPhearson (2017)

03.6.3.2. Green-Blue Grids

Pötz (2016)

Green-blue grids - Manual for resilient cities focuses on developing scientific and practical knowledge in a wide range of fields, such as climate adaptation and mitigation, heat stress, air quality improvement. Scientific knowledge is translated into practical measures by using the examples from the Netherlands and overseas to demonstrate the implemented. Moreover, a toolbox is provided as an assistant in realizing urban green-blue grids and the illustration and explanation of the measures' synergetic potential.

Initial research has shown that more provision of green and water in urban areas effectively attracts biodiversity, mitigating heat stress, water retention, and improving water quality. Having more green significantly enhances the sponge effect of cities.

Since Bangkok is confronting water challenges posed by the rising sea level, water accumulation from the Northern part of the basin, and high precipitation, urban water management must ensure that no damage is caused during the unpredictable or unprecedented situations. Multiscalar approaches are used as examples in this manual. On the national scale, the Netherlands' multi-layered safety approach is raised, showing its concept and responsibilities by many sectors, from national, provincial, municipal, and private parties. Whereas in the city and local scale, a wide range of guidelines and examples are provided, for example, measures that buffer, infiltrate and purify water, suggestions on what can be applied to the building and built structures such as green roof, rainwater storage below building, and green wall.

There is enormous room for Bangkok to improve in pursuit of urban sustainability. The scientific and practical knowledge crafted in the Netherlands is what Bangkok can learn from and adapt appropriately to a developing city.

03.6. Theoretical Underpinning
03.6.4. Future mobility
03.6.4.1. Demand Responsive Transport

Franco, Johnston, and McCormick (2020)

Demand Responsive Transport (DRT) services provide on-demand transport from passengers using fleets of vehicles scheduled to pick up and drop off people according to their needs. This intermediate form of transport is between bus and taxi, covering a wide range of transport services ranging from less formal community transport to area-wide service networks (Mageean & Nelson, 2003). In the past few years, DRT has played a significant role in supporting the first/last mile of a journey. Also, it is an essential requirement for Mobility as a Service (MaaS) implementation. However, sustainable and durable DRT is not delivered by the current business models in urban areas. The main focus of the research by Franco, Johnston, and McCormick (2020) seeks how to model demand for ride-shared mobility services and how to plan for these services when running in integration with mass transit. The prediction of demand for two flexible on-demand services. Identification of best routes to maximize the number of users and quantification of the benefits integrates with public transit services and modal change from private vehicles are made by Agent Based Models (Figure 3.15). The output is predicted to be used within Local Authorities for transport planning purposes and for sectors searching for financially sustainable DRT.

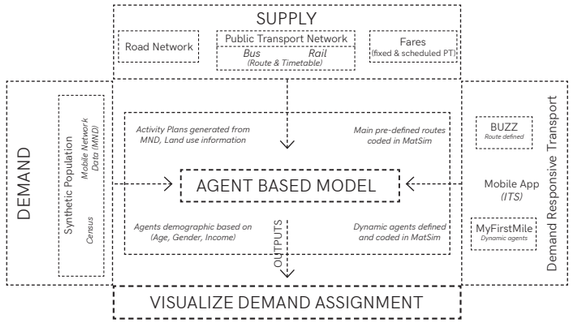


Figure 3.15. The Agent Base Model framework for the MODLE project in Bristol
Source: Author, adapted from Franco, Johnston, and McCormick (2019)

03.6.5. Urban quality
03.6.5.1. Public Life

Gehl (2011)

Each culture has a distinct way of life; likewise, public life people in different cities or countries spend is different. Since Gehl (2011) claims that the character of life between buildings alters within the societal condition, however, the major principles and quality criteria used for human quality in the public realm are constant. The literature review about public life by Jan Gehl helps understand how people use public spaces and how to improve them to offer livable and socially inclusive environments

Activities are influenced by various conditions. One of the factors is the physical environment, which is demanded differently by three types of outdoor activities.

Necessary activities cover the compulsory ones. Daily tasks and pastimes are part of this category, and they are mostly done by walking.

Optional activities need wish, time, and place to make them possible, including taking a stroll to get fresh air, standing around enjoying life Moreover, they occur only under favorable exterior conditions, when nice weather attracts people to go outdoor. Also, they primarily depend on exterior physical situations.

Social activities depend on the existence of others in public spaces, including children at play, greetings, conversations, and communal activities. These occur in many places: in residences, in private outdoor spaces, in public buildings. Another term that can define these activities is "resultant" since they evolve and develop connected with the other activity types.

Taking a look back at the street scene, how all three activity types occur in the interwoven pattern can be seen. Life between buildings not only comprises pedestrian traffic or recreational or social activities but also includes the whole range of activities, making urban communal spaces and residential areas meaningful and attractive.

Since life between buildings and physical conditions in Bangkok are distinct from those in developed cities. Streets are where the majority of public activities take place. However, due to the disorganization, they are filled with cars, leaving minimal spaces for pedestrians and other activities to happen, for example, clusters of motorcycle taxis at the beginning of side roads and street vendors next to bus stops. These are only the brief introduction of the review of the public life tenet, and further research on this field has to be conducted in the next steps.

03.6.5. Urban quality
03.6.5.2. Social Diversity

Talen and Lee (2018)

Design for Social Diversity by Talen and Lee (2018), explores how planning and design could enable social diversity in places. Places that are already socially diverse are studied to comprehend the possibilities of a design response and recommend ways how the built environment could support the diverse social makeup. The fundamental thesis is that there are design principles that can help sustain diverse neighborhoods. However, modern urbanism emphasizes functionalism, automobile, accommodation, and land use separation aggravated the design requirements of diverse places. The book discusses how separated we are and why diversity within one neighborhood is significant by posing the current status of social separation and diversity and reviewing why these patterns exist.

Separation
Classes and incomes can segregate societies. The stability of homogeneity exacerbates this separation: affluent neighborhoods remain rich, poor neighborhoods remain poor, while middle-income neighborhoods alter. Other forms of segregation that are similar to Bangkok's condition are the gated communities that sort people by age, lifestyle, and other forms of demographic identity. Small physical elements can be substantial human barriers too: home security systems, fences, gates are the "discourse of urban fear" that encode class separation.

Diversity
People consider a "socially diverse neighborhood" as a place where residents are racially and ethnically mixed, having different income levels and wealth. Also, the most important parts are the mixing of age, family type, and household. The factors that could indicate why some neighborhoods are socially diverse are historical/economic/social, policy-related, and physical/locational. These factors are interrelated, to illustrate, the policy is affected by historical/economic/social; this factor with the policy affects physical/locational factors (Figure 3.16).

Historical/economic/social factors
Diverse places might be those with a long tradition of diversity. Building age mix can result in a lower median housing age for the overall area than the newer suburban ones. A mix of building ages ensures a mix of rents and prices and plays a significant role in diversity.

Policy-related factors
There are policies that support diversity; some are designed to limit gentrification, which might affect the encouragement of stable income diversity, including rent control and strategies that subsidize low-income housing in high- or middle-income neighborhoods.

Physical/locational factors
Certain forms and patterns are believed to be associated with social diversity, such as mixed uses, housing types, and lot types.

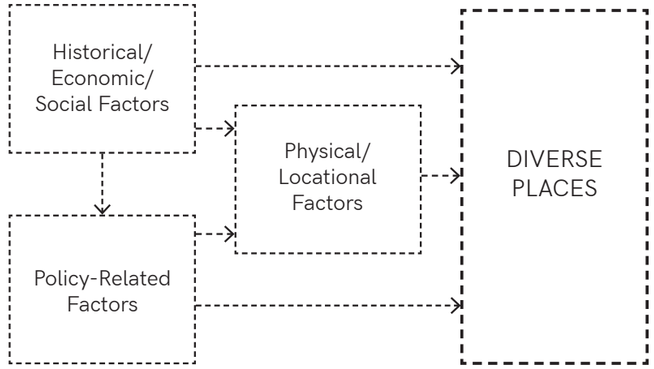


Figure 3.16. Conceptual framework of factors that explains diversity
Source: Author, adapted from Talen and Lee (2018)

03.6. Theoretical Underpinning
03.6.5. Urban quality
03.6.5.3. Urban Livability In the Context of Bangkok

Alderton et al. (2019)

Livability can be differently interpreted and assessed in various contexts. The existing livability frameworks in the developed countries could not cover all of the livability considerations for the developing cities in low- and middle-income countries (LMIC).

This research aims to conceptualize and prioritize urban liveability elements within Bangkok while identifying alignment to or divergence from other existing livability tools. Also, it identifies potential indicators and data sources to be used within a pilot livability framework in Bangkok. It offers a structure to measure and evaluate livability in Bangkok that can be instantly implemented by the Bangkok Metropolitan Administration (Figure 3.17).

To conclude, this study envisages urban livability for Bangkok; also, the output can be used in the adjustment to other cities with similar conditions. The indicators derived from this research can be used as guidelines in the integrated model for macro-scale and micro-scale design. Moreover, they can be used to evaluate the outcomes to ensure that the project enables urban livability.

Indicator	Most useful measure	Data custodian
Indicators for immediate action		
Crime	Criminal cases per 100,000 persons	Central Information Technology Royal Thai Police Data National Statistical Office
Tree coverage	Number of green areas	Department of Environment (Bangkok Metropolitan Administration)
Air quality	Nitrogen dioxide in the air (ppm) Dust/suspended particles in the air - micrograms/m^3	Department of Environment (Bangkok Metropolitan Administration)
Water quality	Number of canal water quality testing points showing dissolved oxygen centent of ≥ 2.0 mL/L	Department of Drainage and Sewerage (Bangkok Metropolitan Administration)
Flooding	Number of floods per year	Department of Drainage and Sewerage (Bangkok Metropolitan Administration)
Access to temples	Number of temples per district area	District Office (Bangkok Metropolitan Administration)
Access to schools	Number of schools per 1000 residents (N.B: both primary and secondary schools)	District Office (Bangkok Metropolitan Administration) Department of Education (Bangkok Metropolitan Administration) Ministry of Education
Waste management	Average volume (kg) per household of non-recycle garbage	Department of Environment (Bangkok Metropolitan Administration) District Office (Bangkok Metropolitan Admistration)
Indicators for medium-term action		
Sense of community	Ratio of community population to district population	District Office (Bangkok Metropolitan Admistration) Department of Social Development (Bangkok Metropolitan Admistration) Strategy and Evaluation Department (Bangkok Metropolitan Admistration)
Job security	Unemployment rate	Ministry of Labour The Revenue Department National Statistical Office
Income	Average monthly household income	The Revenue Department National Statistical Office
Education	Percentage of residents with primary school education	Census
Health	Average life expectancy Number of cases of mental and behavioural disorders	WHO (2016) Health Department (Bangkok Metropolitan Administration)
Local employment	Percentage of residents living and working in the same district	District Office (Bangkok Metropolitan Admistration)
Quality food	Percentage of samples of food that is in accordance with health and hygiene standards	Health Department (Bangkok Metropolitan Admistration)
Traffic congestion	Number of vehicles per kilometre of city roads	Traffic and Transport Department (Bangkok Metropolitan Admistration)Department of Land Transport (BKK)
Sewerage	Percentage of population with sewerage at their dwelling	Department of Drainage and sewerage (Bangkok Metropolitan Admistration) District Office (Bangkok Metropolitan Admistration)
Indicators for long-term action		
Areas for passive recreation and physical activity	Percentage of residents living ≤ 400 m of public open space Percentage of residents living ≤ 400 m of a large park (> 1.5 ha) Percentage of residents living ≤ 400 m of local park	District Office (Bangkok Metropolitan Admistration) Department of Environment (Bangkok Metropolitan Admistration)
Public transport	Percentage of residents living ≤ 400 m of local bus stop Percentage of residents living ≤ 800 m of train station	Traffic and Transport Department (Bangkok Metropolitan Admistration) District Office (Bangkok Metropolitan Admistration)
Housing affordability	Percentage of land being used for informal housing	National Housing Authority Department of Lands District Office (Bangkok Metropolitan Admistration)
Work/Life balance	Number of hours of working per day and per week Number of hours per week engages in leisure activities	Ministry of Labour Ministry of Social development and Human Security Culture Sport and Tourism Department
Access to community centers	Percentage of residents living ≤ 400 m of community center	District Office (Bangkok Metropolitan Admistration) Department of City Planning (Bangkok Metropolitan Admistration)
Neighborhood amenity	Percentage of residents living near locally-defined 'social infrastructure;	District Office (Bangkok Metropolitan Admistration) Department of City Planning (Bangkok Metropolitan Admistration)
Drinking water quality	Percentage of populatiob with piped water	Health Department (Bangkok Metropolitan Admistration)
Access to liquefied petroleum gas	Liquefied petroleum gas connections per household	Ministry of Energy

Figure 3.17. Priority indicators of liveability for immediate, medium-, and long-term action
Source: Authour, adapted from Alderton et al. (2019)

03.7. Conceptual Framework

The conceptual framework depicts the main aspects of this project, which comprise integrated urban mobility, density configuration, and revitalizing water systems (Figure 3.18). These layers contribute to the livable and socially diverse environments and aligning with them; the pathway from sprawl to the compact city is defined. Moreover, the theoretical framework incorporates this framework to understand which layers of particular theory will contribute.

The integrated urban mobility intertwines with spatial organization theories since it relates to the TOD concept. In this project, the need for a strong relationship between water-based and land-based transport is put forward to enhance Bangkok's mobility. Simultaneously, the supportive theory of future mobility will assist this layer in inserting innovative technology for more efficiency.

The density configuration synergizes with the first layer as the TOD concept is the integration of the mobility networks and the spatial development around stations. Therefore, the spatial organization theory enlightens this layer and guides the way toward the deliverable of densification strategy that will be tested in the micro-scale intervention.

The revitalization of the water systems, falls under the theory of climate change adaptation. It acts as a supportive layer of the two mentioned ones that enhance public space. The practical guidelines will be adapted to revitalize and subsequently resurrect these public realms.

The livable and socially diverse environments layer is the outcome of the previous three layers and is the project's aim. It addresses the desirable values that need to be provided to the residents. Thus the theories related to urban quality will shed light on the process toward this layer's outcomes. Besides, the local community must be considered in the TOD, while seeking the balance between the bottom-up and top-down approach. Ultimately, integrating these layers will contribute to the multi-scalar outcomes and lead to achieving the desired aim.

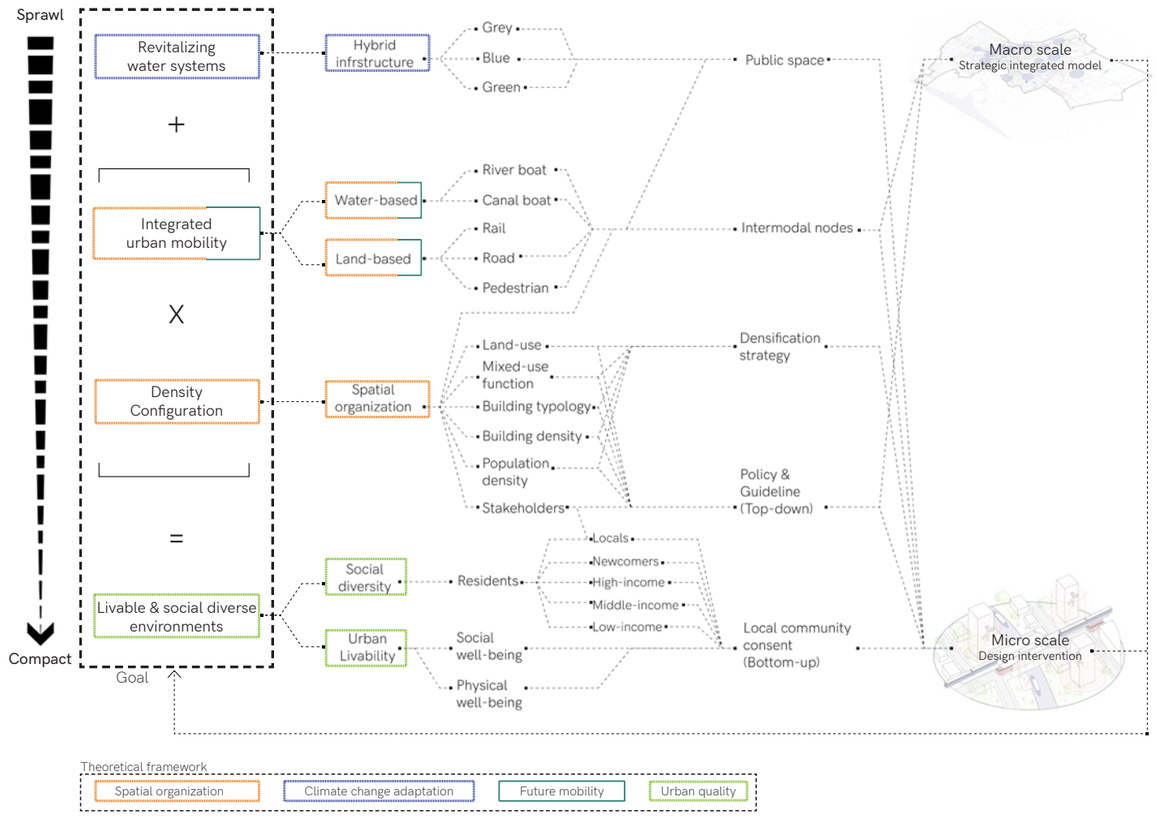


Figure 3.18. Conceptual framework
Source: Author

03.8. Analytical Framework

The methods used in this project are located in the analytical framework in Figure 3.19, concerning the steps to be taken to respond to research questions. Sub research questions are rearranged based on the aspects of the conceptual framework. Sub-research questions 2 and 3 fall under the integration of urban mobility. In contrast, sub-research question 4 relates to the revitalization of water systems. The density configuration layer covers sub-research questions 1 and 5, and finally, sub-question 6 will be answered by the layer of livable and socially diverse environments.

The research is divided into three phases: finding potentialities, strategic planning, and design intervention. The first two phases will be conducted at the macro scale. The finding potentialities stage covers the metropolitan scale analysis to search for the potential waterways and interchange stations. Following with the strategic planning phase in which the pilot locations and potential canals will be integrated into the strategic integrated model, along with the proposal of the adjustment of land-use plan, guidelines, and incentives for TOD, which will be tested in two local-scale locations. The design will be evaluated consistently to acquire the best output, which will be reflected, and ensure that the research questions are answered, leading to the research's conclusion.

How can Transit-Oriented Development transform the area surrounding emerging intermodal nodes in Bangkok and integrate with the water-based transport, in order to achieve the more compact city, where livable and socially diverse environments, are provided?

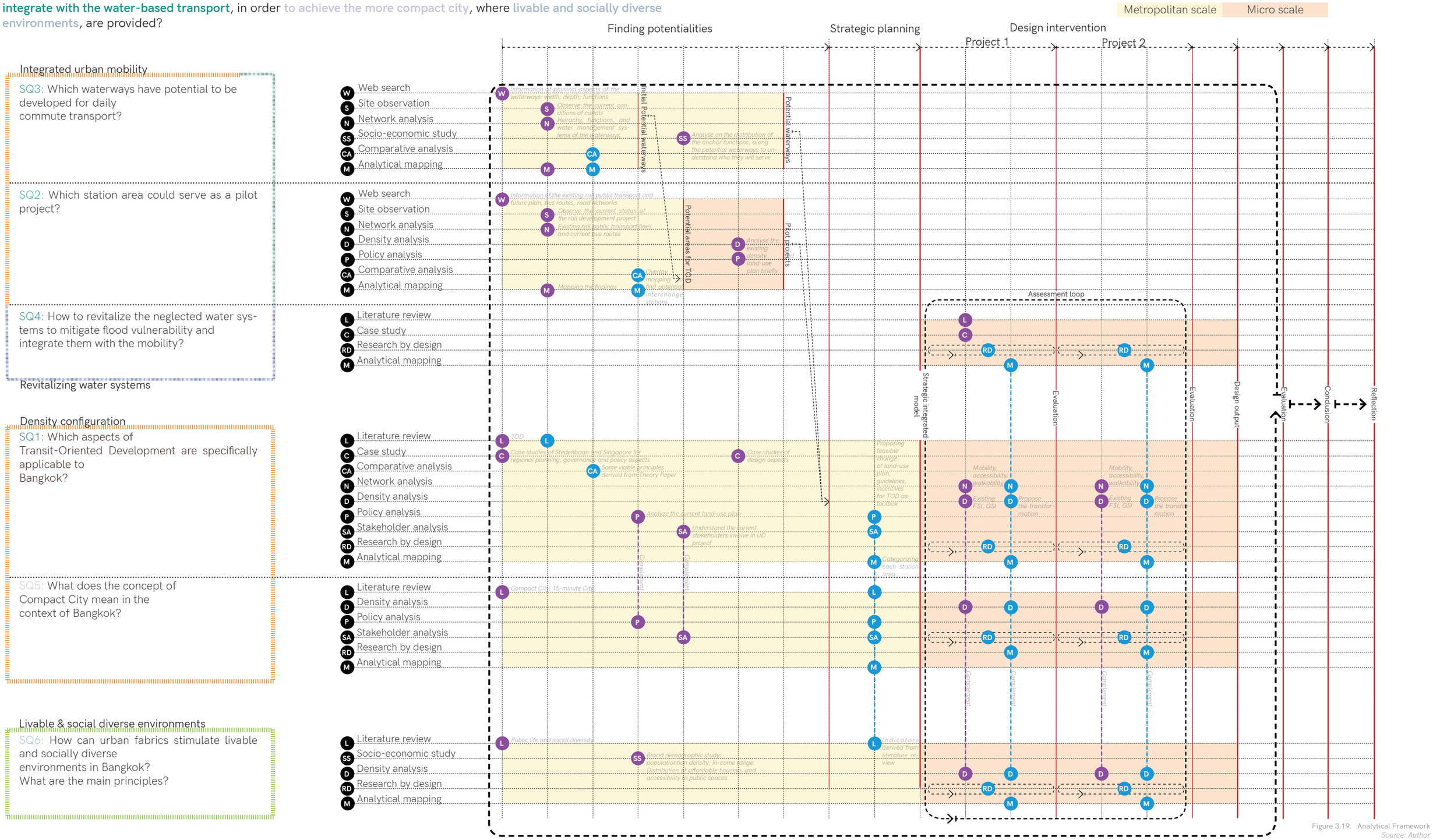


Figure 3.19. Analytical Framework
Source: Author

03.9. Project Timeline

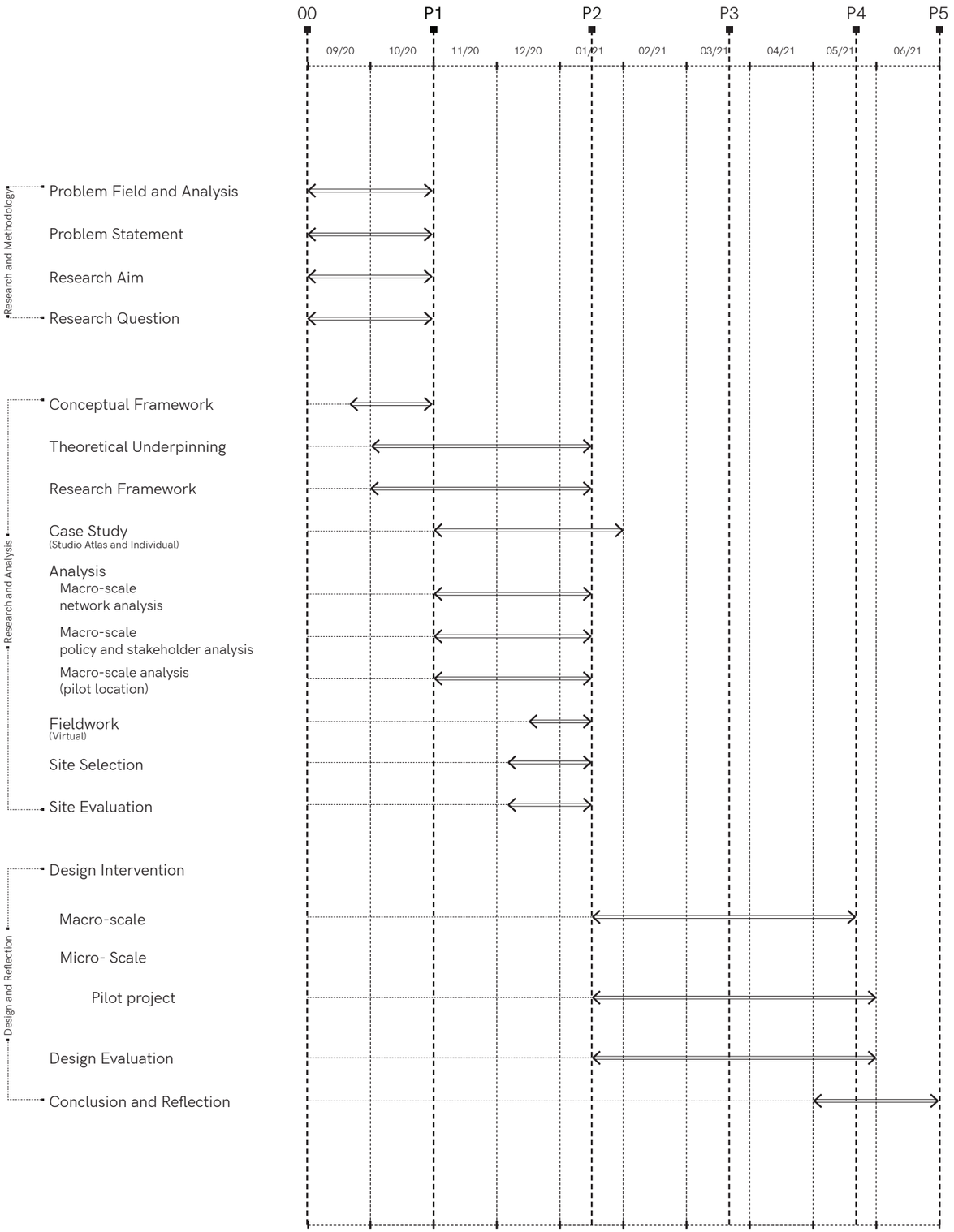
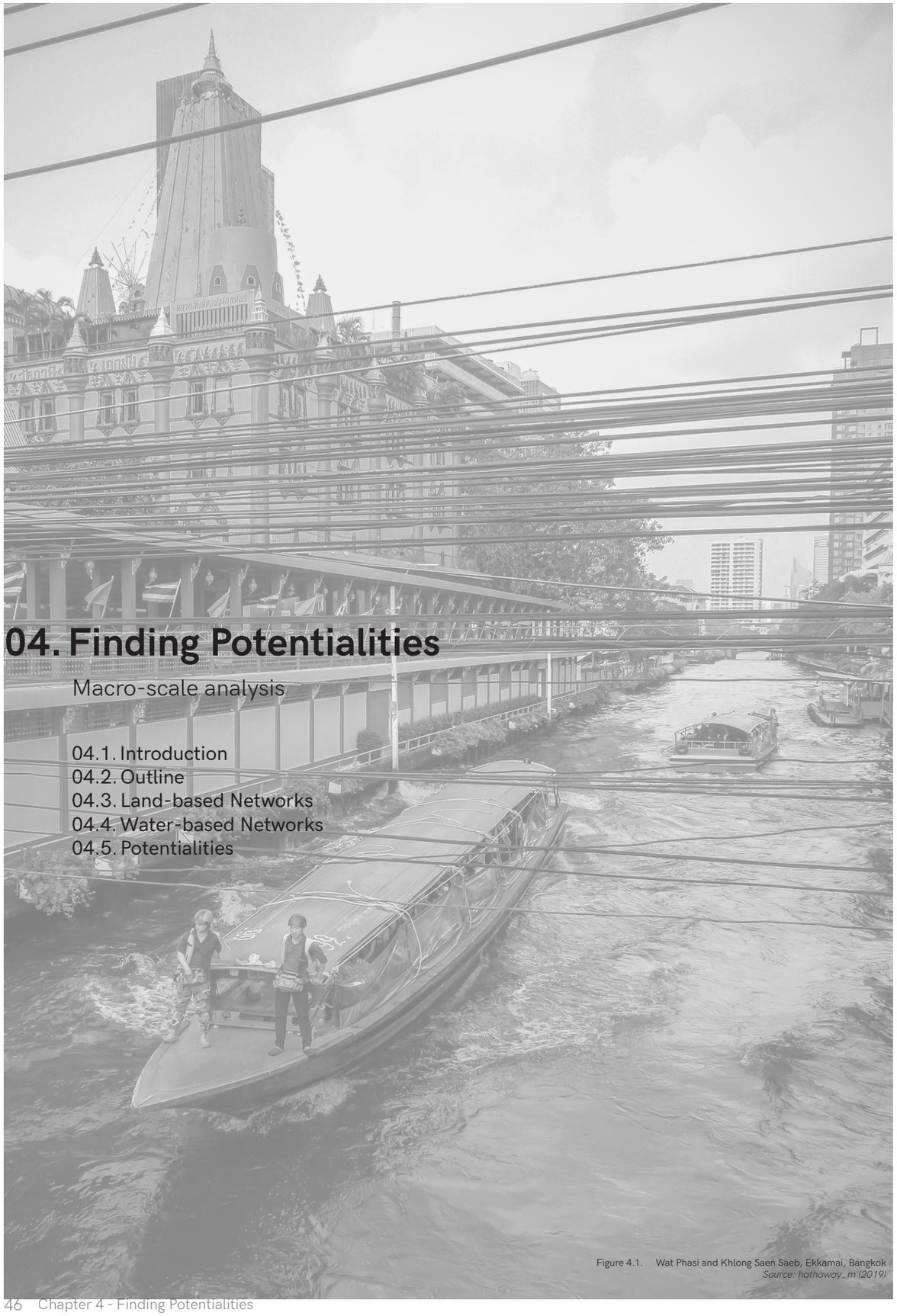


Figure 3.20. Project Timeline
Source: Author

03.10. Conclusion

The methodology chapter has described the approaches of the research. The purpose of this chapter is to structure how the research is approached and identify the appropriate methods for data acquisition, analysis, and design to achieve the desired research output.

At the beginning of the chapter, research framework demonstrates the roadmap originating from the motivation to the outcomes and conclusions. While research question is recapped together with the alignment of methods, outcomes and aims. Following with the methodology framework which elaborates the suitable methods by classifying them as descriptive and analytical. Then the relevant theories are introduced and categorized based on their different themes and roles toward the project which later are underpinned to find possible guidelines that can be adapted in the research. These categories range from the theory used as a framework for the analysis, spatial organization, urban quality, climate change adaptation, and future mobility. The conceptual framework integrates the theoretical framework with the main layers of the project which contribute to the last layer of livable and social diverse environments. As discussed in the methodology framework part, the analytical framework elaborates the use of the methods by positioning them concerning the steps to conduct the research and answer the questions. This analytical framework can serve as a conclusion of this chapter that helps guiding the way to approach the research and pave the way for the next steps.



04. Finding Potentialities

Macro-scale analysis

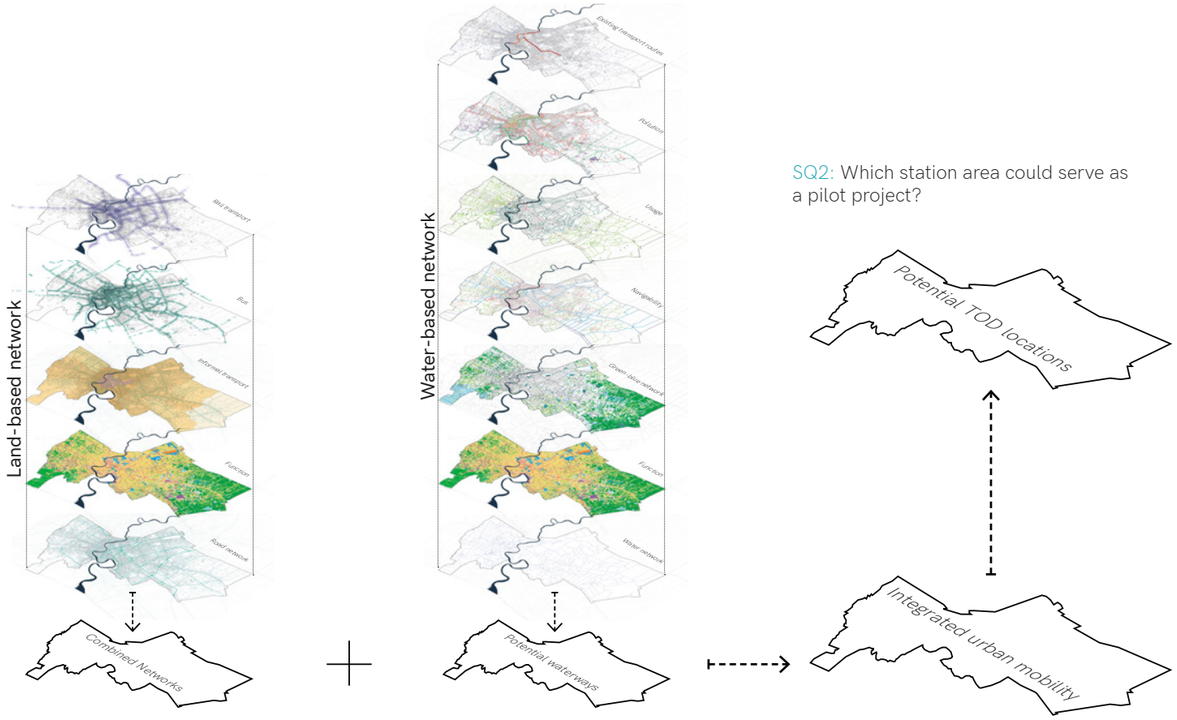
Figure 4.1. Wat Phasi and Khlong Saen Saeb, Ekkamai, Bangkok
Source: hathaway_m (2019)

04.1. Introduction

This chapter covers the metropolitan-scale analysis of Bangkok. The study is divided into two parts: land-based network; and water-based network to search for the potential waterways that can be utilized for public transport. Combining these networks leaves out the "shadow" area, which a water-based network can help reduce. Therefore, its existing spatial conditions are analyzed to find potential routes, which concludes with eight primary waterways integrated into the entire transit network—following with the selection of two potential locations and pilot project for the TOD design.

04.2. Outline

Roadmap



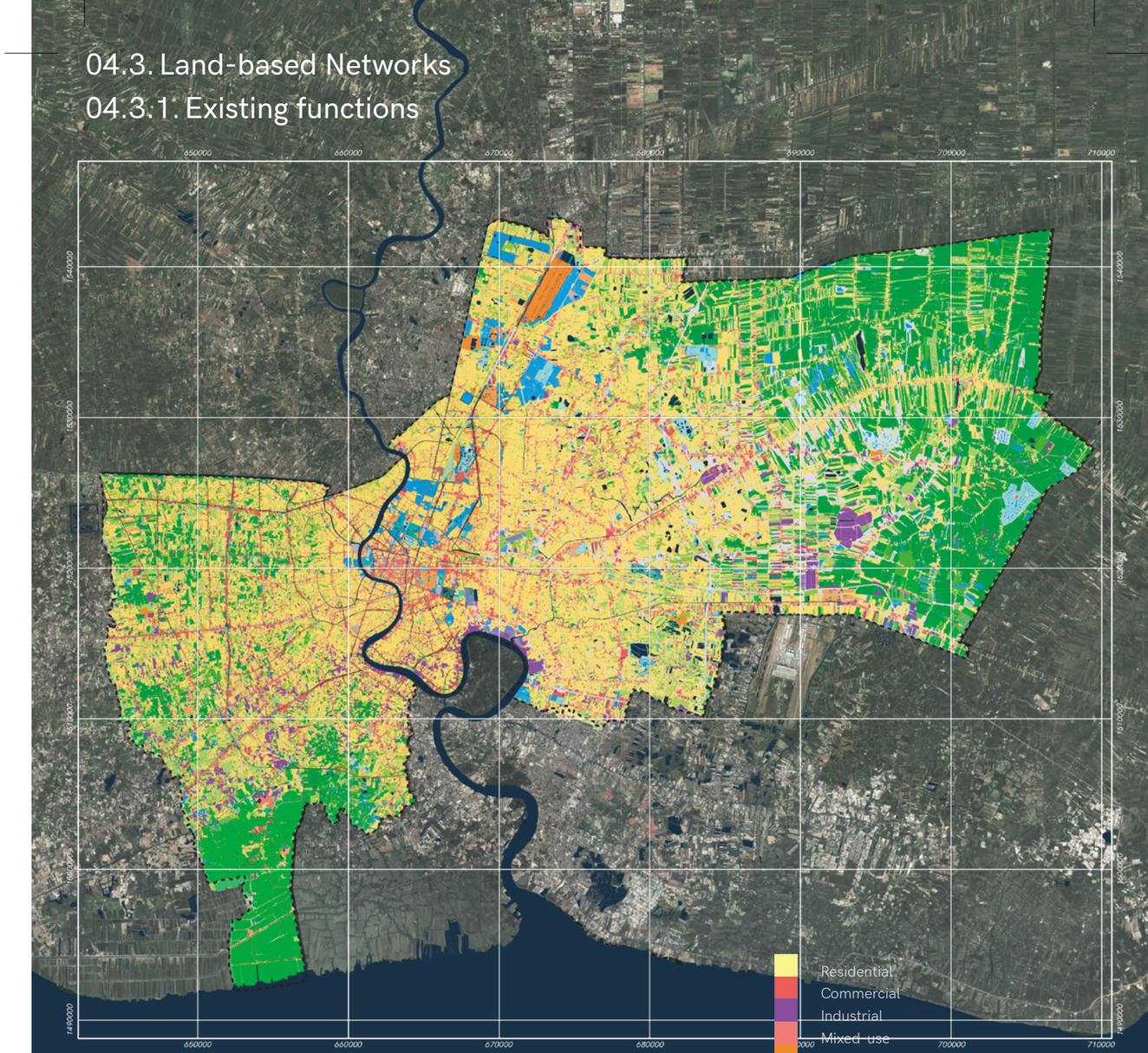
SQ3: Which waterways have potential to be developed for daily commute transport?

The approach of the metropolitan-scale analysis is divided into land-based network and water-based network. The study aims to answer sub-research question 3 with the potential waterways that could serve Bangkokians as a waterborne transport route. When superimposing these two networks, the concentration of routes at nodes is apparent highlighting the potentialities to be developed as a TOD locations. Therefore, the sub-research question 2 will be responded with the proposal of pilot location (Figure 4.2).

Figure 4.2. Road map of macro-scale analysis
Source: Author

04.3. Land-based Networks

04.3.1. Existing functions

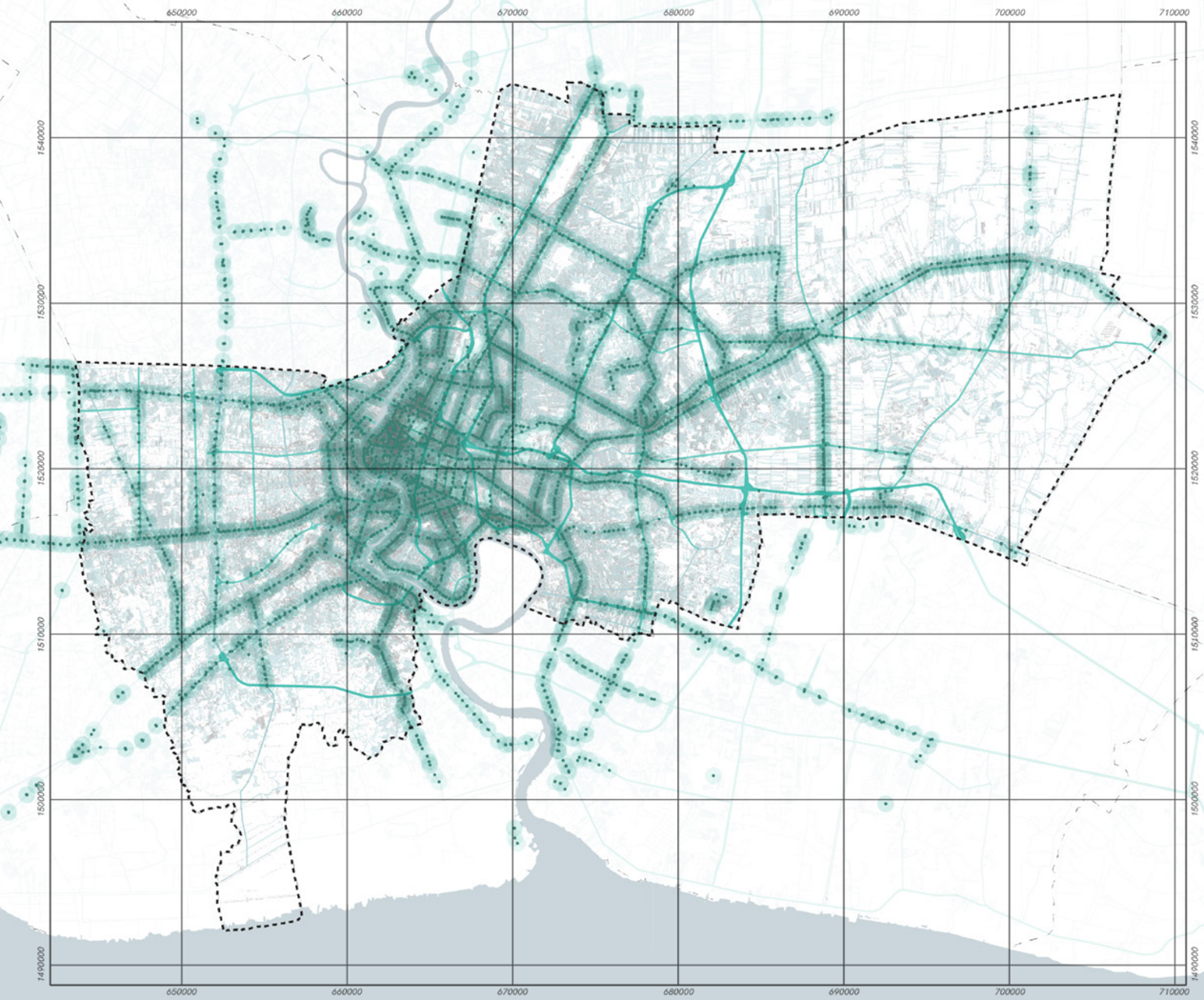


The urbanization of Bangkok has been initiated from the Chao Phraya River, dispersed in every direction (Figure 4.3).

On the Eastern bank, the city is more developed with many commercial centers, business districts, and attractions. Along the main roads, commercial and mixed-use functions are located as the types of shophouse, and office building. The large patches between these arteries are filled with residential areas where superblocks are created. In the east, the residential area stretches along the major roads, while the agricultural fields remain in between them. According to the former agrarian landscapes, the urban fabric patterns shift from delicate and complicated in the West to larger grain, with a long rectangular shape.

On the other hand, the Western bank is less flourish than the Eastern side. The mixture of residential and agricultural areas can be still be found.

Figure 4.3. Urbanization and overall functions of Bangkok
Source: Author, derived information from The Department of City Planning (n.d.), Google (n.d.)



The primary public transport that runs on the road network is a bus, which is the most affordable mode that serves low- to medium-income population. Figure 4.4 shows the locations of the bus stop, which take place along the primary and secondary roads. In the city center, where urban fabrics are delicate, bus stops are situated close to each other, making the surrounding area more accessible. Whereas in the outskirts, blocks bound by primary roads are broad, wider gaps and inaccessible areas can be seen.

Figure 4.4. Road network and bus stops in Bangkok
Source: Author, derived information from OpenStreetMap (n.d.), BMA GIS Center (2020)

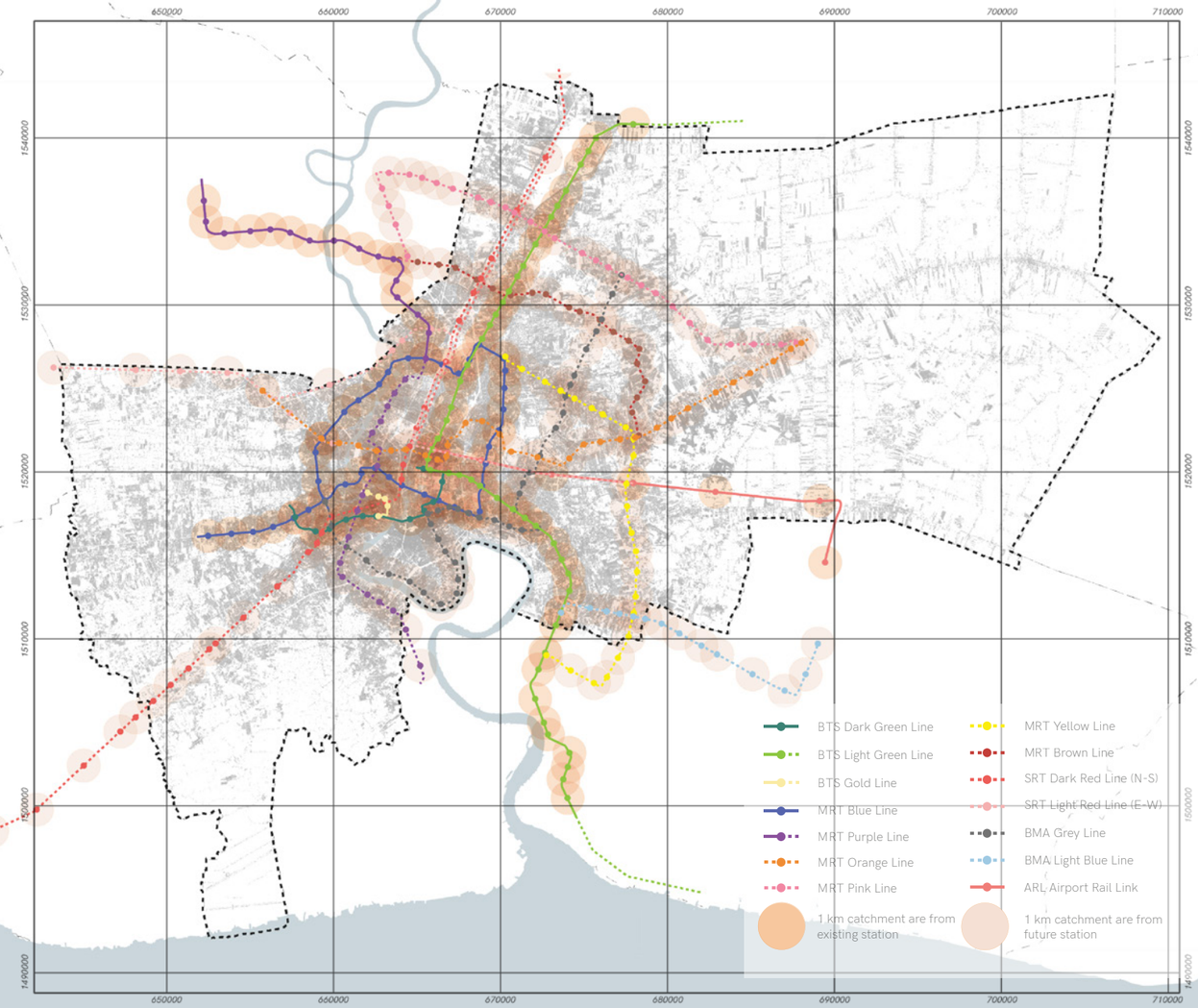


Figure 4.6 demonstrates the existing and planned project of rail transport in Bangkok. These lines are constructed along the existing primary and secondary roads to avoid the private lands' expropriation and reduce the project cost.

To understand which routes most people choose to take is by investigating the ridership numbers. Figure 4.5 shows the daily average ridership of the existing rail transit lines. The most taken lines are the BTS Dark and Light Green lines that connect three provinces: Bangkok; Samutprakarn; and Pathumthani. However, the current sky train and metro lines might not serve the suburb dwellers due to the in-continuity of the networks operated by many stakeholders. As shown in Figure 4.6, there are several main operators of the existing lines. This condition contributes to the higher fare commuters need to pay when traveling across the lines.

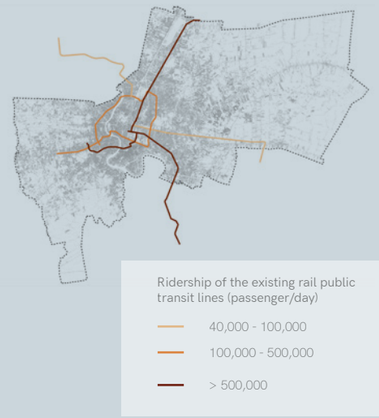
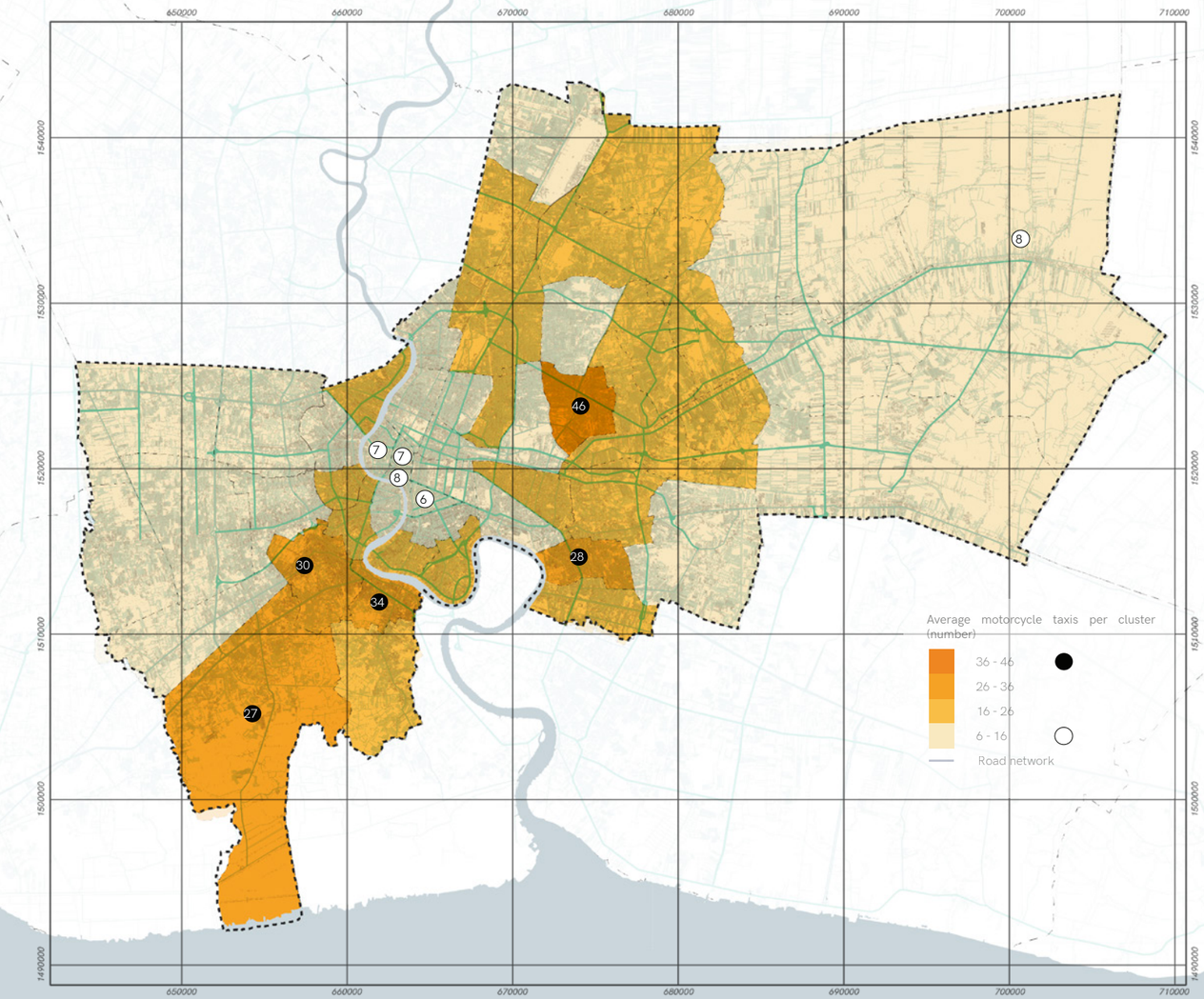


Figure 4.6. Rail public transport in Bangkok
Source: Author, derived information from OpenStreetMap (n.d.), BMA GIS Center (2020), Site observation

Figure 4.5. Ridership of the existing rail public transit lines
Source: Author, derived information from



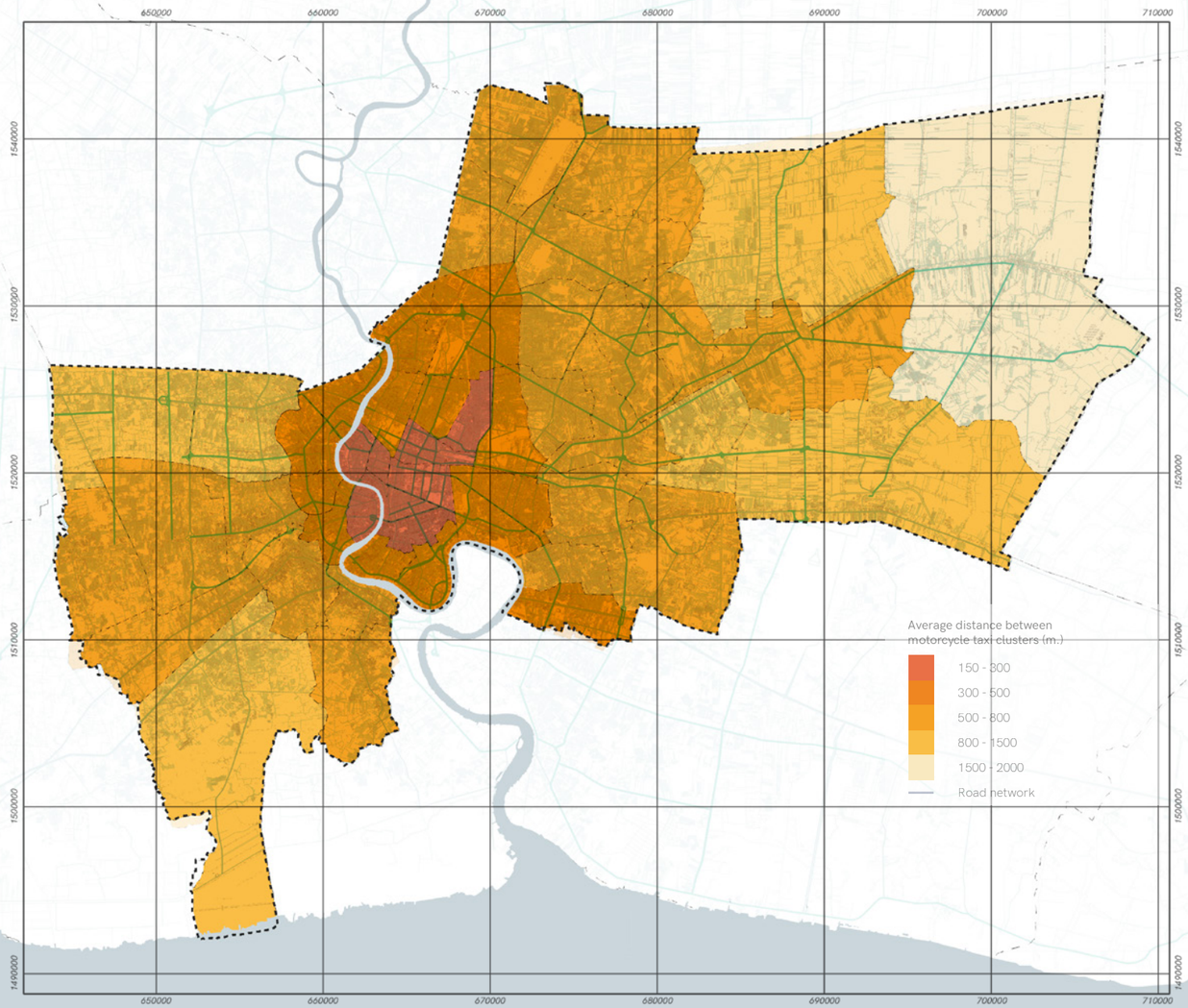
Informal transport plays a crucial role in solving the problem of first and last-mile connectivity in Bangkok. Since the urban fabric mainly consists of dead-end side roads *(sois)*. Bangkok's essential informal transport is a motorcycle taxi *(win)*, a rider in an orange vest who can zigzag through the packed streets (Figure 4.8). The group of *wins* is mostly situated at the metro exits and the beginning of deep *sois* thus people can hail *win* to reach their workplace in the deep *soi* (Figure 4.10).

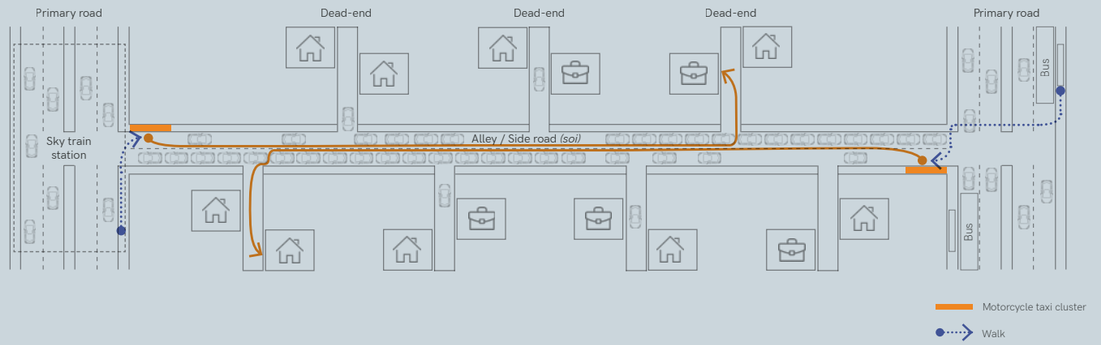
These *win* clusters have their catchment area. In the city center, clusters are situated closer to each other than in outskirt ones because of the finer grain of street network where *sois* are complicated (Figure 4.9). Also, the more anchors in urban areas, such as office buildings, universities, and malls, are the reasons for the higher concentration of clusters. Whereas in the suburban residential areas, they are located more than 800 meters away from each other, which are further than the walking distance.

Another factor that helps to enhance the efficiency of *win* cluster is its number of riders. Figure 4.7. shows that the urban clusters mostly consist of less than 16 wins, making sense for the shorter distance between clusters. In contrast, in the areas in between urban and suburb, for example, the area with the distance between clusters around 500 to 800 meters, the rider numbers are higher than in the city center and can compensate the larger catchment. However, in the outskirts, where especially the farthest eastern district could be least inaccessible by *wins* as the more extensive catchment and the lesser rider numbers.

Top Figure 4.7. Average motorcycle taxis per cluster in Bangkok
Source: Author, inspired by The Urbanis (2019), derived information from OpenStreetMap (n.d.), Department of Land Transport (2019)

Figure 4.8. Motorcycle taxi cluster
Source: Thairath (2018)

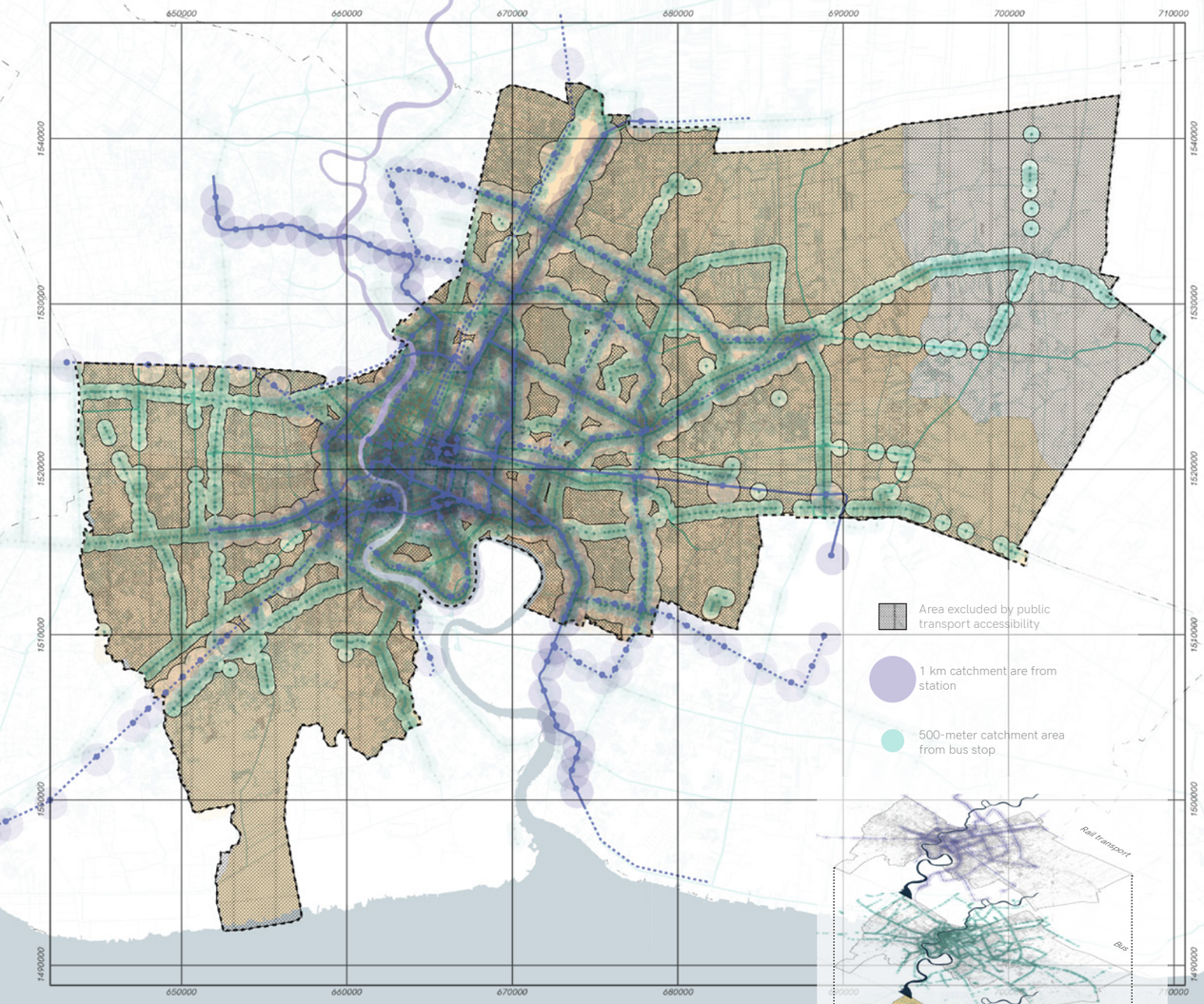


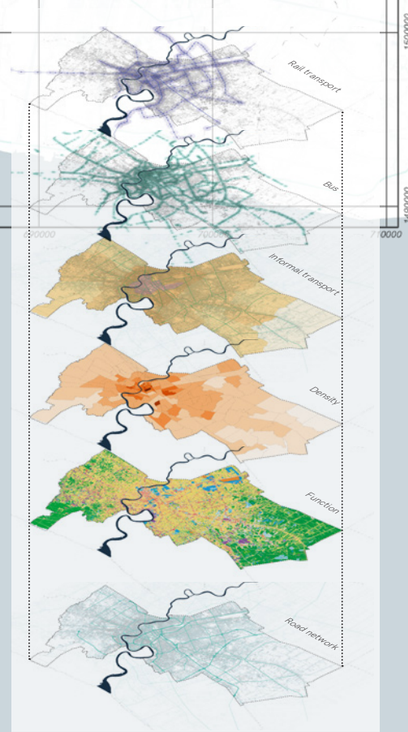


Top Figure 4.9. Average distance between motorcycle taxi clusters in Bangkok
Source: Author, inspired by The Urbanis (2019), derived information from OpenStreetMap (n.d.), Department of Land Transport (2019)

Figure 4.10. First and last mile connectivity by win
Source: Author

04.3. Land-based Networks
04.3.5. Shadows





When superimposition all the layers of land-based networks (Figure 4.12), the overlap of bus routes and rail public transport lines can be seen. Simultaneously, the informal transport helps enhance the accessibility of in the areas where formal transport modes cannot reach.

However, suppose only formal land-based transport means are taken into account as they are safer and more predictable than the informal ones. In that case, they leave the inaccessible spaces in-between or "shadow" (Pinto & Remesar, 2012).

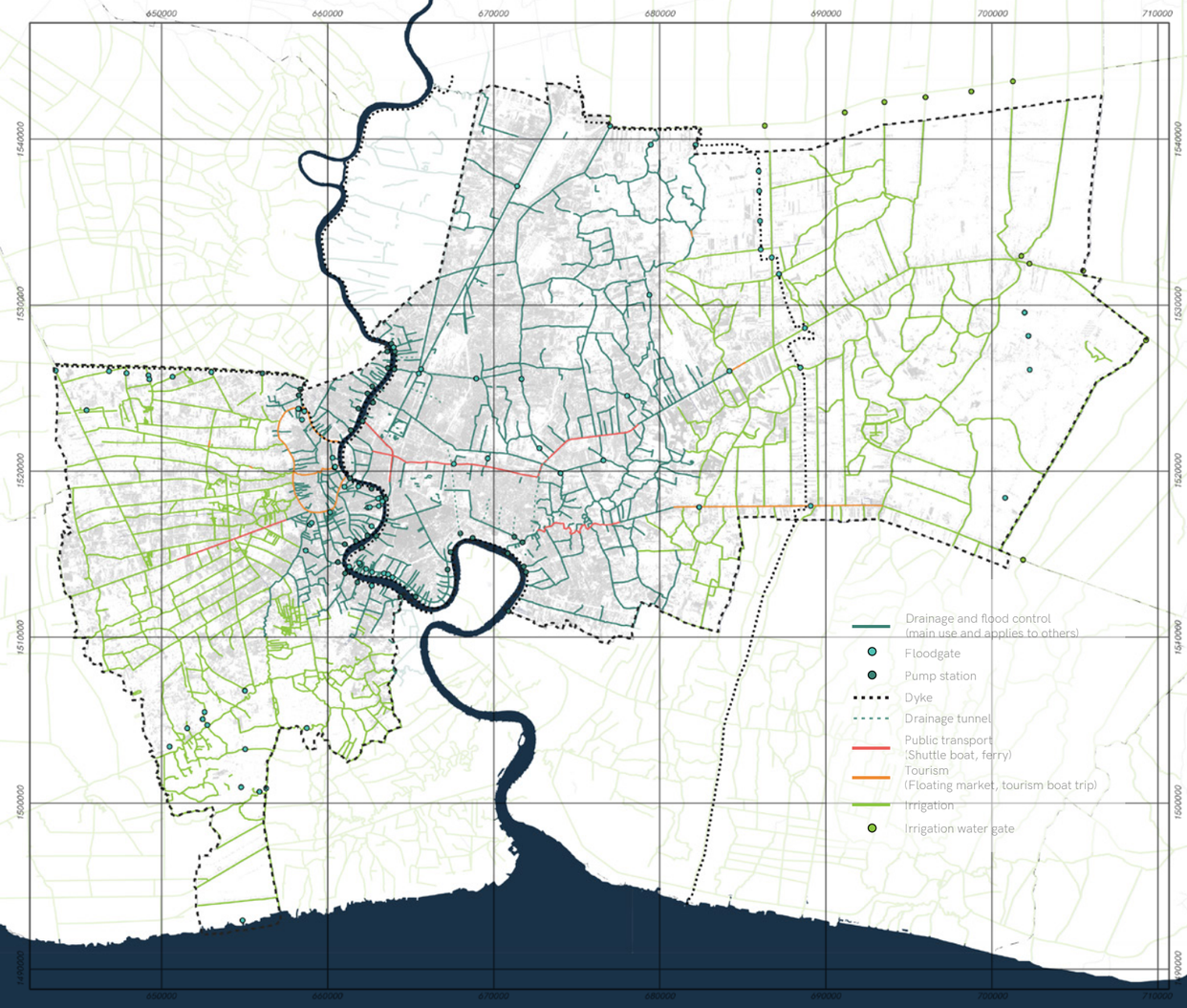
Figure 4.11 highlights these areas, which are predominantly in the suburbs where people reside, showing that even if all rail transport lines are completed, many areas will still be excluded. Bangkok already possesses invaluable assets: water networks that can enhance urban mobility and reduce these shadows' size.

In the next part, a water-based network is analyzed to find potential waterways that can serve as a means of transportation.

Figure 4.11. Combined land-based networks and shadows
Source: Author

Figure 4.12. Superimposition of land-based networks
Source: Author

04.4. Water-based Networks
04.4.1. Existing use



The purposes of waterways are investigated by categorizing them into four primary objectives (Figure 4.13). The first function is drainage and flood control. Canals play a crucial role in coping with an urban flash flood. This purpose applies to all the canals in Bangkok since they all connect to the larger waterways: major canals; and Chao Phraya River. Moreover, various grey infrastructures support Bangkok's water management system: floodgate; and pump station controls the water level in the canals; king dyke on the East and Chao Phraya River dyke help defend the inner city from the water flows from the North and high seawater level. Moreover, what helps enhance water drainage performance is the tunnel, leading an excessive amount of water to the Chao Phraya River.

In the Eastern and Western outskirts, where lands are still used for agriculture, the objective is for irrigation (Figure 4.15). Besides, few canals are utilized for tourism, for example, a floating market and a boat trip along the historic canals (Figure 4.14). However, water transport has been seen as less prominent, with only five canals used for this purpose.

Figure 4.15. Canal for irrigation
Source: Google (n.d.)

Figure 4.14. Canal for tourism (floating market)
Source: Wongnai (n.d.)

Figure 4.13. Existing use of waterways in Bangkok
Source: Author, derived information from BMA GIS Center (2020), The Department of City Planning (n.d.), and Site observation

04.4. Water-based Networks

04.4.2. Water pollution

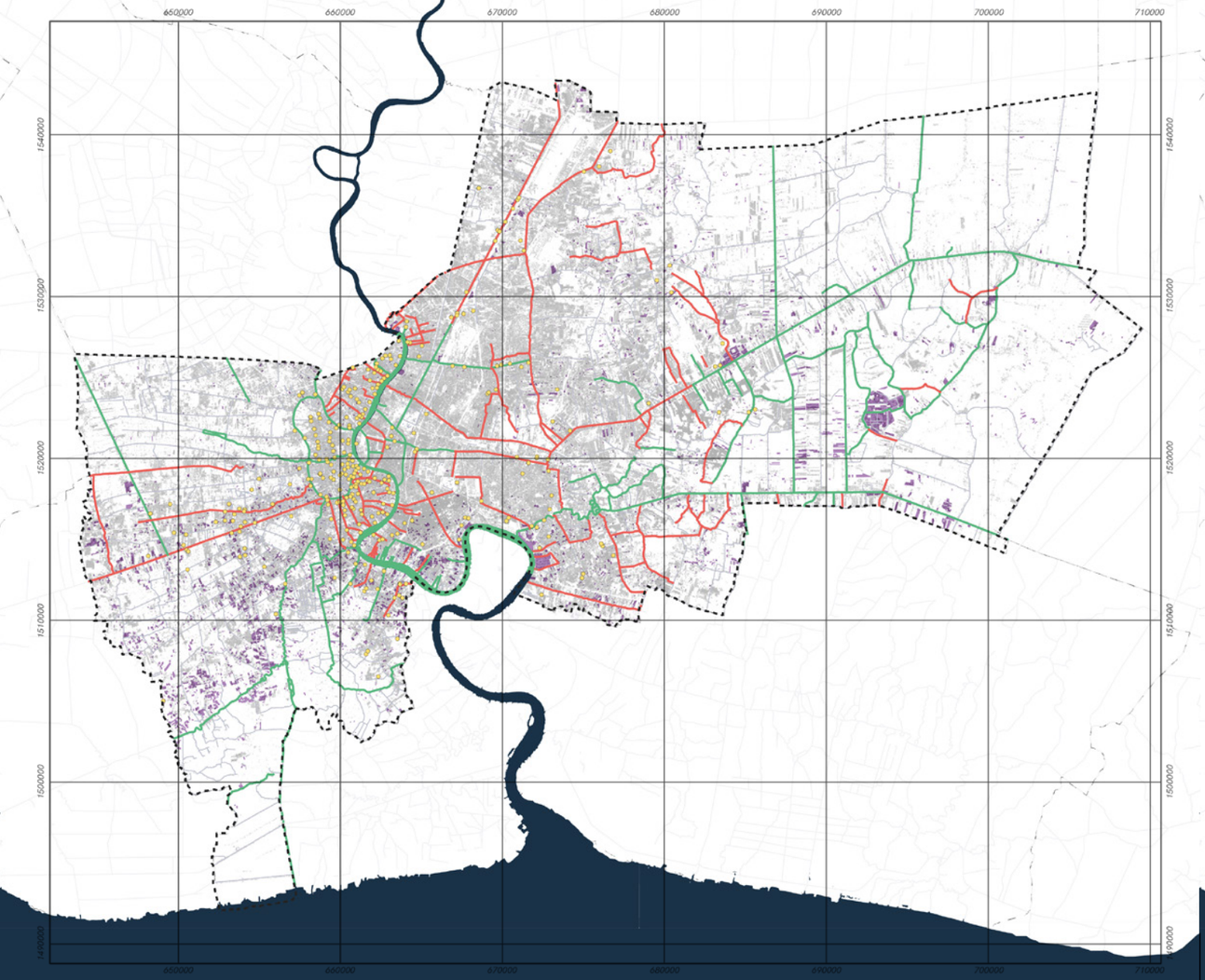


Figure 4.16. Combination of BOD and DO of canals in Bangkok
Source: Author, derived information from Department of Drainage and Sewerage (2019) , Pollution Control Department (n.d.)

The Pollution Control Department of Thailand has its categorization of water bodies, divided by purposes. Water bodies that can be used for industrial purpose and consumable, but needs disinfection and going through the water treatment process fall under categorize 4. This type requires lesser than 4 mg/l of BOD and greater than 2 mg/l of DO (Pollution Control Department, n.d.).

Figure 4.16 concludes the current situation of contamination of waterways in Bangkok with a combination of BOD and DO (appendix 10.3.2. on page 196). Indicated by the mentioned criteria, it can be seen that all canals do not meet the criteria and are considered polluted. Although they are acceptable for transport, it is urgent to clean and resurrect them to be public spaces where everyone is willing to spend leisure time.

04.4.3. Existing water transport

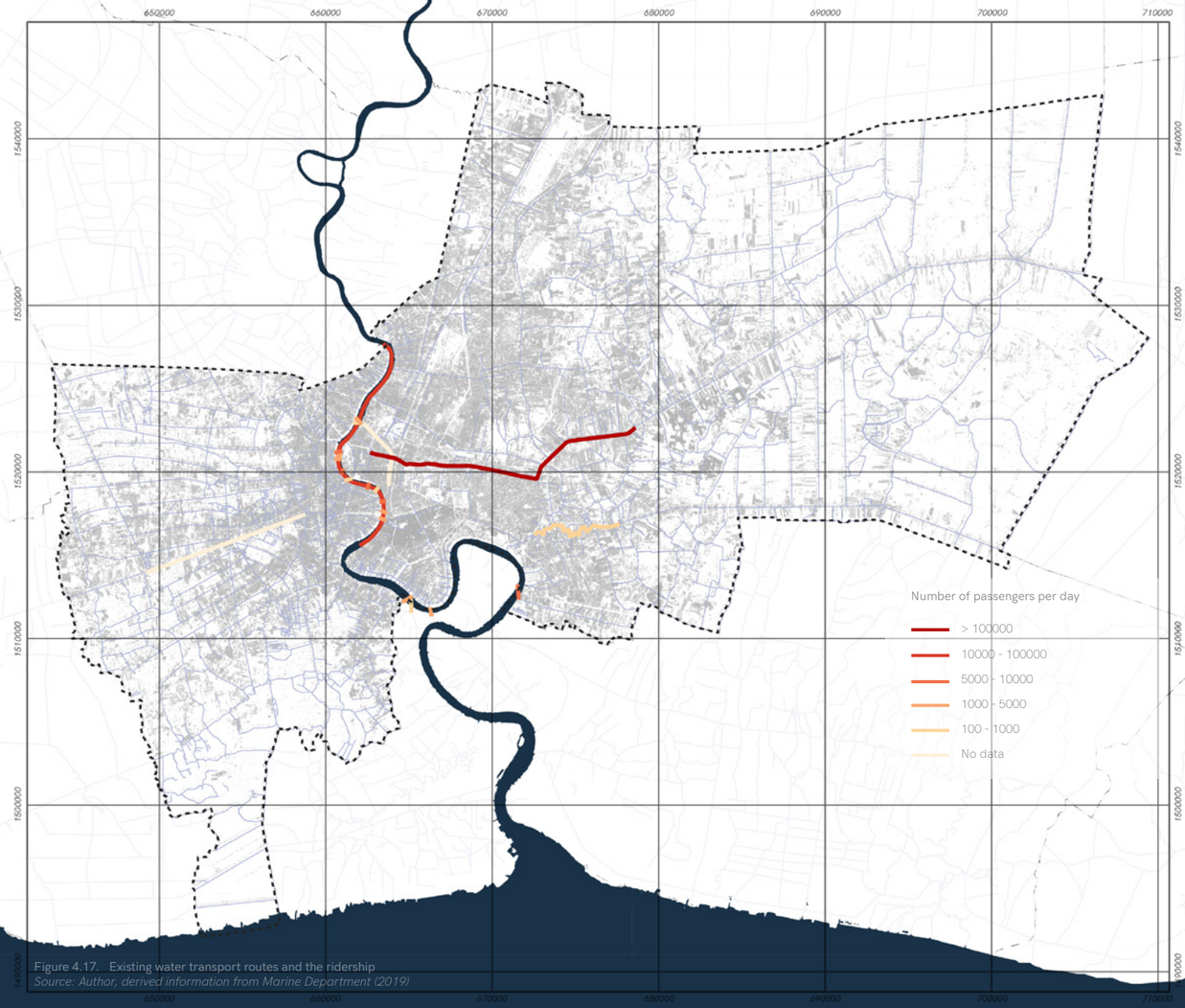


Figure 4.17. Existing water transport routes and the ridership
Source: Author, derived information from Marine Department (2019)

Five waterways are currently used for public transport. The first and significant route is the Chao Phraya River, in which Chao Phraya Express Boat operates, connecting Nonthaburi (the North-eastern satellite province) and Bangkok (Figure 4.19). Also, many ferries are crossing to and fro both sides of the river. The second waterway is Saen Saeb, which has an average daily ridership of around 105k passengers per day, higher than that of Chao Phraya River (Figure 4.17, Figure 4.18). The service is operated linking commuters directly from Bangkok's Eastern side to the city center and vice versa. The third route is Phasri Charoen Canal, the only canal boat route on Bangkok's Western side. The fourth line is Pra Khanong Canal, which runs to the Eastern residential area. The last canal is Phadung Krung Kasem Canal, which stretches in the historic area of the city (Figure 4.20).

Figure 4.18. Saen Saeb Canal Boat
Source: Thaihealth (2018)

Figure 4.19. Chao Phraya Express Boat
Source: Siamrath (2018)

Figure 4.20. Phadung Krung Kasem Canal Boat
Source: Weeranan (2018)

04.4. Water-based Networks
04.4.4. Navigability

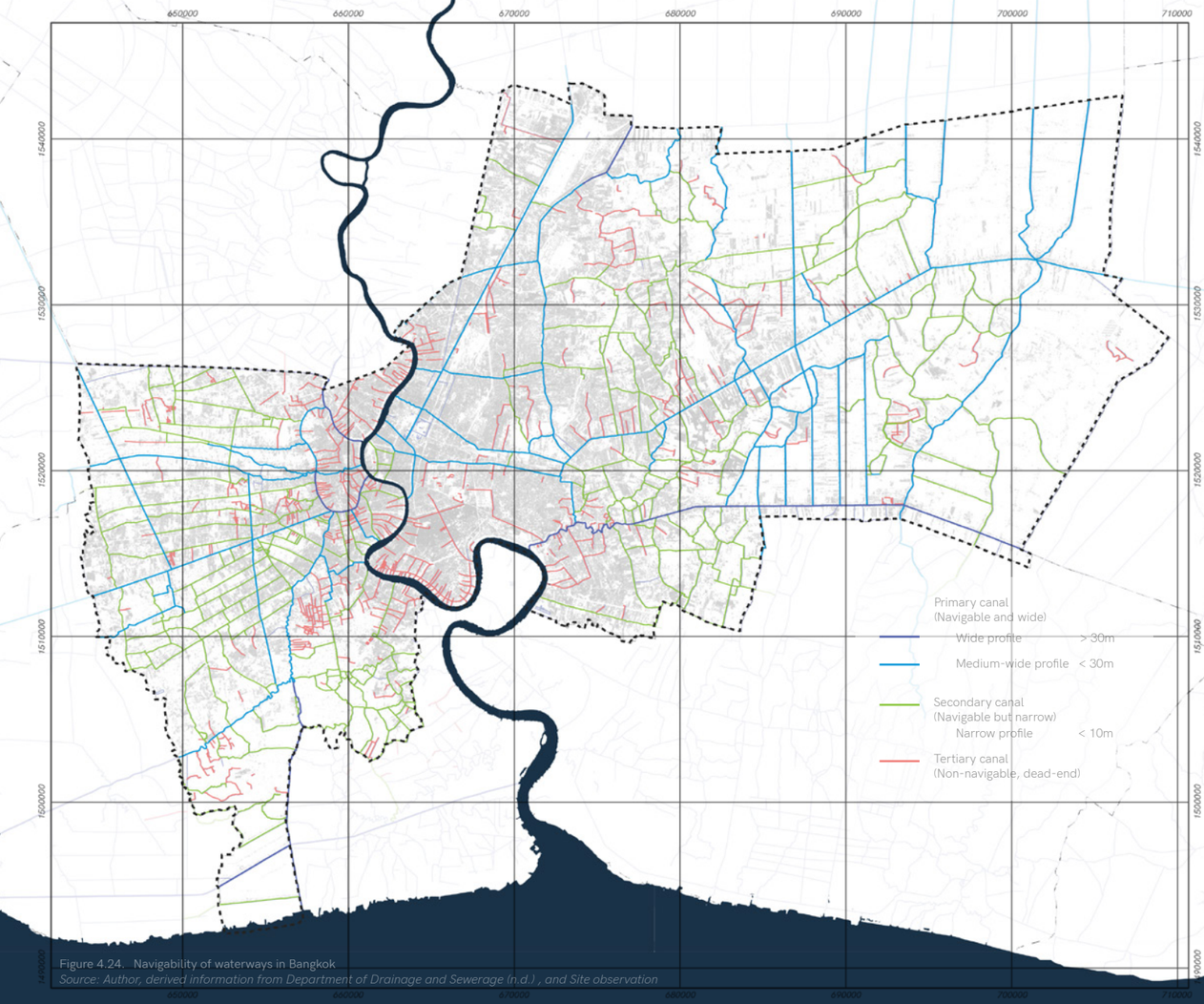


Figure 4.24. Navigability of waterways in Bangkok
Source: Author, derived information from Department of Drainage and Sewerage (n.d.) , and Site observation

Navigability is another crucial factor that needs to be taken into account to find the potential waterways capable of public transport. Canals are classified as primary canals, secondary canals, and tertiary canals, based on the information from the Department of Drainage and Sewerage (n.d.), the spatial analysis through maps to see if they are dead-end, and spatial observation (Figure 4.24). The primary canals are navigable and wide enough for transportation, all the existing transport routes fall under this category (Figure 4.21). It is divided into two categories: canals with a profile wider than 30 meters; and the canals with a medium-wide profile, narrower than 30 meters.

The secondary canals are able to navigate but narrower than 10 meters (Figure 4.22). They mostly connect with the primary canals and can be used for transport if they are widened. Lastly, the tertiary canal represents the narrow, non-navigable, and dead-end canals that cannot be used for public transport (Figure 4.23).

Figure 4.21. Primary Canal
Source: Tonkit (2019)

Figure 4.22. Secondary Canal
Source: Google (n.d.)

Figure 4.23. Tertiary Canal
Source: Google (n.d.)

04.4.5. Green & blue network

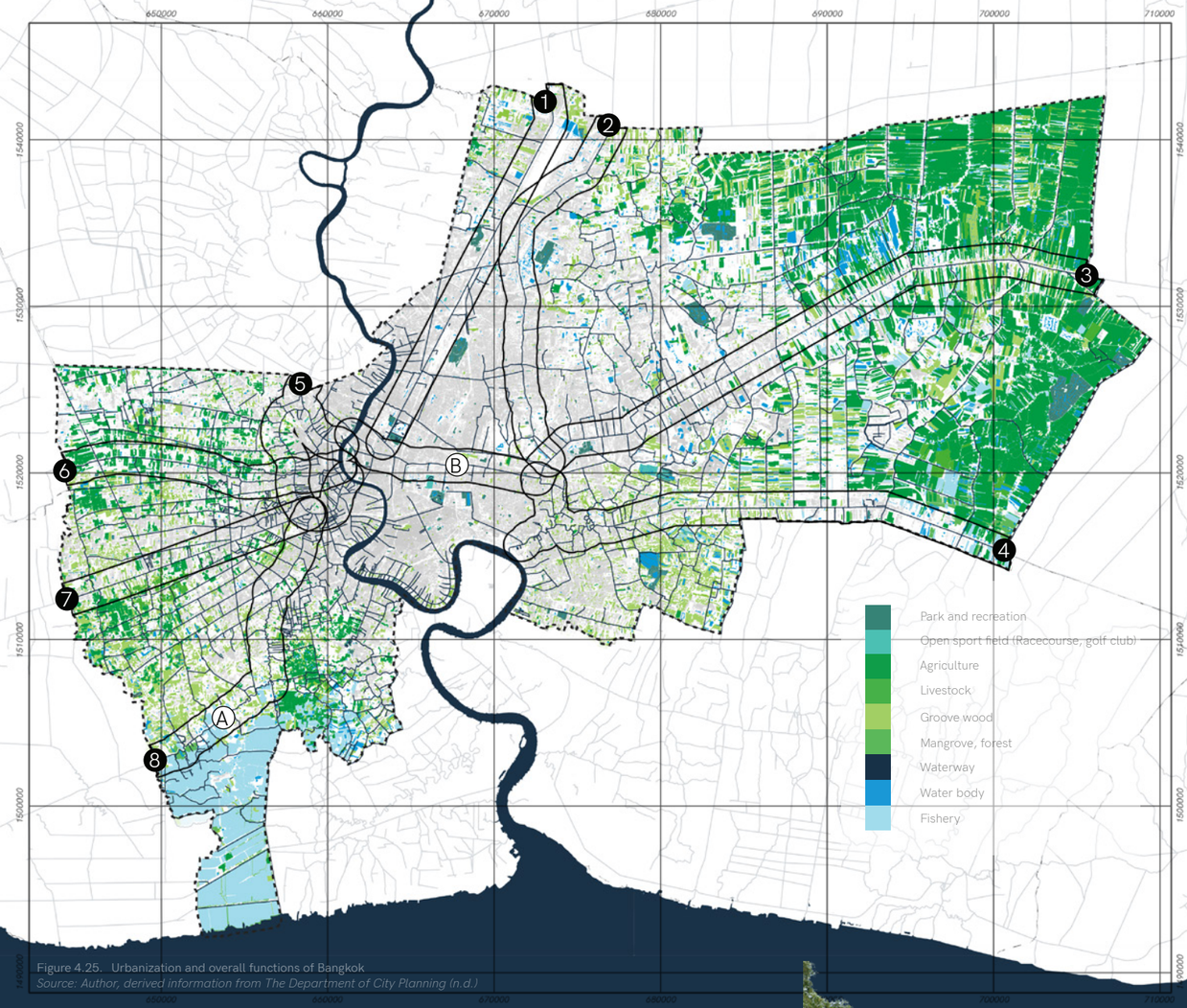


Figure 4.25. Urbanization and overall functions of Bangkok
Source: Author, derived information from The Department of City Planning (n.d.)

The primary canals are chosen to be examined on the green-blue infrastructure to understand their ecological value (Figure 4.25).

The urban parts of every canal do not connect directly with green infrastructure, which only exists as a type of park and recreation. Moreover, the canal edge is concrete to handle the tidal wave from a canal boat and prevent the bank's subsidence (Figure 4.27). Also, considering the water pollution, the ecological value is, therefore, less significant in the inner city.

More to the West, all three canals run through natural landscapes and built areas and connect with the surrounding agricultural lands. The canal edges are soft, distinct from the inner city (Figure 4.26).

Figure 4.26. Sanamchai Canal
Source: Google (n.d.)

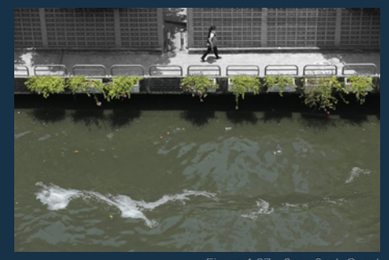


Figure 4.27. Saen Saeb Canal
Source: Ecology Alert and Recovery - Thailand (2016)

04.4. Water-based Networks
04.4.6. Potential waterways

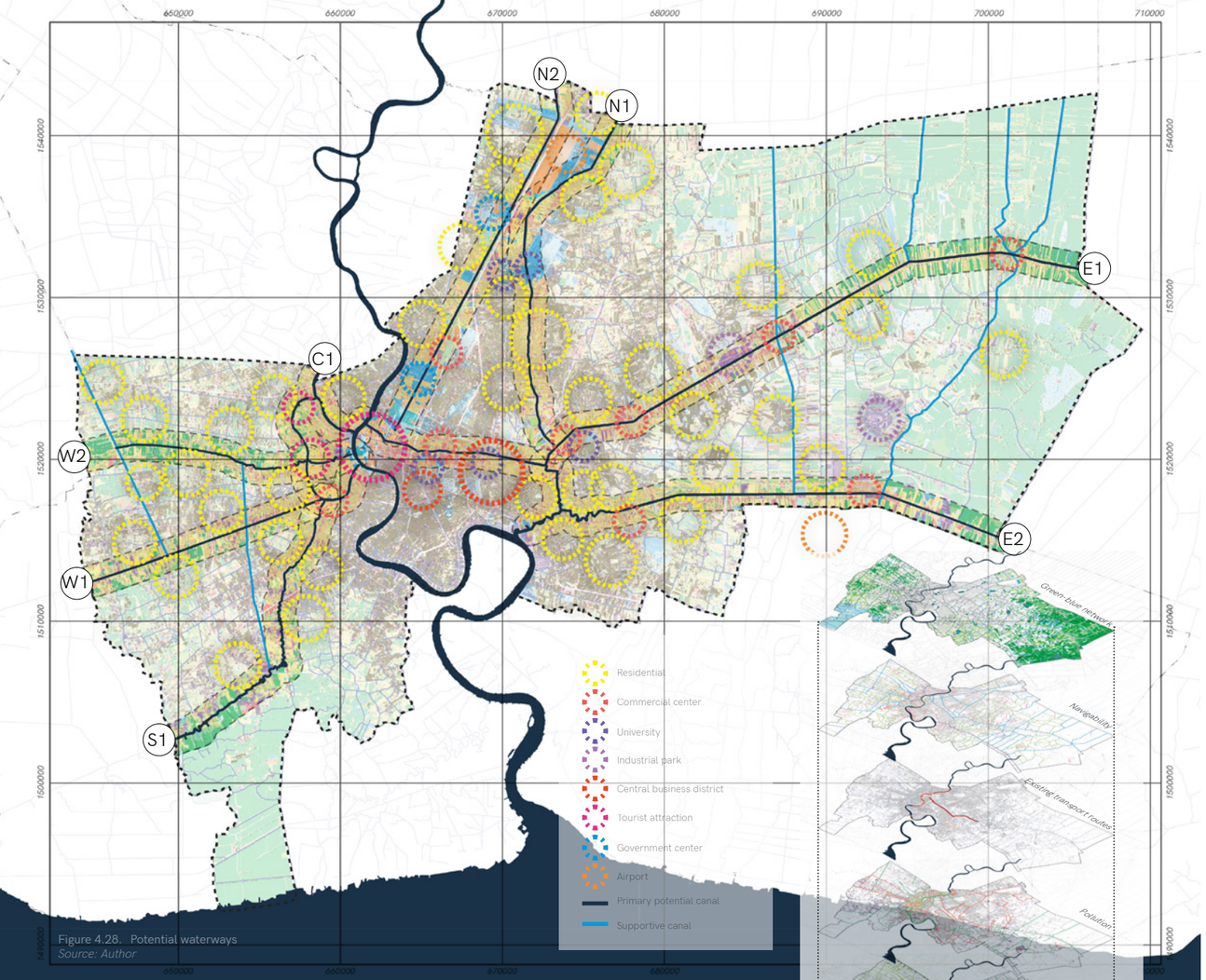


Figure 4.28. Potential waterways
Source: Author

Figure 4.29. Superimposition of water-based networks
Source: Author

To derive potential waterways, all water-based and land-based networks are superimposed (Figure 4.29). Figure 4.28 shows the conclusion of selected potential waterways. All waterways are primary canals that can navigate and be used for transportation, as some are operationalized as commuter routes. They all can be revitalized and resurrected to be cleaner and enhance the livability of the residents along the canals. Moreover, the current indecent urban canal edge that does not connect with the green infrastructure brings about the opportunities to be developed. Regarding the functions, Figure 4.28 demonstrates the attractions attached to the waterways, which create the purposes of commute on these routes. Moreover, the supportive canals will act as a feeder and enhance accessibility in the "shadow" area.

In the next part, all the potential canals will be combined with land-based transport which results in the potential locations for TOD.

04.5. Potentialities
Pilot project and potential locations

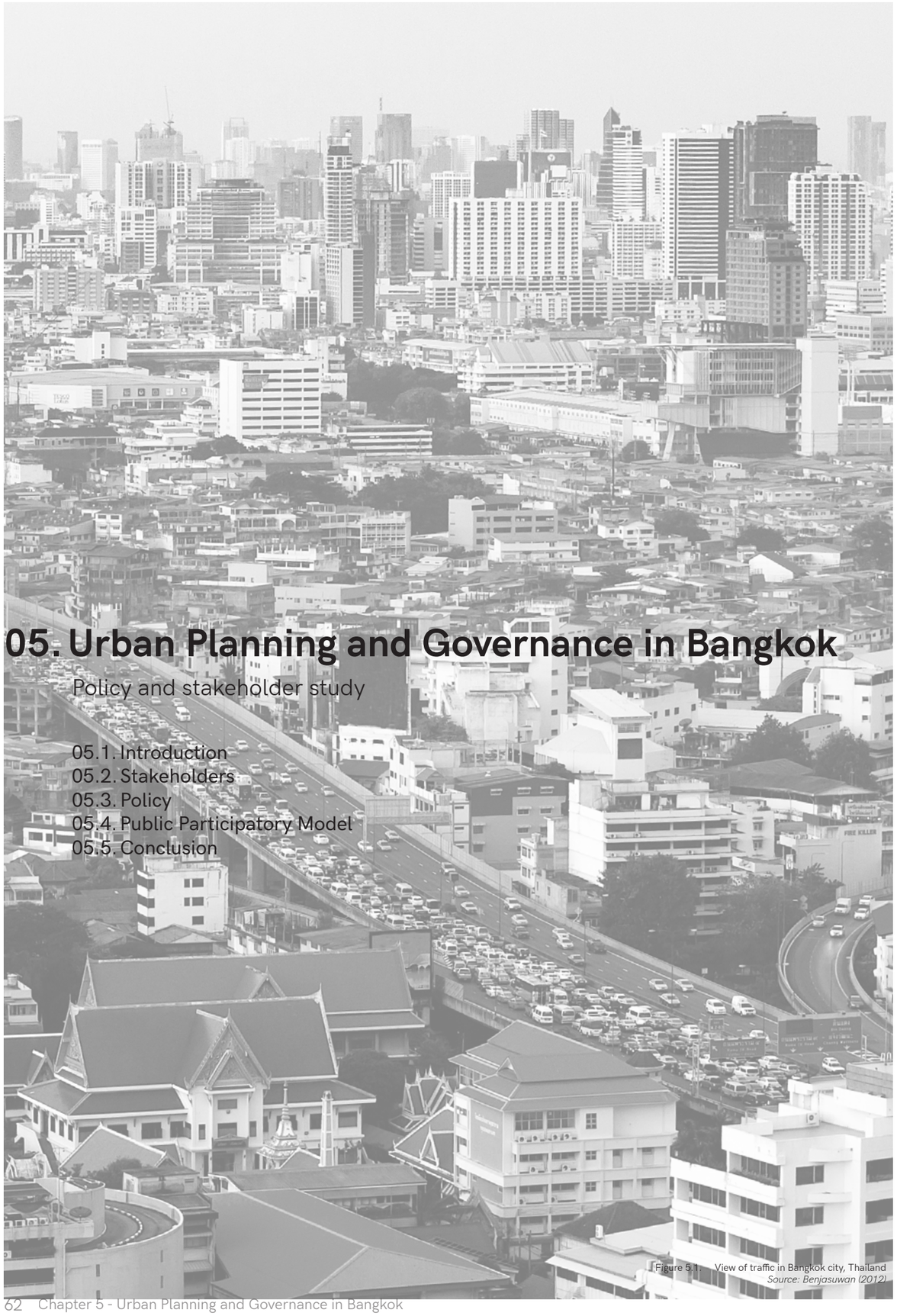
The potential intermodal hubs are highlighted in Figure 4.30 the concentration of routes and the numbers of the canal that cross at particular nodes are the factors in selecting the potential location. The pilot project comprises the most lines interchanging in the area. Besides, the chosen areas are located between the inner city and outskirts, where there are high possibilities of development that attract suburban and urban populations. The strategy is to develop TOD guidelines as a toolbox and, in the first phase, apply and test it to the pilot project to understand how applicable the principles are in the specific context. The process includes the evaluation to learn if the guidelines work. The second phase will then test the deducted guidelines at two other potential locations and continuously adapt them at other locations. The pilot project and the following two potential locations are as follow:

1 Ramkhamhaeng
The pilot project is situated at the intersection of three potential canals leading to the North and East: N1; E1; and E2. Moreover, there are other rail lines passing through this area: existing ARL; SRT Light Red line; MRT Orange line; and BMA Grey monorail line, totally seven lines. This in-between area is where people from the East passing through to the city center to work and study. Besides, the country's largest public university, Ramkhamhaeng University, is located near the site. Also, the ARL line and highways lead to Suvarnabhumi Airport, giving a high potential to this area to attract travelers by providing hotels and accommodations.

2 Chaengwattana
The second location is located in the North of the city, where N1 and N2 canals converge. Additionally, four rail lines, the existing BTS Light Green line, SRT Dark Red line, ARL, and MRT Pink monorail line, synergize with the canals. The main attraction in this area is the government center and the second large airport in Bangkok, Don Mueang Airport.

3 Thonburi
The third location is in the West of Bangkok across the Chao Phraya River. It is where three canals: C1; W1; and S1 meet. The rail transports interconnect in this area are MRT Blue loop line and BTS Dark Green line. Moreover, apart from this residential area's high density, what enhances this location's potentialities is the consisting of many attractions, including the tourist attractions along the C1 canal and significant commercial area of the Thonburi side.

Figure 4.30. Pilot project and potential locations
Source: Author



05. Urban Planning and Governance in Bangkok

Policy and stakeholder study

Figure 5.1. View of traffic in Bangkok city, Thailand
Source: Benjasuwan (2012)

05.1. Introduction

This chapter examines the Bangkok Metropolitan Administration (BMA) 's governance perspectives by studying existing land-use policy and stakeholders. The current building regulation and incentives for developers are studied to comprehend what BMA has already adapted from the TOD concept. Also, public participatory models in low-income and mixed-income settings are investigated. These findings are criticized and assessed on what can be included in the strategies while suggesting what can be improved.

05.2. Stakeholders

Who are involved in the urban planning in Bangkok

In Bangkok, many stakeholders participate in the urban development project, two leading authorities conduct the large contributions, Bangkok Metropolitan Administration (BMA) and the national administration (Figure 5.2.). The same type of project could be operated by different stakeholders, depending on who wins the tender. For example, the transportation projects are steered by different authorities, such as the two MRT lines operated by Bangkok Expressway and Metro PCL, the public transport company that received a concession agreement under Mass Rapid Transit Authority of Thailand (MRTA).

In comparison, BTS lines are operated by BTS Group Holdings PCL, under the concession granted by BMA. This results in more difficulties in the integration of the entire network. Moreover, too many layers of organizational hierarchy contribute to the project's delay as the decision is made by the higher sections step-by-step.

To conclude, the problems in the governance perspective are the complexity of the system with various stakeholders and the hierarchical authorities. These conditions need to be sorted out to make the execution more efficient.

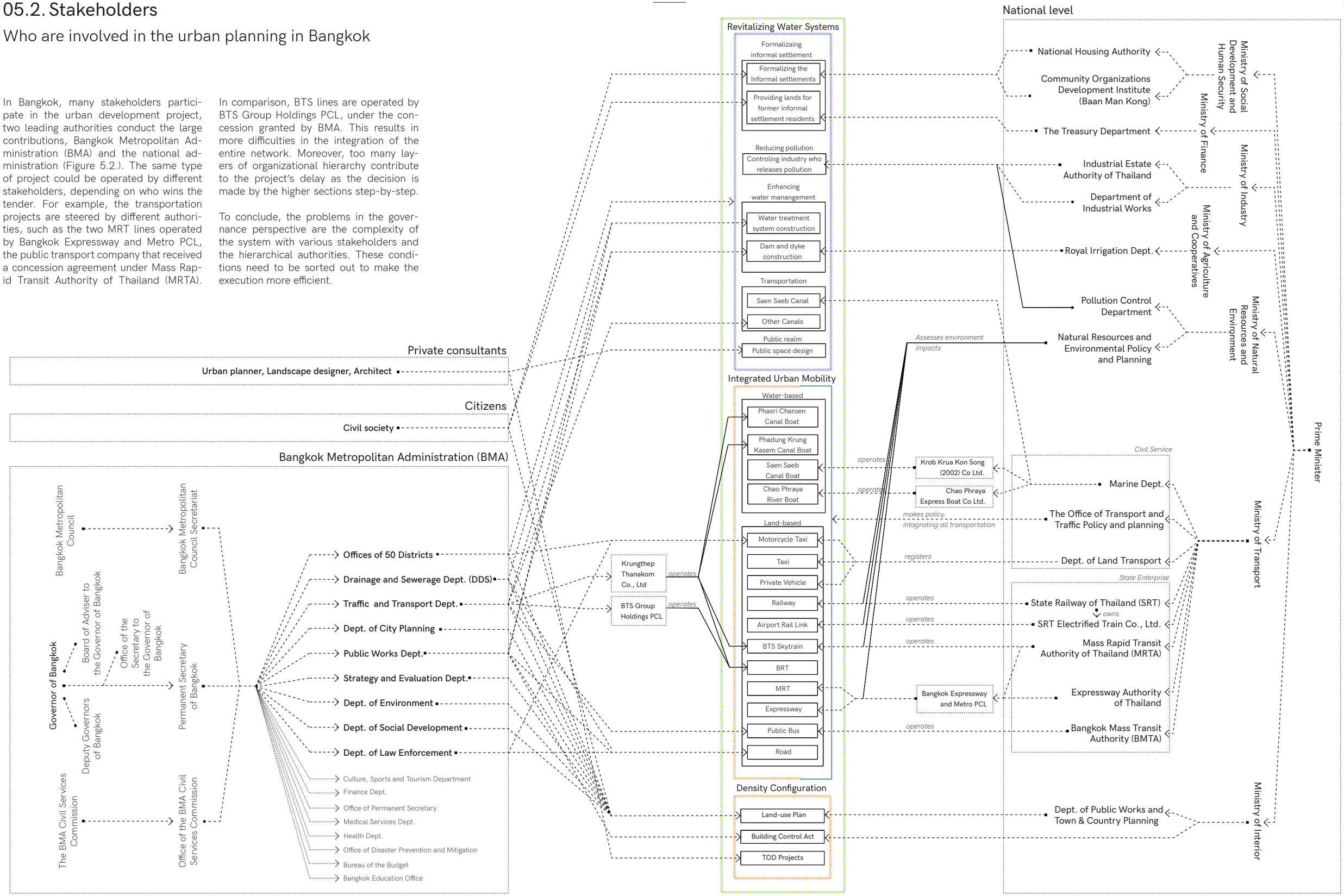


Figure 5.2. Stakeholder analysis
Source: Author

05.3. Policy

05.3.1. How BMA envisions the densification

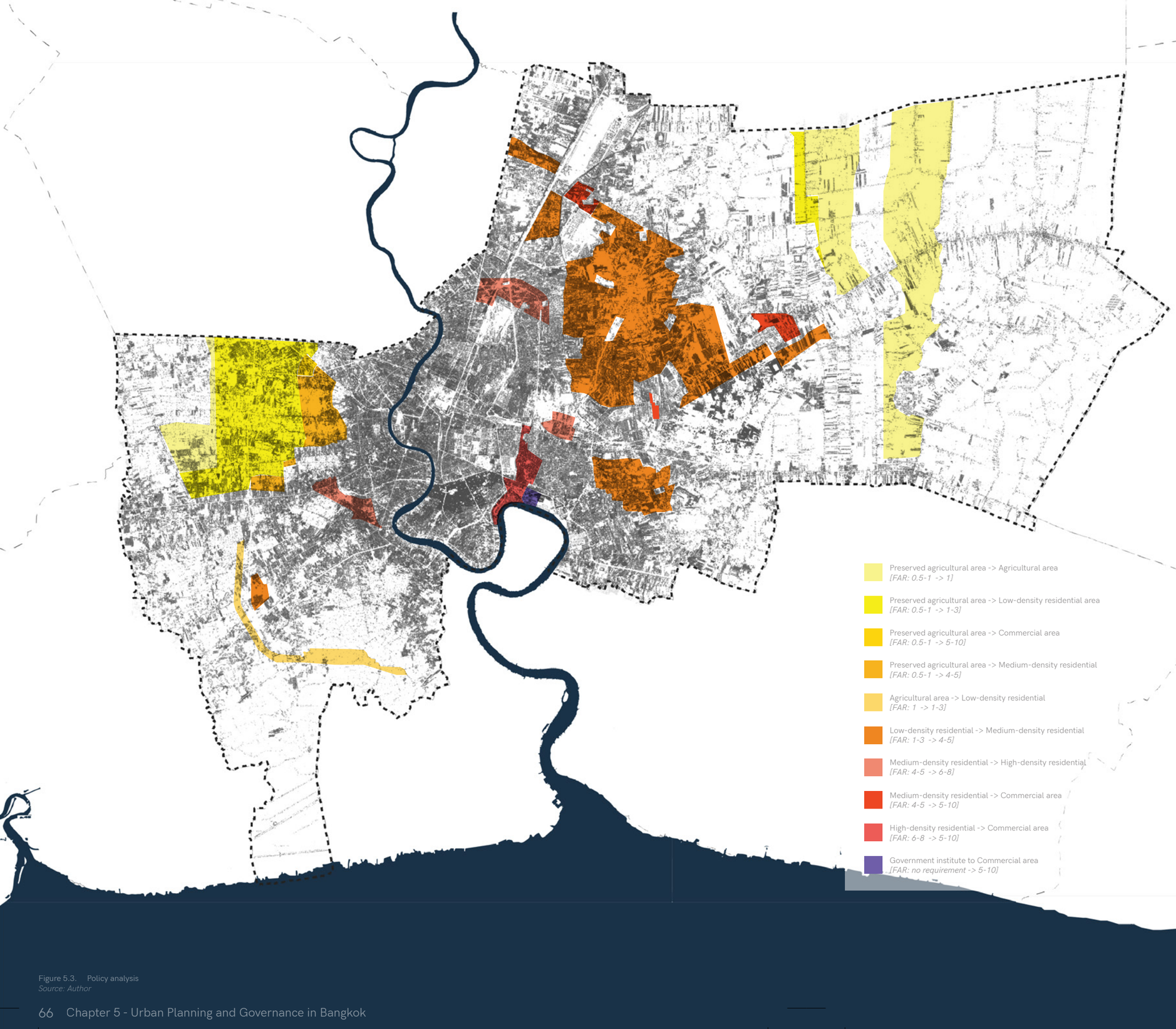


Figure 5.3. Policy analysis
Source: Author

Land-use 2013

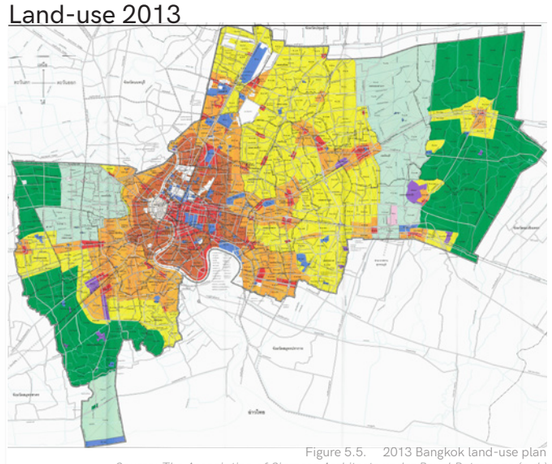


Figure 5.5. 2013 Bangkok land-use plan
Source: The Association of Siamese Architects under Royal Patronage (n.d.)

Land-use 2019

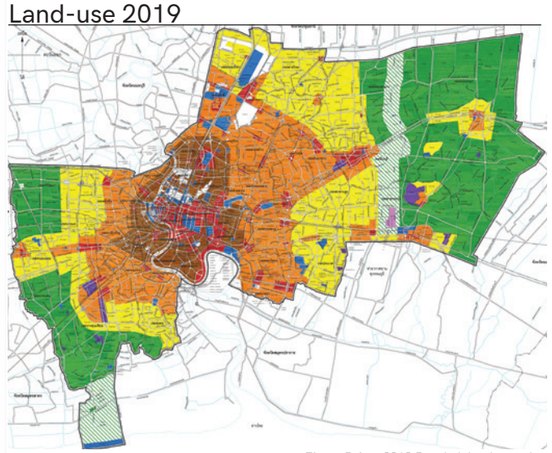


Figure 5.4. 2019 Bangkok land-use plan
Source: Plan4Bangkok (2020)

To understand the Bangkok's administrative authority visions towards the city's development, two comprehensive land-use plans are comparatively analyzed.

The synthesis is illustrated in Figure 5.3. which shows that some determinations will not contribute to the compactness as aimed. For example, low-density residential zone in the 2013 Land-use plan will be densified in 2019, which covers the large area in the East. Moreover, in the West, the current sizeable preserved agricultural area will be turned into a low-density residential zone.

To conclude, the latest land-use plan that regulates the city's development will not result in a more compact city. It will even contribute to the more disperse than it is nowadays, and consequently, encouraging people to rely on private cars.

05.3. Policy
05.3.2. Regulations and incentives

Another element that regulates the built perimeter in Bangkok is the building code. This part elaborates on the essential regulations and incentives that developers have to abide by in their developments. Also, this is to understand what BMA has adapted from the TOD concept, and assessed what can be improved to effectively fit in the Bangkok context.

Floor Area Ratio (FAR) Bonus

This incentive measure offers up to 20% more gross floor area permission to the developers if they provide the elements that benefit public. The provision includes one of these elements shown in Figure 5.6.

Transfer of Development Right (TDR)

TDR is a zoning technique that intends to decrease development potential in areas that should be preserved by increasing development potential in places where growth is needed (Pruetz & Standridge, 2009). In the latest land-use plan, BMA has planned to enact TDR in various conditions (Figure 5.7).

Planned Unit Development (PUD)

PUD integrates development adhering to a comprehensive plan and located on a single plot or several plots that may be separated only by a street. It offers flexibility that allows creativity in land planning, site design, and protects environmentally sensitive lands (American Planning Association, 2009). BMA will implement PUD measure in three residential zones and commercial zone where plots are larger than the determined numbers (Figure 5.10).

On-site parking reduction

Aligning with TOD concept, developed sites, located within 500-meter station's catchment can reduce the number of required parking lots by 25%. This measure allows real estate developers to increase more profitable commercial area in there project (Figure 5.11).

Green area provision

According to the requirement of Environmental Impact Assessment (EIA), developers need to provide green area based on the size and number of users in their building (Figure 5.8). This includes on-building and on-ground green area that can allow rain water to permeate (Figure 5.9).

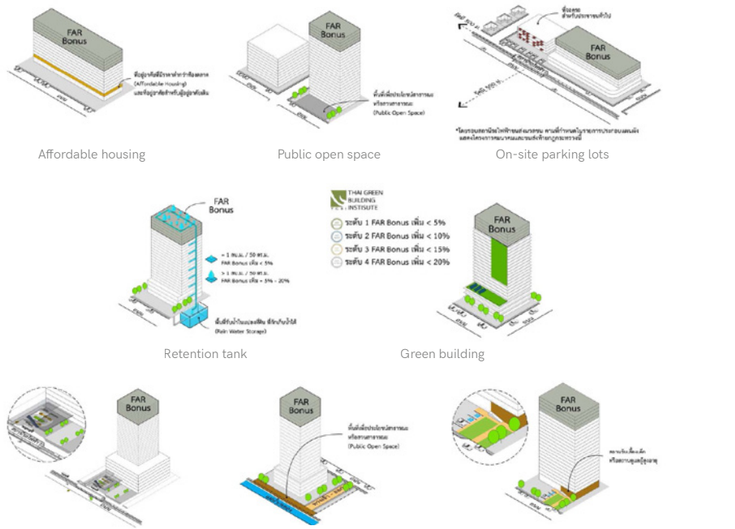


Figure 5.6. FAR Bonus
Source: Plan4Bangkok (2020)

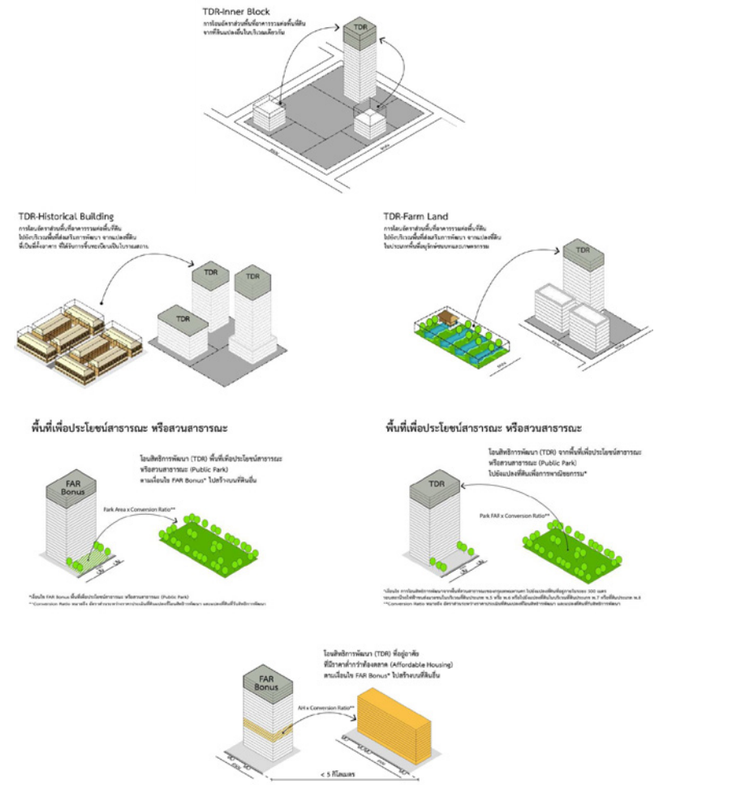


Figure 5.7. Transfer of development right (TDR)
Source: Plan4Bangkok (2020)

To sum up, some of these measures are adapted from the American context and may not work in Bangkok, for example, the incentives for affordable housing. Real estate developers prioritize their profit over the public benefit. This creates ambiguity if the building is developed for high-income residents but also welcome low-income resident. Moreover, the TDR and PUD measures have not been applied in Bangkok, therefore, it is necessary to be tested first before they are enacted in the actual context. These approaches will be sorted out and included in patterns which will be elaborated in the design later.

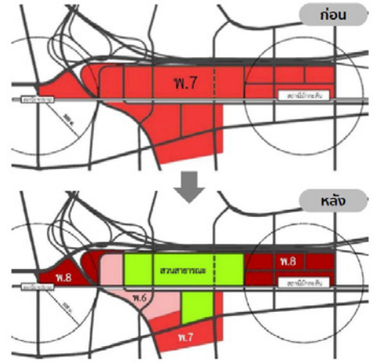


Figure 5.10. Planned unit development
Source: Plan4Bangkok (2020)

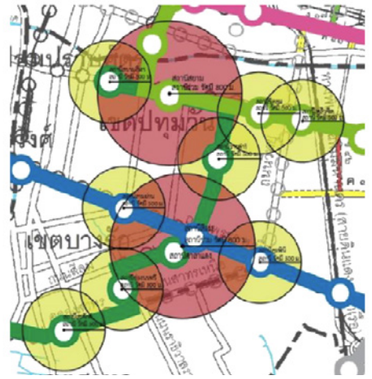


Figure 5.11. On-site parking lots reduction
Source: Plan4Bangkok (2020)

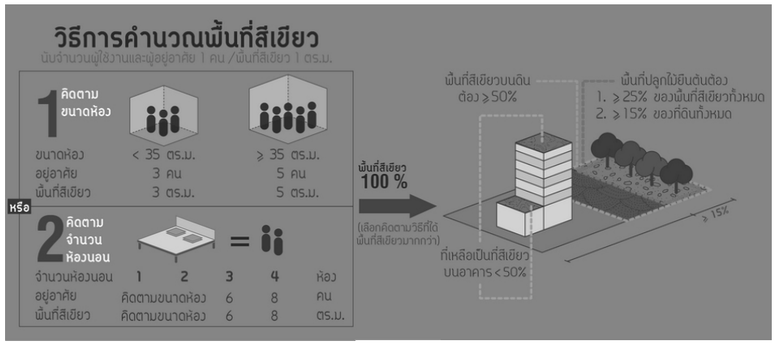


Figure 5.8. Calculation of green area in developed site
Source: Realist (2015)

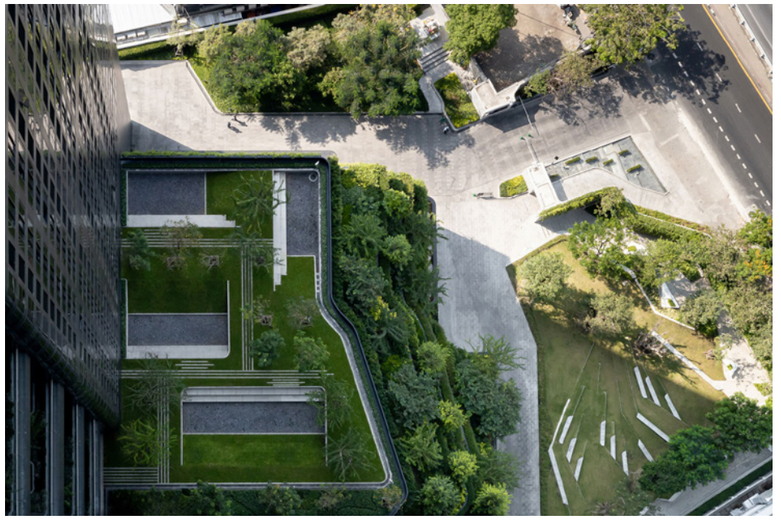


Figure 5.9. On-building green area
Source: Landezine International Landscape Award (n.d.)

05.4. Public Participatory Model

05.4.1. Low-income setting

This part elaborates on the existing situation of public participatory models that have been used in Thai urban planning, divided into low-income setting and low- to high-income setting.

The current formalization of slum communities in Thailand is executed by the Community Organizations Development Institute (CODI). Baan Mankong is its slum upgrading and secure housing program that is widely known for placing slum dwellers at the centre of planning and financing housing improvements (Castanas et al., 2016; Bhatkal & Lucci, 2015). Participation is an essential feature in which the communities need to establish and manage a saving groups. Moreover, the upgrading projects are planned by the communities and conducted in corporation with the local authorities (Castanas et al., 2016).

The program begins with a survey of low-income settlements in the city to comprehend their needs. The collaboration between community networks, NGOs, local government, and professionals then initiates to plan and implement an upgrading project, and land tenure arrangements. It benefits the community with the secured land tenure, financial support from their saving groups, and accessibility to loans under the program. Residents are involved in funding the program as they are required to save 10% of the amount they borrow in a collective saving account to qualify for a loan under Baan Mankong. Figure 5.12. shows the flexibility of the program providing upgrading choices and tenure arrangements. This allows community to tailor the program based on their needs. Various types of upgrading projects under Ban Mankong include on-site improvement, re-blocking, reconstruction, and relocation.

The first succeeded Baan Mankong project is upgrading Klong Bang Bua communities. Twelve informal settlements stretching 13 km along the Bang Bua canal joined with the Baan Mankong program to upgrade their secure land tenure due to the unsecured living conditions, the daily fire hazard, eviction, and facing a constant accusation of polluting the canal. The negotiation for a 30-year renewable lease to the public land has been achieved under Treasury Department (TD) ownership.

The development includes new houses, infrastructure, and revitalizing canal. New canal-side walkway provides access by motorbikes and bicycles to the communities and enables fire trucks to enter in an emergency. Dwellers see this walkway as an essential pedestrian amenity which offers space for children, vending carts.

In the past years, there has been an attempt to resurrect Bang Bua canal through regular canal-cleaning jamborees. Unconventional organic "E.M." compost and water plants have been used to clean water. Moreover, grease traps have been installed in all kitchens to filter wastewater before being discharged to the canal. These implementations were intended to demonstrate the city that these communities are not polluters but the important asset that helps to maintain canal system.

The participatory process in Bang Bua project covers public hearing, saving group, survey and planning, design with architect and focus group discussion, and implementing construction management (Figure 5.15). Collaboration with architects allows residents to consult with the experts and come up with the solution. Housing prototypes are developed: single house; semi-detached houses; and row houses, with the concern of cost and the possibility to recycle materials from the former houses (Figure 5.14).

Single house

Semi-detached house

Row houses

Figure 5.14. Prototypes of houses
Source: Usavagovitwong (2012)

Figure 5.13. Baan Mankong project
Source: CODI (2020)

Figure 5.15. Public participation in Bang Bua project
Source: Usavagovitwong (2012)

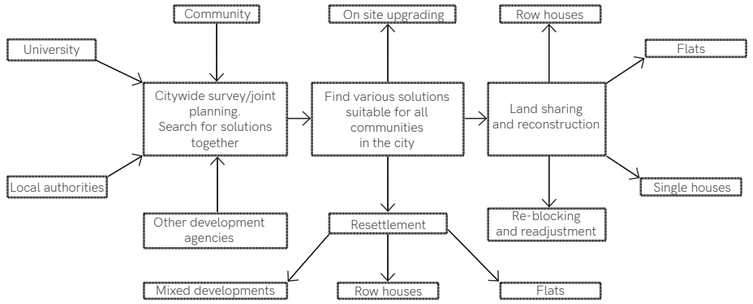


Figure 5.12. Flexible upgrading options available under Baan Mankong
Source: Author, redrawn from Bhatkal & Lucci (2015)

05.4.2. Low- to high-income setting

In order to hear local residents' voice towards new developments, public participatory process has been included in the EIA. It is a measure that needs to be carried out according to the Thai Constitution. Public participation is, therefore, necessary in decision-making process when the upcoming project is going to be built in the area with residential communities. To reduce negative impacts, project owner has to conduct the report, forecasting possible negative and positive impacts, covering natural resources, economy, society, culture, health and livelihood.

Public consultation offers opportunities to local residents to participate in the EIA process. It needs to be held before the project starts, thus local residents could ask questions or request information about the impacts that they should know since the project begins. Large residential, commercial, or infrastructural projects need to go through EIA process. These projects in Bangkok fall under the normal EIA which requires at least two times of public conslutions where people could engage in the scopes of screening projects, and defining scope of study (Figure 5.17).

Notwithstanding, there are some problems occuring in the EIA consideration according to TAI's report (2014). The first issue relate to the hierarchy in organization as EIA report is conducted by the consultant firm employed by project owner. Thus, they have to satisfy the employer as an employee. As a result, the report might not correspond to the truth, and the way project owner force people to admit the development is by bribery. Moreover, the local residents do not have participation in the consideration phase and not being informed about the progress of the project.

However, even if EIA report has been approved and building is being constructed, the project can still create externalities that affect local residents (Figure 5.16). This happens if the project owner and contractors do not abide by the measures for example working on construction at night, creating noise and air pollution. For this reason, EIA's public participatory model might be not effective and only done for the sake of the project to be approved. This could indicate that the EIA procedures should be improved and sorted out in order to reduce the impact on surrounding areas and people's livelihoods.

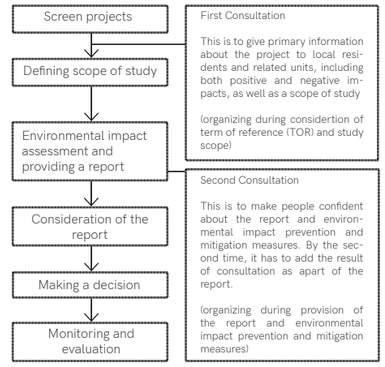


Figure 5.17. Environmental impact assessment procedure for common projects or normal EIA
Source: Author, redrawn from Thailand National Chapter, The Access Initiative (TAI) (2014)

Figure 5.16. Construction site next to residence
Source: Peerapol-tools (2019)

05.5. Conclusion

It is apparent that the complexity of the system contributes to the conflict within the projects and causes delay and discontinuation. As Pojani (2020) argues, Southeast Asian capitals confront a poltical logjam. Figure 5.18. shows a comprehensive implementation model proposed by Matland (1995), considering political conflicts and policy ambiguity. Thus far, the implementation in Bangkok has been predominantly "symbolic" or "experimental". Particularly, the stakeholders that have been active and involved in the micro-implementing environment has contributed to the fluid processes and unpredictable results. Therefore, Bangkok's goal would be to remodel the forms of implementation to "administrative" and "political" which carry less ambiguity (Pojani, 2020).

Moreover, the latest land-use plan will not result in the compact city since certain zones are determined to be densified, particularly the low-density residential areas and preserved agricultural zones. Thus, the next chapter will elaborate on the vision and strategy that aim at the compaction where livable and socially diverse environments happen.

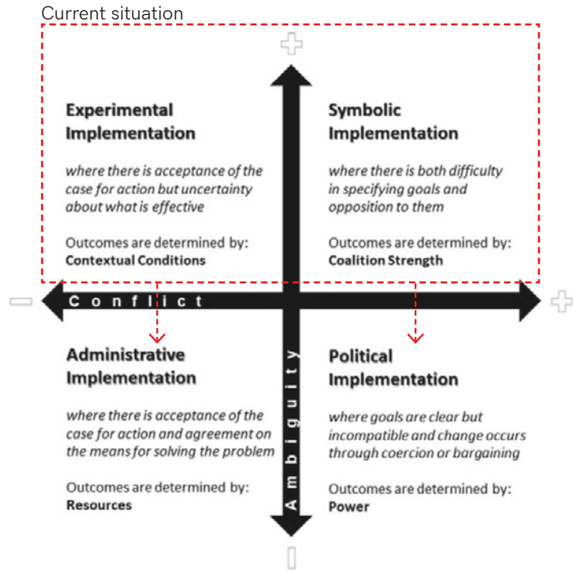


Figure 5.18. The impact of political conflict and policy ambiguity upon implementation. Adapted from Matland (1995) and Hill (2016)
Source: Pojani (2020)

06. Strategic Planning

Macro-scale Integrated Model

Figure 6.1. Cityscape of Bangkok
Source: NSU MON (2020)

06.1. Introduction

This chapter proposes the vision that illustrates the overall picture of Bangkok in 2050. Following with the elaboration of individual layers with strategies, giving examples of what measures are to make the vision happens. At the same time, the implementation phase is planned to shows the roadmap within the timeframe. Lastly, the chapter ends with the design toolbox that will be applied in the micro-scale intervention.

06.2. Strategic Integrated Model

06.2.1. Outline of Strategies

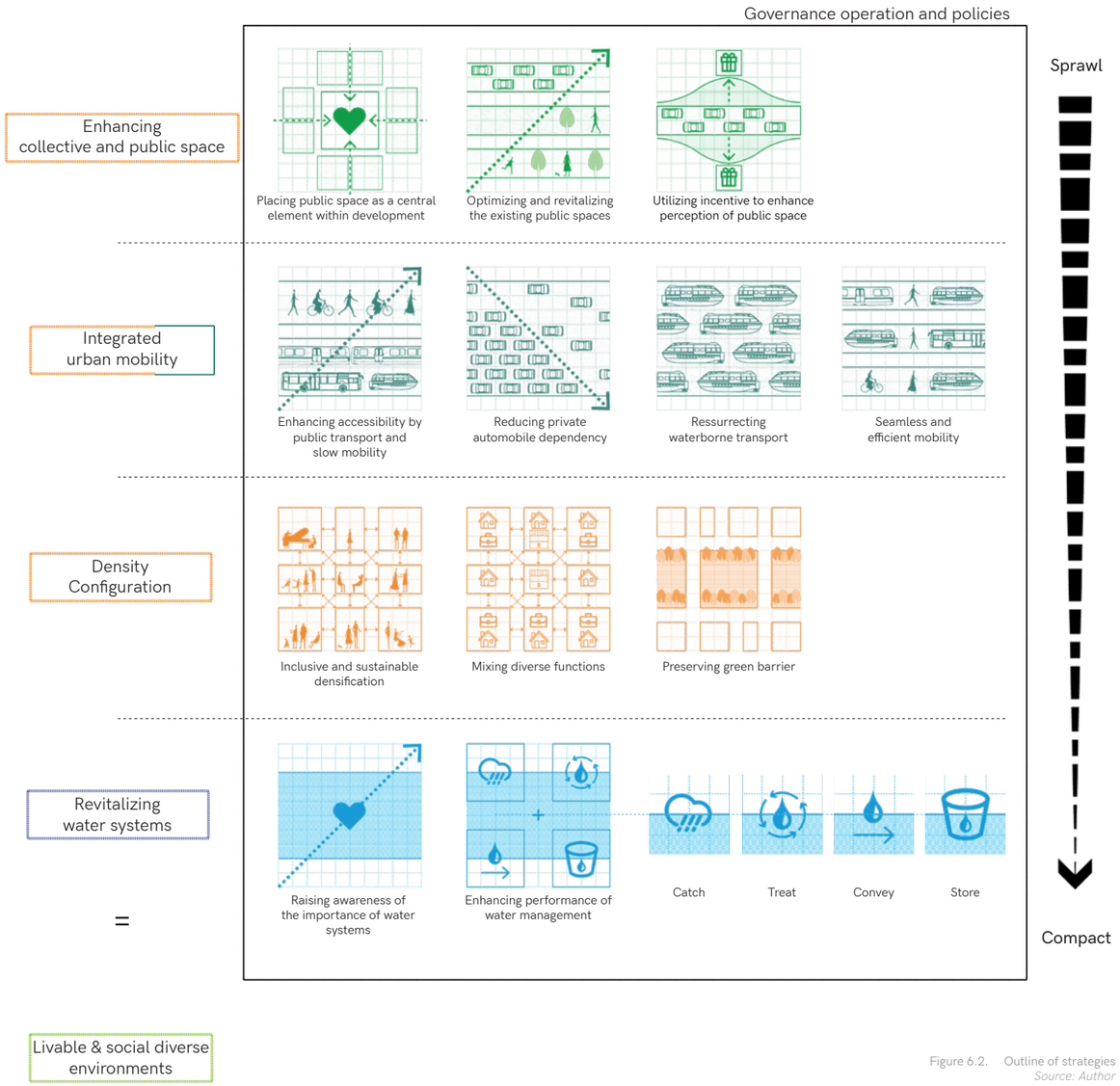


Figure 6.2. Outline of strategies
Source: Author

This chapter starts with the outline of strategies that will convey Bangkok's development towards compactness—referred to the project's conceptual framework in chapter 3, Figure 6.2. depicts the layers with main goals. In addition to the three layers, the layer of enhancing collective and public space is introduced in this part since it should be considered in urban design and planning and provide more public space in Bangkok. Another extra layer is the governance institution which aims to suggest the governance rescaling that results in the more efficient implementation.

The next part proposes the vision illustrating the overall picture of Bangkok in 2050. Following with the elaboration of layers with strategies. Simultaneously, the implementation phase is planned to show the roadmap within the timeframe. Lastly, the chapter ends with the proposed patterns that will be applied in the micro-scale intervention.

06.2.2. From Sprawl to Compact Primary City, Bangkok 2050

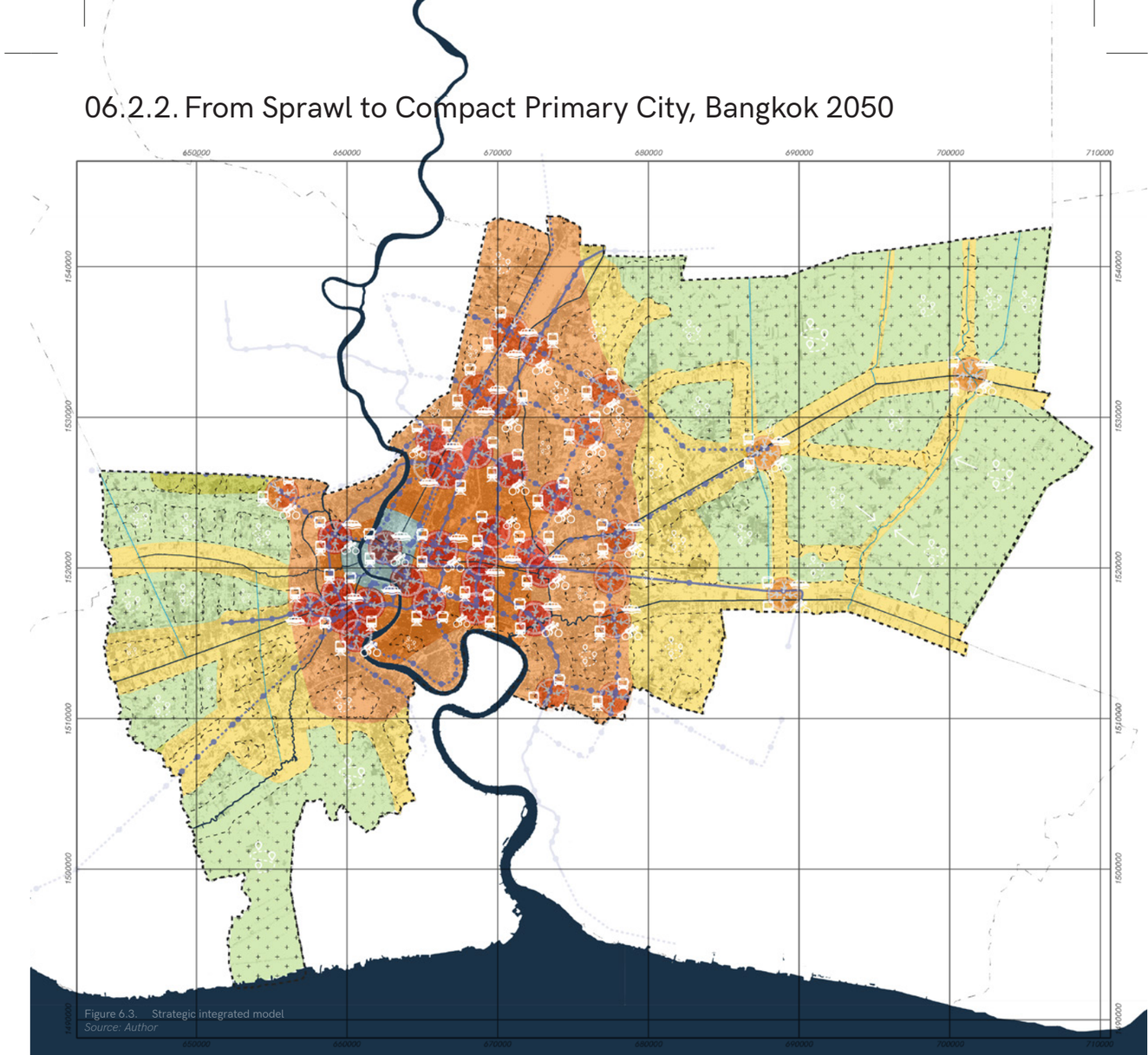


Figure 6.3. Strategic integrated model
Source: Author

"In 2050, Bangkok will become a compact city where fast mobility and slow mobility integrate and contribute to the efficient and healthy lifestyles. Waterways will be ressurrected and equipped with clean and innovative waterborne transport, synergizing with other modes. As more collective transport systems are provided, they will be the first option that citizens choose to commute with, while private automobiles will become less prioritized, and be limitedly used. The optimization of green-blue-grey infrastructure will increase the performance of the water management and sustainably counteract flood risk. Most importantly, collective spaces will be enhanced and placed as a center of densification to enable diverse social and livable urban environments."

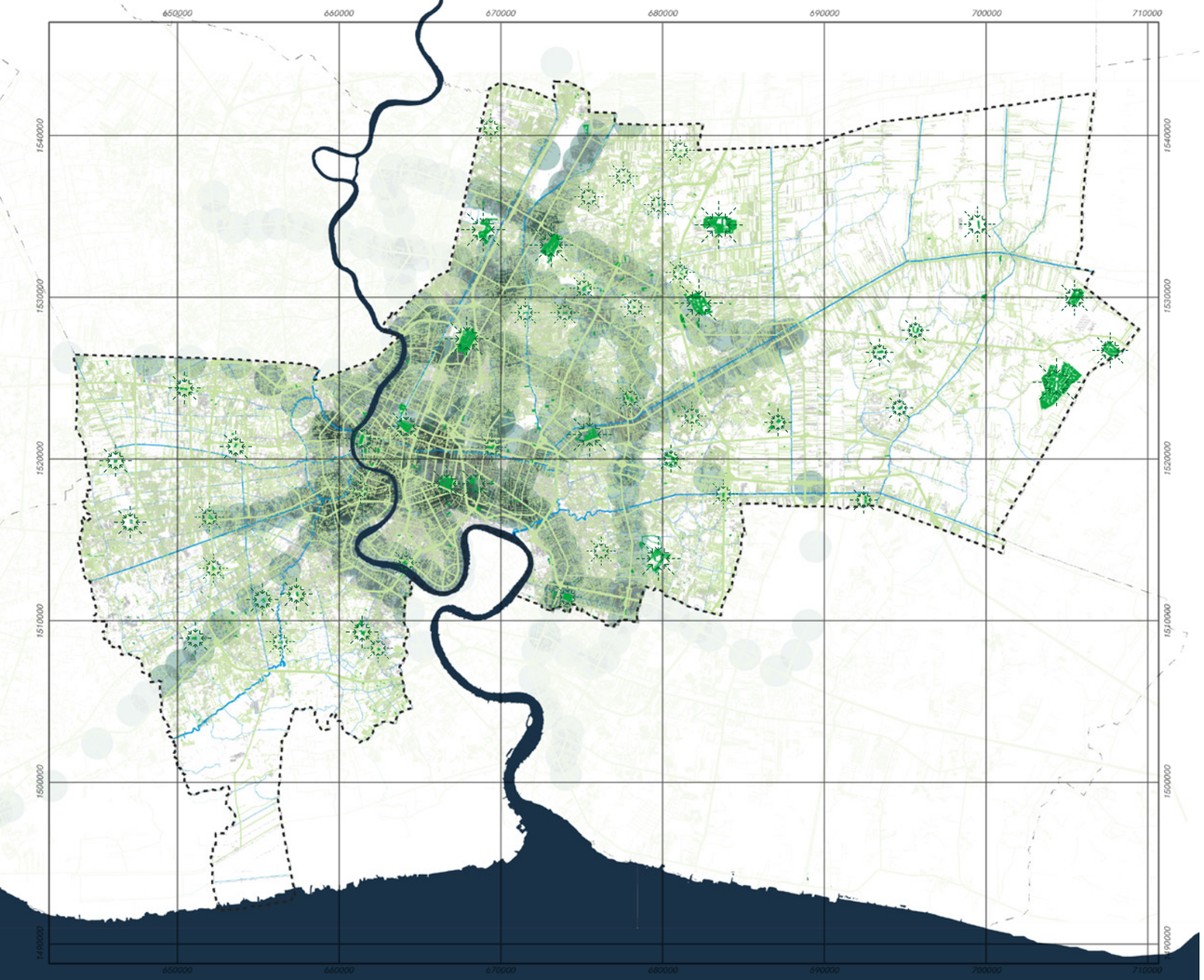
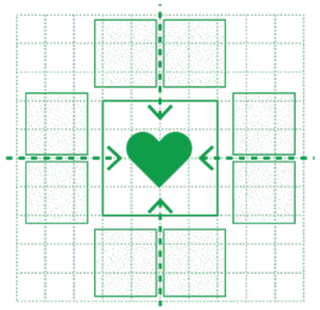


Figure 6.4. Enhancing collective and public space
Source: Author

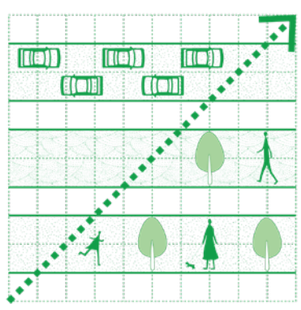
The first layer of "Enhancing collective and public space will be the initiating aspect as it is a central element that all developments are oriented to. As public space in Bangkok is scarce, this layer aims to propose possibilities to gain such spaces within the urban development process. Figure 6.4. illustrates the overall picture of this layer spatially while the included strategies will be discussed later.



1 Placing public space as a central element within development

Public space has to be placed as a center of urban development and needs to be prioritized in the densification planning process.

Concerning the TOD sphere's concentration of use and central position, transit station could be considered the most public place. It should be developed to invite people to spend time and support the surrounding economic development, especially retail and commercial functions. Moreover, public spaces along the canal are essential since the areas will be densified. Similarly to the station area, they stimulate social and economic activities around them. In the residential area, community square can be inserted in the central area of the cluster, for example, in the affordable housing community.

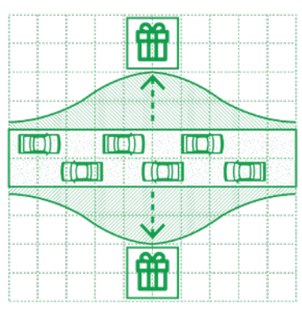


2 Optimizing and restoring existing public spaces

Another way to enhance public spaces is to optimize the existing ones that people might not value. These spaces are *sois*, roads, and highways. Currently, automobiles are prioritized and take most spaces which leaves insufficient area for people. Therefore, it needs to be redesigned to allow for active mobility.

Currently, street vendors are an obstacle on the sidewalks. They have to be organized so that the walkways are not obstructed. Besides, the neglected network of waterways and water bodies has the potential to be restored. They will be cleansed and beautified for recreational use and slow mobility. Moreover, interior public spaces such as library, museum, and gallery can be upgraded to facilitate Bangkokian's lifestyle. These spaces could be integrated with co-working spaces, allowing people to work and meet.

The financial mechanism that supports public space development could be Land value capture (LVC), allowing the generation of funds to capture the increase in land value. These funds will be used for urban infrastructure and public space development and improvement. Consequently, these developments will increase the economic value of the surrounding residential and commercial functions and perpetually allows the government to capture the increase.



3 Utilizing incentive to enhance perception of public space

The perception of public space can be enhanced through incentives for privately-owned public space (POPS). To illustrate, real estate developers are offered the incentive to provide spaces open to public use and get more buildable areas in return.

This tool has been implemented with private sectors. It works for commercial buildings such as offices and malls that want to attract people to their developments. However, it has not worked with the residences since the owner wants the development to be private, and it is one of the concerns of tenants. Therefore, there needs to be a mechanism that encourages developers to have diverse functions within a building, commercial on podiums and plinths to allow permeability on the ground level, and more privacy can remain on the upper floors for housing. These POPSs can be integrated into any plots, especially ones adjacent to the main roads and canals.

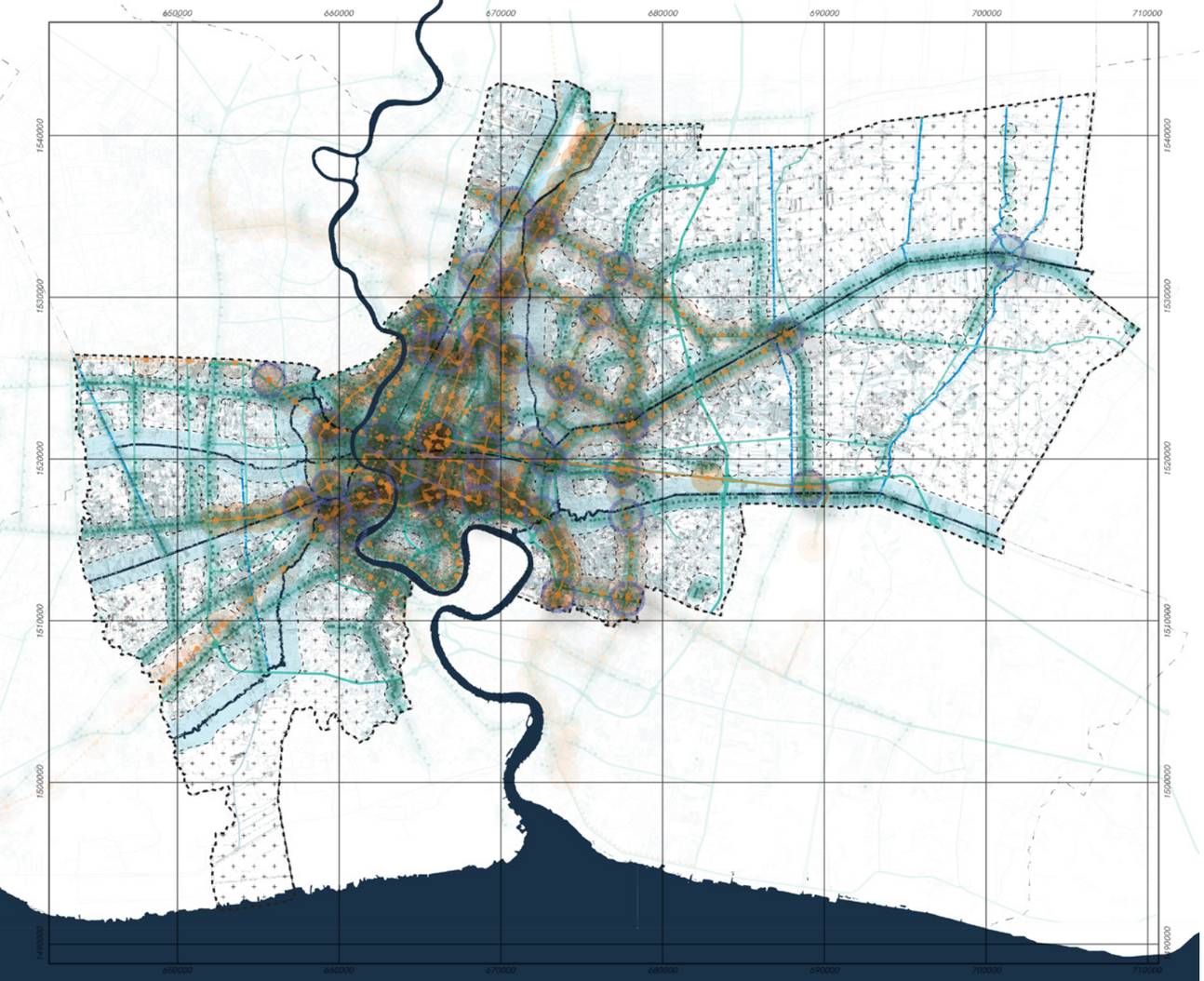


Figure 6.5. Integrated urban mobility
Source: Author

As proposed before in chapter 4 where all layers of public transport systems are superimposed and TOD locations are derived, this combined layer is integrated in the strategic model will be elaborated.

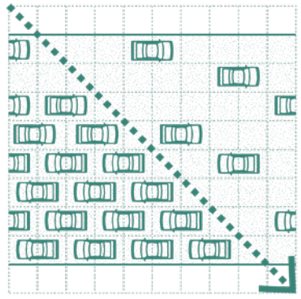
1 Enhancing accessibilty by public transport and slow mobility

Public transport systems are prioritized, acting as a catalyst for the surrounding development. The existing and planned rail public transit systems will be integrated with the water transport. To enhance accessibility to these systems, walkability and bike-ability within the station area have to be considered. Major streets filled with traffic will be restored with the provision of slow mobility path. Safe pedestrian paths and bicycle tracks, separated from a driveway, will be provided to encourage people to walk and cycle. This includes tree canopies, covered ways, universal design that facilitate walkability in the tropical climate. Also, bus shelters will be improved and equipped with technology that facilitates efficient transport.

First, what has to be implemented is to make public transport systems more extensive and affordable. Public transport fares have to be controlled, resulting in the inclusiveness and accessibility to low-income residents.

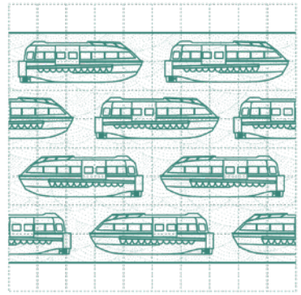
In the hinterland and suburb areas, DRT will be used to provide more accessibility, transporting people to the main public transport hubs. This technology can be integrated into informal transport systems, for example, minibusses and *win*.

Another spatial problem that dissuades people from walking is dead-end streets. However, to open these blocks, negotiation with the owners of private properties has to be executed and contextually evaluate case by case. If this is achieved, it will allow more flow of slow mobility in the urban fabric.



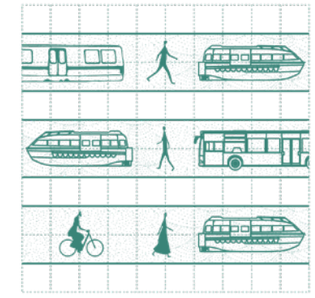
2 Reducing private automobile dependency

After public transport has covered most areas, offering the alternatives to private cars, and people can leave them at home. Bangkok can adopt Electronic Road Pricing (ERP) in the inner-city and city centers where public transport systems are concentrated. Furthermore, green taxes can be used to increase tax on motor vehicles and fossil fuels. These raised revenues will generate funds that can be used to develop public space and infrastructure.



3 Resurrecting waterborne transport

Smart mobility can be integrated into boat systems and make them more efficient, sustainable, and safe. The autonomous boat is not far from happening in the future, and it is promising for transporting people (Figure 6.6). This sheds light on the future urban waterborne transport and can be adopted to enhance urban mobility in Bangkok canals.



4 Seamless and efficient mobility

Various methods can be utilized to make transport runs more seamlessly and efficiently. In terms of spatial design, pedestrian path should be easy to lead people between modes of transport at the interchange stations with the supporting facilities such as bicycle parking space and sufficient parking lots.

The system that does not exist in Bangkok's public transport is the provision of schedule. Commuters cannot plan ahead how much exact time they need to take. Therefore, real-time monitoring has to be integrated to make the journey more efficient and reliable. Additionally, every public transport mode has to have an integrated fare collection system which will offer convenience in the transfer between modes.

On the road, intelligent traffic lights receive a signal from navigation systems on mobile phones in each vehicle. As a result, the traffic lights can respond to the traffic density and prioritize the heavily congested ones. To apply in Bangkok, there needs to be cooperation between professionals and government authorities to build and administer a database and make the project happens.

Figure 6.6. Zeabus
Source: The Explorer (n.d.)

06.2. Strategic Integrated Model
06.2.5. Density configuration layer

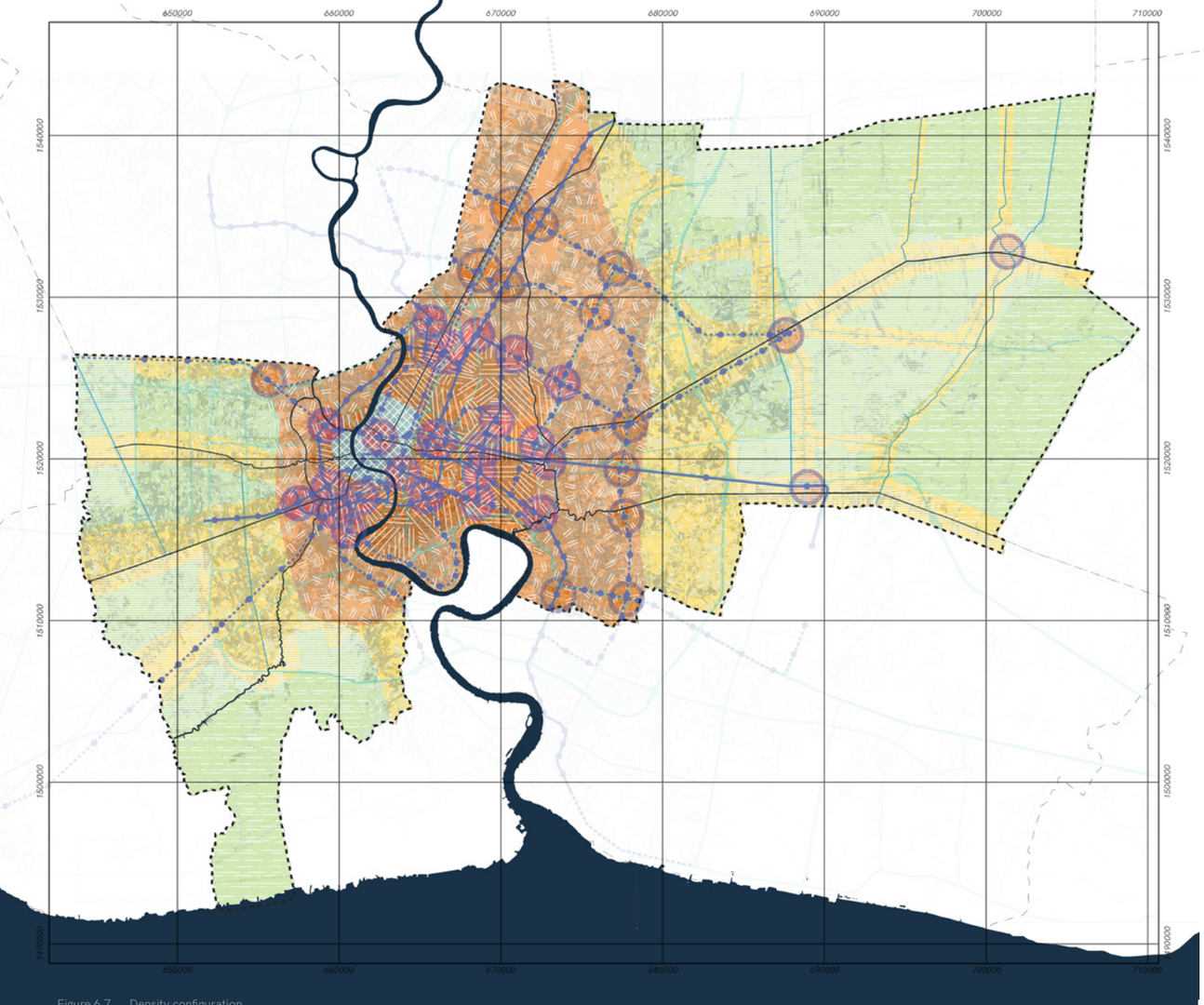


Figure 6.7. Density configuration
Source: Author

What has to go along with the intervention of urban mobility is the land-use and density planning. The redefinition of zone is illustrated to in Figure 6.7. to help suggesting the new zoning in consideration of the compact city concept.

1 Inclusive and sustainable densification

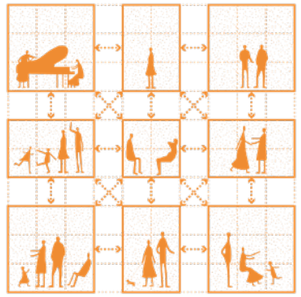
The first strategy is to densify within the area around the stations and canals. However, the areas have already been occupied by the local residents, and to prevent gentrification; inclusive densification needs to be executed.

Bangkok's market-led development has resulted in housing displacement in station areas and increased land value. One way to mitigate this is to reduce and freeze property taxes, maintain the affordability for current residents. Moreover, public engagement can bolster the sense of community, mitigating displacement by new developments. However, if developers already consolidated plots and developed large properties next to or in the neighborhood, public consultation works as an instrument that allows current residents' opinions to be heard.

Housing affordability is another crucial element that makes densification more inclusive, and to provide it, policy instruments are utilized. Perpetual use of social housing can be introduced by national housing legislation for rent. Additionally, this needs to be provided with inclusionary zoning and minimum public spaces and infrastructure (Monroy et al., 2020). This social housing program needs to be flexible in terms of location and type of dwelling; otherwise, it will contribute to spatial segregation and adverse effects, including inaccessibility to jobs and services (Åslund et al., 2009; OECD, 2018b). Affordable housing is not only provided by governments but also by private investors. Tax incentives are given to them to encourage equity developments in affordable rental housing (Monroy et al., 2020).

Furthermore, local business needs to be preserved. For example, the old market, which houses many famous food stalls, and industries in which the legacy has been inherited through generations.

The inclusivity also includes the accessibility to the local services and amenities within walking distance, for example, park, playground, school, healthcare, fresh food, and other essential things for a living.

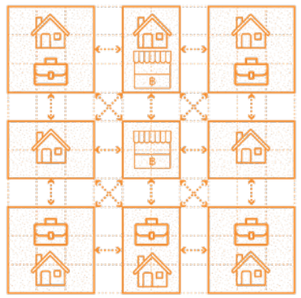


2 Mixing diverse functions

A vibrant city requires a diverse mix of users, bringing different types of activity to spaces throughout the day. This can be achieved by mixing various functions within the same building and area.

The mixture of functions can be integrated into multiple scales of the building type. On a minor scale, shophouse, the traditional mixed-use development, could be leased and houses commercial on the ground floor and residential on the upper floors. While on a larger scale, high-rise mixed-use buildings comprise offices, shopping malls, hotels, and housing.

The strategy is to transform the area around transit stations and routes into a multifunctional area where people can live, work, and unwind. Simultaneously, the current monofunctional shadows will be turned into multifunctional precincts with essential services and amenities. This will reduce the necessity to traverse a long journey to other areas for work and access basic functions.



3 Preserving green barrier

The third approach is to preserve the green zones. This can be done through the containment policy of urban growth boundary (UGB), indicating the line separating an urban area from surrounding rural areas. In contrast, greenbelts are open spaces surrounding urban areas that act as physical territories against the urban sprawl (Monroy et al., 2020).

Additionally, the policy that helps conserving greenbelts is TDR, mentioned in chapter 5. This measure has to be integrated into strategy and tested in the Bangkok context.

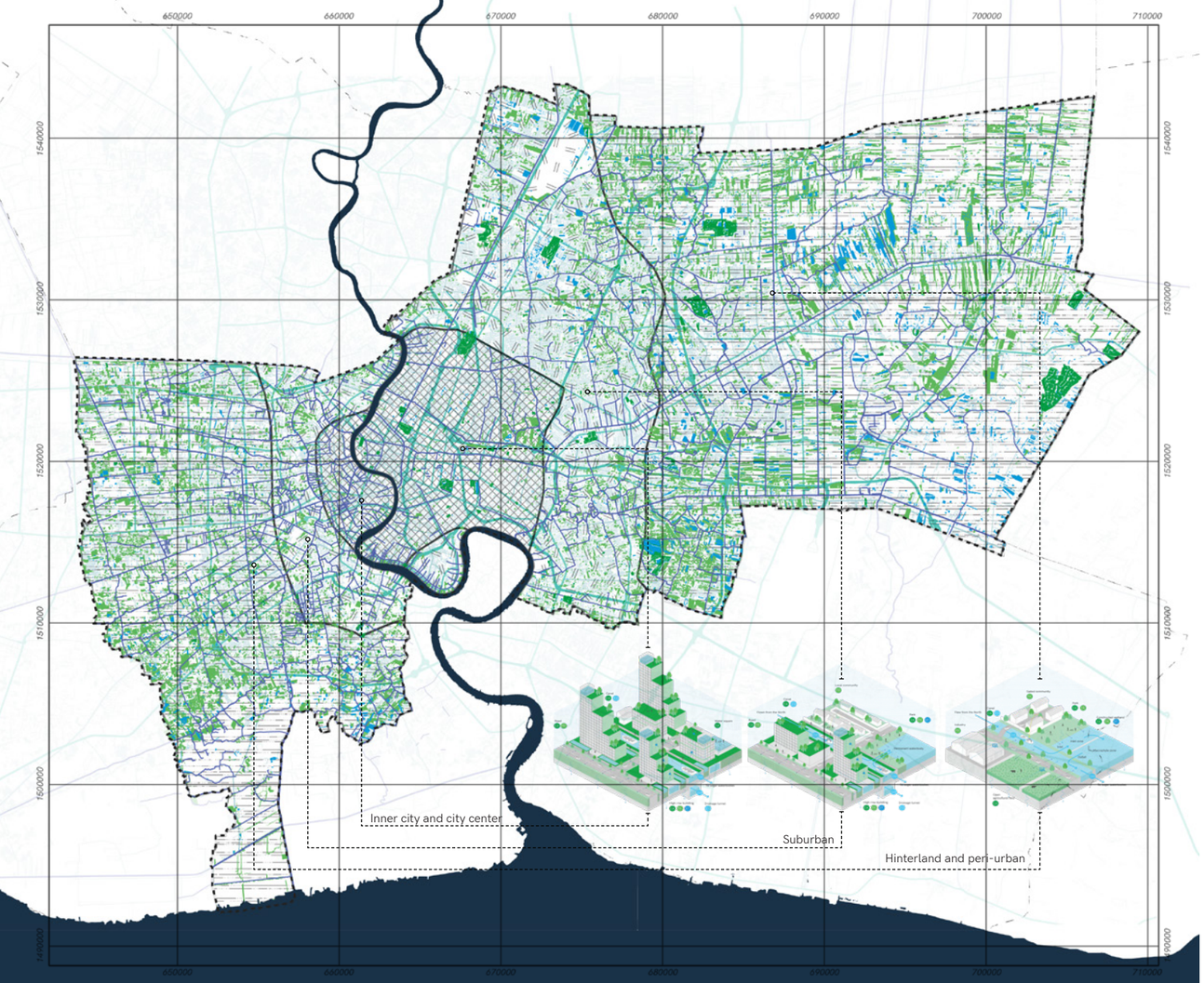
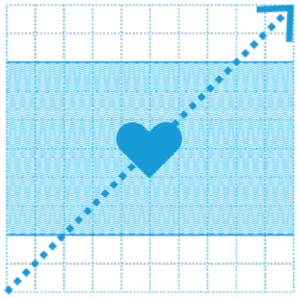


Figure 6.8. Revitalizing water systems
Source: Author

The layer of revitalizing water systems aims to enhance water management's performance to cope with the urban flood vulnerability. Another goal is to beautify and encourage the more pleasurable journey through water vessels since the water contamination is in a critical situation. Moreover, it aims to pose a sense of belonging and alter citizens' perception towards waterways, from dumpsters to public spaces. These strategies will be elaborated on in the coming part.

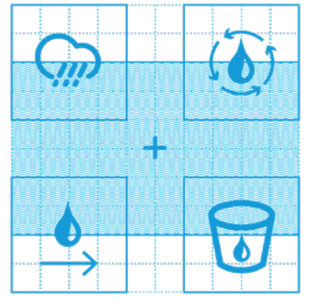


1 Raising awareness of the importance of water systems

The first strategy starts with raising awareness of the importance of water systems, aiming to alter people's perception of canals and create a sense of belonging. The approaches used to control diffuse pollution are policy, economic, and voluntary or information-based instruments (OECD, 2017).

To make the existing mechanism like the Polluter Pays Principle (PPP) effective, there should be public engagement within the policy-making process to allow people to share their consents. Moreover, the implementation should be more concrete and transparent with stringent monitoring from the higher authority on collecting a fee.

For the voluntary or information-based instruments, it can be done through information and awareness campaigns, for example, workshops that teaching how to treat wastewater. Besides, communities can be engaged in the canal cleaning project by establishing the jamboree that schedules the cleansing session weekly. The collected waste can generate income for residents from sorting the materials and selling them to the recycling centers. These strategies' outcomes are the less contaminated and clean canals, encouraging a pleasant waterborne journey.



2 Enhancing performance of water management

As the incident in 2011 has posed an awareness of how rigid the flood defense system is. This part elaborates on how to optimize blue-green and grey infrastructures and create more resilient water management systems. The water systems elements are divided into four categories to be intervened: catch, treat, convey, and store (Figure 6.9). They are planned in three exemplary zones to demonstrate how they work together. This strategy is adapted from Singapore's ABC Waters Design Guidelines due to the similarity in the climatic tropical zone and culture (PUB, 2018).

1) Catch

CA

In an urban environment, catchment elements can be found as circulation infrastructure (*soi*, sidewalk, road, highway), structures such as buildings, softscape in the parks, waterways, and water bodies. These elements will be integrated with green-blue and grey infrastructures to enlarge the catchment.

The vehicular structure in Bangkok predominantly consists of hardscape and stormwater runs off through roadside drains while softscape is scarce. Therefore, there needs to be an incorporation of green infrastructure in a typical street profile. Particularly, bioretention swales and basins can be integrated into the design, which helps with the detention and cleansing stormwater before it is discharged to drains.

Furthermore, stormwater can be caught by buildings. Architectural elements such as a rooftop, sky garden or terrace, balcony,

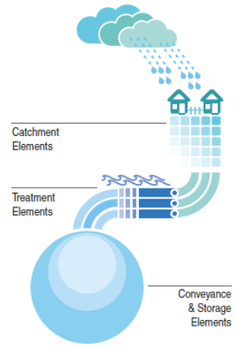


Figure 6.9. Elements in water systems
Source: PUB (2018)

planter box, and ground-level greenery can be integrated with the natural solution to maximize the catchment (Figure 6.10).

Intensive green roofs are ample green spaces designated as public recreational areas at rooftops of commercial buildings. The design allows rainwater to be collected and cleansed through rain gardens and cleansing biotopes on the roof then conveyed to water features on lower floors. Cleansed water can be used to irrigate plants within the buildings and wash pavements. In contrast, extensive green roofs are a low-maintenance vegetated roof that is not designed for recreation, aiming to decrease water runoff and store rainwater supplied to plants in the dry season.

Balconies, planter boxes, green walls enlarge catchment in the development that has limited space. This also reduces heat island effects and beautifies urban environments.

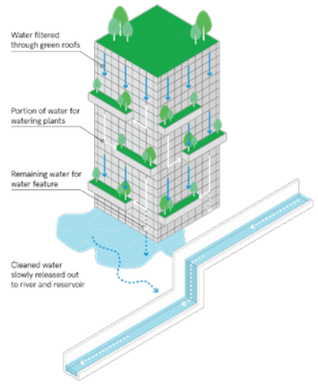


Figure 6.10. Architectural rainwater management
Source: Author, redrawn from PUB (2018)

2) Treat

In this strategy, three plausible cleansing ways are proposed: natural treatment elements, innovative technologies, and public engagement.

Stormwater management comprises various functions in which each of them works for different purposes. Treatment elements can be applied to urban components to delay, detain or retain the first flush of runoff while cleansing it. Their beneficial aspects are cost-effective, natural, and environmental friendly features for sustainable stormwater management.

This part briefly introduces treatment elements that can be applied in the strategy. The first element is vegetated swales, the natural drainage channels with mild slopes, used to convey stormwater via overland flow at a slow pace to allow sedimentation. While bioretention swales are vegetated swales with bioretention systems located within the base, widely used to treat runoff from roads, car parks, and development sites, where they form an attractive feature (Figure 6.13). Similarly, bioretention basins are vegetated land depressions designed to detain and treat stormwater runoff. Sedimentation basins are ponds that provide temporary detention of stormwater runoff and reduce the flow velocity to promote the setting of particles by gravity. Constructed wetlands are shallow and extensive vegetated water bodies, designed to eliminate suspended particles and dissolved contaminants, and can be constructed in different scales, ranging from building scale, park scale to regional systems. Lastly, cleansing biotopes are a form of artificially constructed vertical flow wetland, typically with recirculation, consisting of nutrient-poor substrates planted with wetland plants. They can be implemented to revitalize lakes and the cleansing of urban water bodies and rooftop gardens.

Apart from the natural components, canal treatment can be executed by technologies, taking The Interceptor, the boat that collects plastic waste in the river, as an example (Figure 6.12).

Lastly, public engagement brings together all local residents to help cleanse the canals. The plastic fishing session can be organized and gathers residents and people who are interested.

3) Convey

Conveyance elements consist of waterways, the significant components that act as a public space and transport vessel. Applying mentioned treatment elements will contribute to the aesthetic canals. The conveyance strategy covers the approach to green and beautifying waterways while enhancing the aspect of water management.

There are diverse techniques that can be used to green canal embankments. Canals' edge in Bangkok is primarily concrete. Thus, the feasible way to improve the aesthetic is to utilize creepers and shrubs (Figure 6.11). Another method is to use gabions that combine natural materials and lush creepers.

Additionally, to bring people closer to canals, amenities and street furniture should be equipped, such as benches, pavilions, and look-out decks along the embankment.

4) Store

Store refers to the component that can stock treated water, including natural and constructed open water bodies and built water storage. In the case of a dry season, grey infrastructures, such as weirs and dams, are essential to creating a permanent waterbody. In an urban area, a retention tank within buildings can store treated wastewater that can be used to irrigate the plants within the development.

To visualize all the practices mentioned earlier in Bangkok, they are applied in three exemplary zones: Inner-city and city center; suburban; and hinterland and peri-urban area.

1) Hinterland and peri-urban

Consisting of dispersed gated communities, agricultural fields, and industrial parks, outskirts and peri-urban areas possess the most capabilities to catch stormwater runoff. Canals are the carriageways water flown from the North to the Sea. They serve as a conveyance and catchment element, receiving runoff from the roads and hard surfaces. Moreover, other crucial catchment components are the existing agrarian lands which also let stormwater permeate through. However, they are main polluters, diffusing nitrates to the ground and surface waters. Therefore, nitrate vulnerable zones must be identified, where specific fertilizer, manure, crop, and livestock farming practices must be adhered to (OECD, 2017). Furthermore, the industrial sector is the significant polluter that discharges degraded water into the canal. Therefore, interior wastewater treatment has to be equipped and ensuring clean water by monitoring before it is channeled to the surface water. Besides, constructed wetlands can be incorporated to catch, treat, and store cleansed stormwater for the dry season (Figure 6.16).

2) Suburban

Bangkok's suburb is where new developments happen, due to the change of land-use plan. Open spaces as parks are available for the permanent waterbody to catch, treat, and store stormwater. Moreover, to enhance the catchment capability in this zone where hard surfaces are extensive, roads will be restored and incorporated with infiltration strips. Newly developed mixed-use buildings have to integrate the system that harvests, cleanses, and recycles rainwater. Apart from the high-rise developments, local communities can play a large part in the waterway treatment through public engagement sessions, aided by autonomous debris collecting boats (Figure 6.15).

3) Inner city and city center

This densest zone in the heart of Bangkok is characterized by intense urban developments of high-rise buildings, leaving fewer possibilities for open spaces. Thus, recently built projects must be equipped with the state-of-the-art rainwater system proposed in the suburban model. Likewise, the road will be revitalized and integrated with green infrastructure for more infiltration. Moreover, due to the fewer available open spaces, water squares can be introduced to this area, particularly at underutilized space under the highways where soft surfaces are difficult to be provided (Figure 6.14).

Figure 6.13. Urban infiltration strips
Source: Pötz (2016)

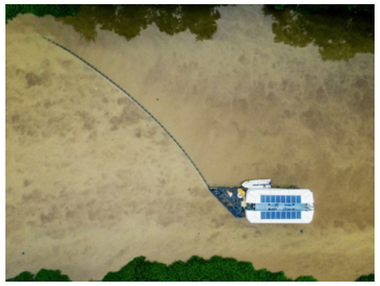


Figure 6.12. Interceptor
Source: Wired (2019)

Figure 6.11. Greening waterways
Source: PUB (2018)

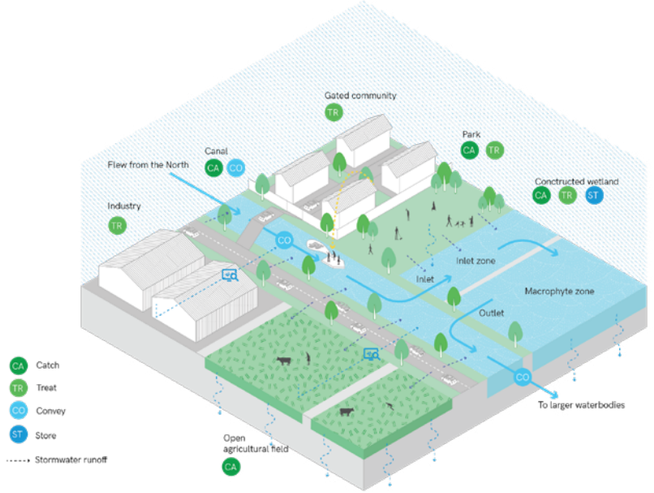


Figure 6.16. Hinterland and peri-urban water system
Source: Author

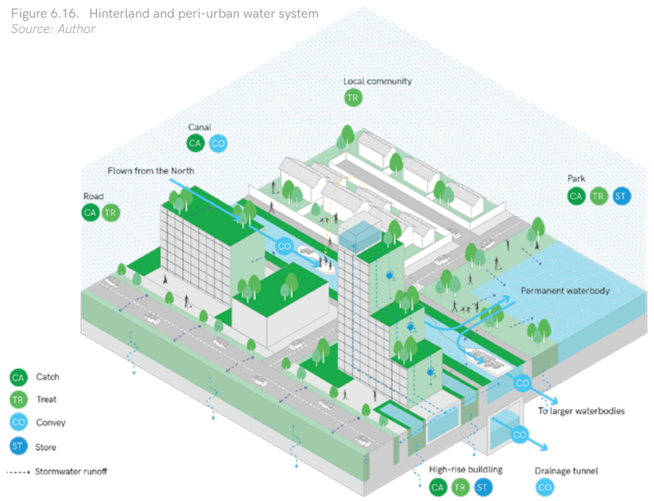


Figure 6.15. Suburban water system
Source: Author

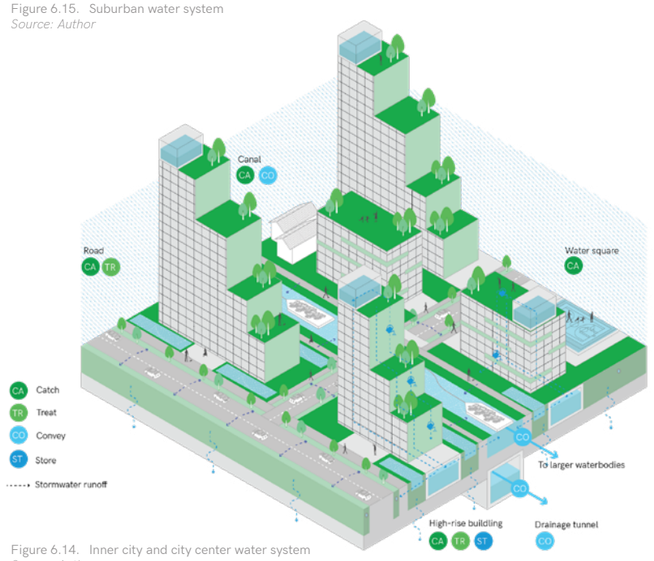
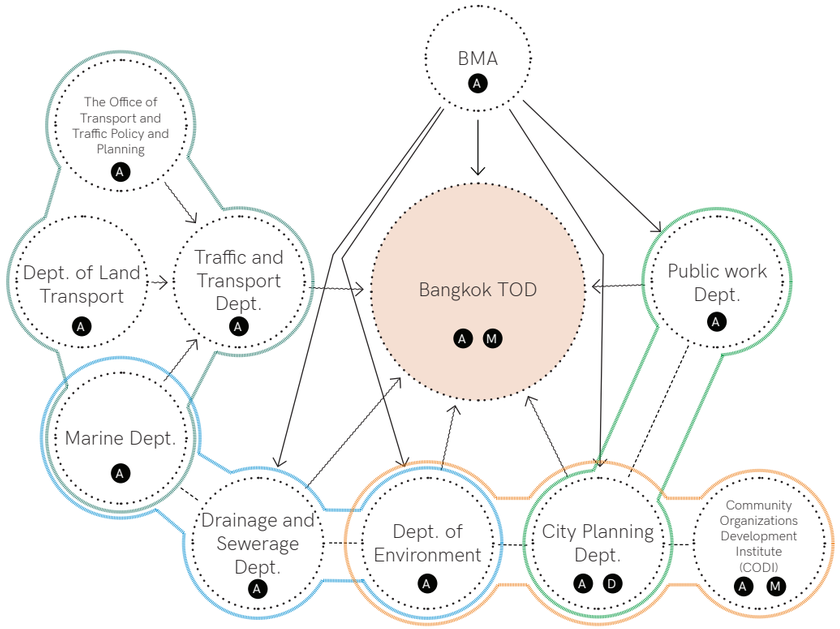


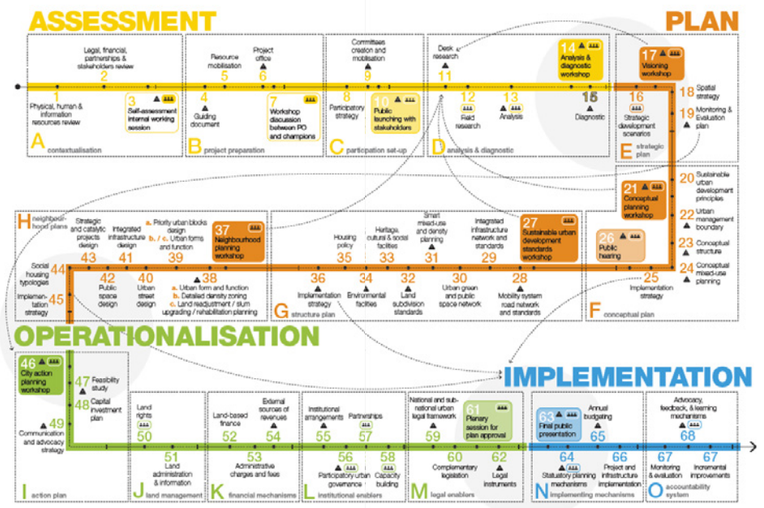
Figure 6.14. Inner city and city center water system
Source: Author

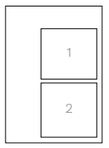
06.2. Strategic Integrated Model
06.2.7. Implementation phase

As discussed in the previous chapter, the planning system in Bangkok is complex, comprising various stakeholders and layers of governance which results in the ambiguity and delay of the project. Therefore, this part suggests the institutional shift that aims to reduce ambivalence and increase efficiency within the process. Figure 6.18 shows the involved stakeholders and their impact towards project. The Bangkok TOD is the proposed authority, responsible for making this vision happens with the support from the existing departments such as City Planning Department for density configuration layer, and Traffic and Transport Department for integrated urban mobility layer.

To actualize the proposed strategies, process planning needs to be executed. Particularly in the developing country like Thailand, where a wide range of governmental stakeholders takes part in the urban development projects, and the top-down approach is the predominant strategy, the integration of participatory models can enhance bottom-up-based planning. UN-Habitat (2020) has created the Participatory Incremental Urban Planning (PIUP) Toolbox to support local governments in developing countries to implement the New Urban Agenda and the Sustainable Development Goals. Its four phases include assessment, plan, operationalization, and implementation (Figure 6.17). Since this suggested tool aligns and suits with Bangkok's context, it is therefore applied in the planning of this project. Figure 6.19. illustrates the implementation phase of four layers with involved stakeholders. In each project, redevelopment phases are planned to ensure the consistency of the improvement. Thus, the repetitive phases are outlined. The extensive version of the phasing table is available in appendix 10.3.3 on page 199.







1 Figure 6.18. Suggested involved stakeholders and relations in Bangkok urban development
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

2 Figure 6.17. Participatory Incremental Urban Planning
Source: UN-Habitat (2020)

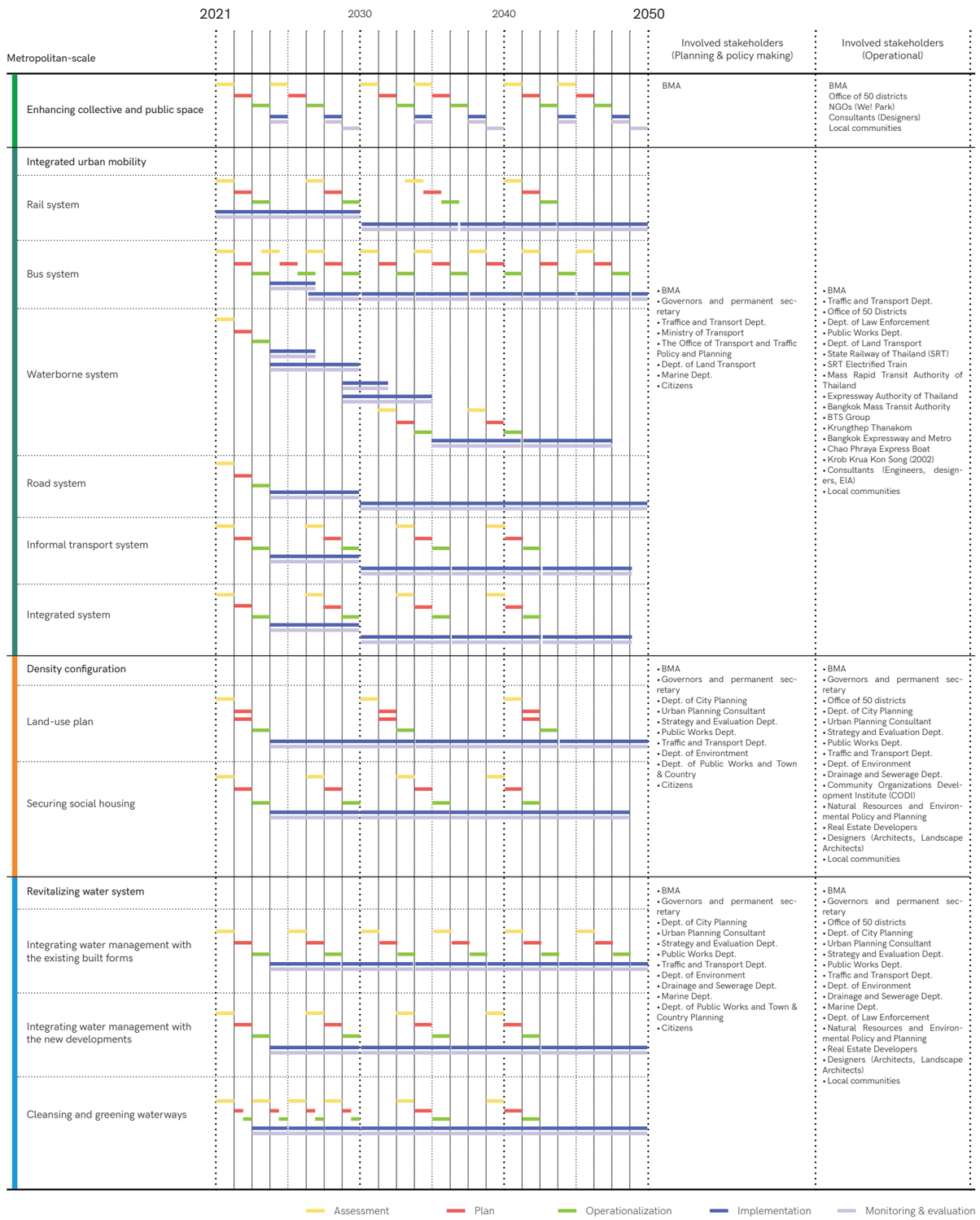


Figure 6.19. Phasing table
Source: Author

06.3. Toolbox

According to Alexander et al. (1977), cities will not be able to become alive, if they are not made by all the people in society, and if these people do not share a common pattern language. Therefore, the proposed strategies are translated into patterns shown in Figure 6.20. They are also divided into four categories as per layers for the application in micro-scale design intervention. Moreover, these patterns can also be used in the public participation, for example design workshop where local community, designers, and authorities participate.

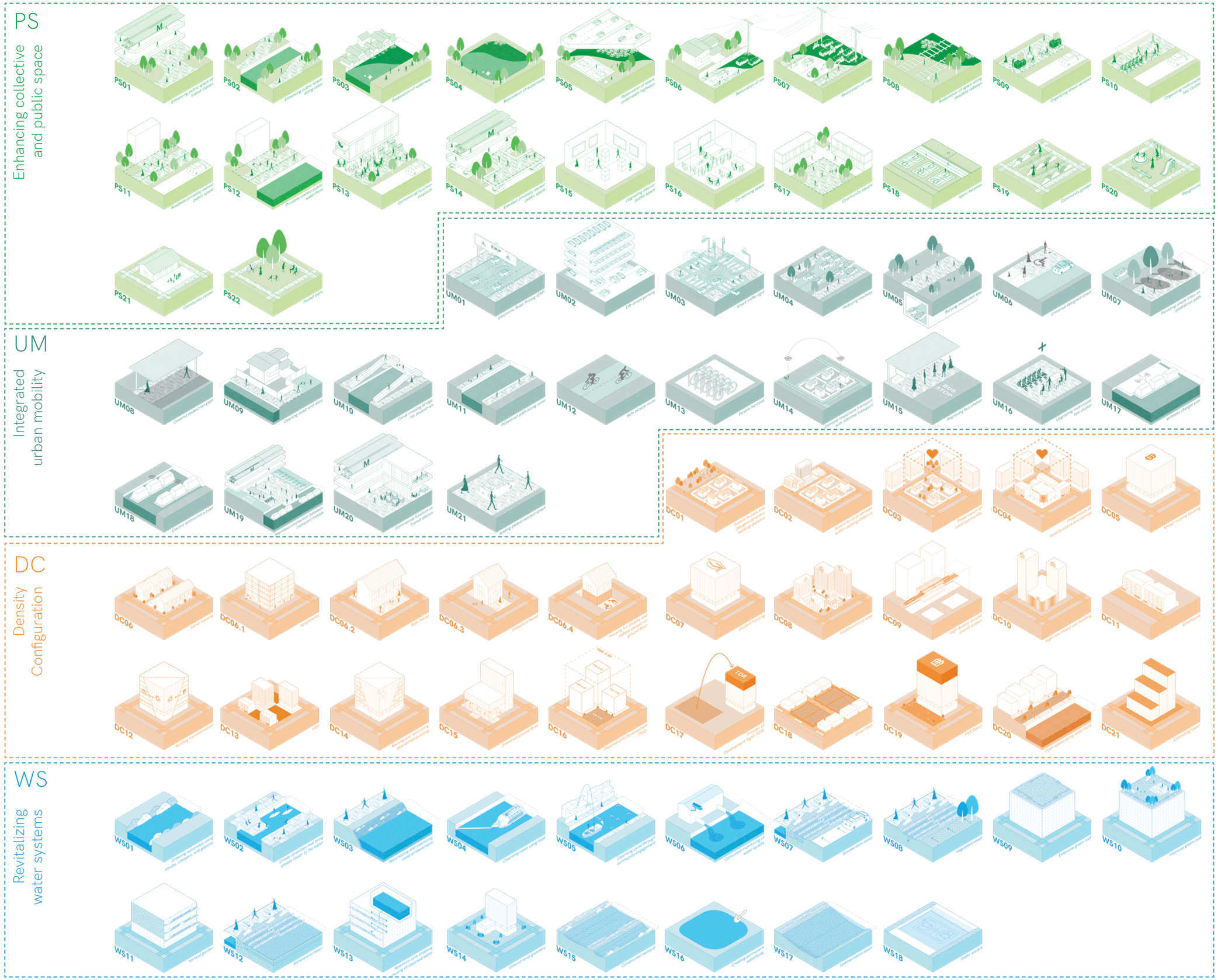


Figure 6.20. Toolbox
Source: Author

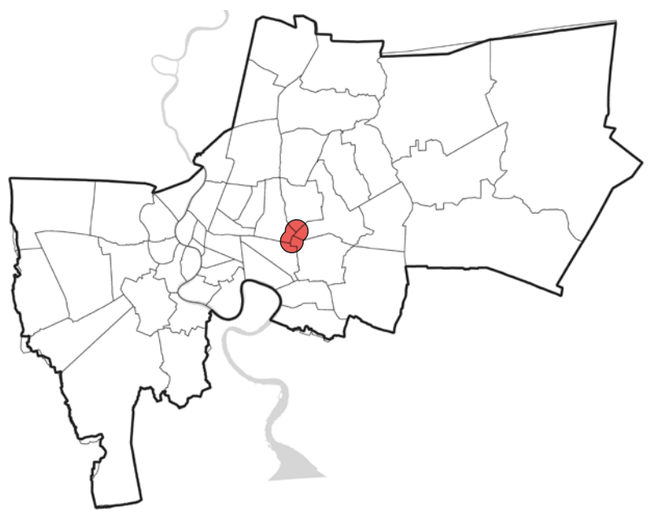
07. Pilot Project Analysis

Micro-scale spatial and socio-economic study

This chapter covers the analysis of the pilot project's location, Ramkhamhaeng. The study begins with the aspect of governance territories and land-use to understand who governs this area. Following with the spatial analysis of road networks, public transport networks, informal transport, public utilities, waterways, and built form is analyzed to comprehend the existing condition. The socio-economic study is then conducted to investigate who lives and works in this area concerning the functions and building types. Lastly, it concludes with development opportunities.

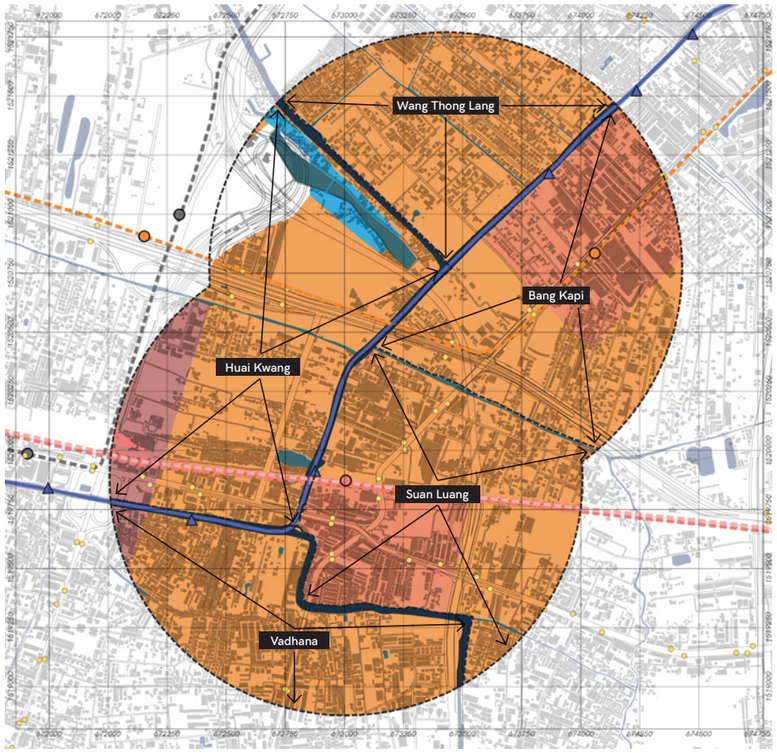
Figure 7.1. Pilot project location
Source: Author

07.2. Governance Territories and Land-use



Ramkhamhaeng is governed by five districts, divided by the canals. Each district has its organization and personnel who make permission to the construction. The division of territories has to be taken into consideration when planning. Regarding the zoning, three zones are planned: medium-density residential, high-density residential, and commercial (Figure 7.2).

The plan aligns with TOD since around the stations, the commercial zone is determined, while further around, the residential areas are zoned. However, if the canals are more essential arteries for mobility, the zoning will be adjusted and redefined to support the upcoming new nodes.



1 Figure 7.3. BMA districts
Source: Author, derived information form BMA GIS Center (2020)

2 Figure 7.2. Governance territories
Source: Author, derived information from BMA GIS Center (2020)

07.3. Mobility Network

07.3.1. Road network

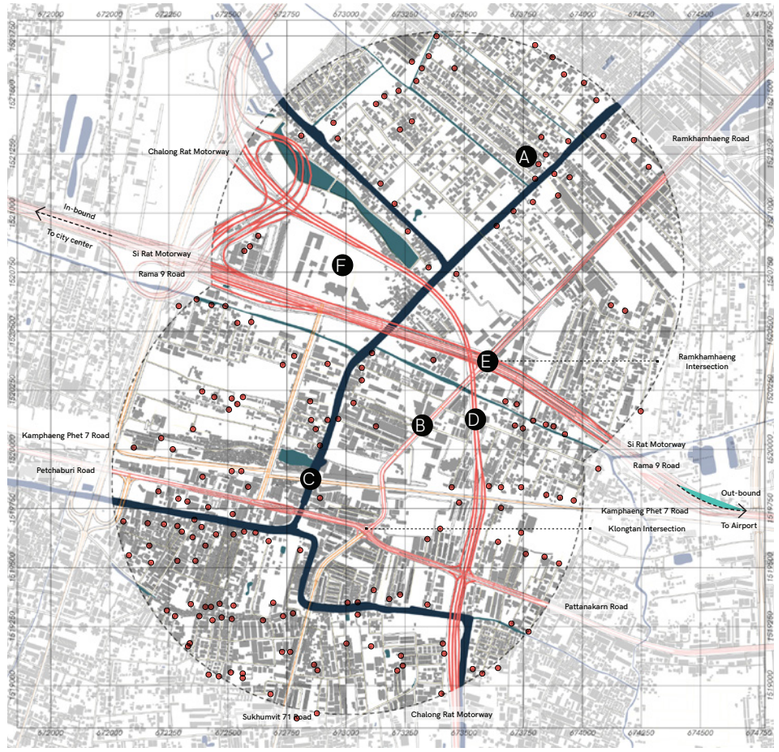
Roads play a crucial role in the mobility network in Ramkhamhaeng. Figure 7.5. demonstrates road hierarchy in which there are several layers to be considered.

The lowest and most intimate level is *soi*, facilitating accessibility to the residential buildings. Although the in-continuity can be seen in the layer as dead-ends are mostly at the end of most *sois*, blocking by the private properties (Figure 7.6.).

The second level is *thanon*, which means road. This layer includes primary, secondary, and tertiary roads, acting as the main arteries on the ground level (Figure 7.7.) The main priority is given to fast mobility, especially in Figure 7.4., the bridge overpassing the canal is only available for vehicles, and there is no pedestrian path provided. Therefore it limits slow mobility crossing the waterway.

The highest level is the highway in which there are two major highways intersect and create the enormous drosscape in between as shown as F in Figure 7.5. Moreover, underneath these highways, waste spaces are in an indecent condition, full of concrete pavement and abandoned. Some of them near the residential area is utilized as sports facilities and commercial area, while others are abandoned (Figure 7.8.).

This intensive road network shows how car-oriented this area, posing various opportunities to deprioritize private vehicles and synergize with public transport with the waterways and enhance the quality of public spaces.



1 Figure 7.5. Road network in Ramkhamhaeng area
Source: Author, derived information from OpenStreetMap (n.d.)

2 Figure 7.6. Dead-end
Source: Google, (n.d.)

3 Figure 7.7. Ramkhamhaeng road
Source: Google, (n.d.)

4 Figure 7.4. Lack of pedestrian path on canal crossing bridge
Source: Google, (n.d.)

5 Figure 7.8. Drosscape under the highway
Source: Google, (n.d.)

6 Figure 7.9. Ramkhamhaeng intersection
Source: Google, (n.d.)

07.3. Mobility Network
07.3.2. Public transport network

The existing and planned public transport network in Ramkhamhaeng comprises both land-based and water-based networks (Figure 7.10.).

Public rail transport that supports this area is ARL, which connects the city center and Suvarnabhumi International Airport. Ramkhamhaeng station is the only station on this line in the location. Underneath the elevated ARL line, the traditional railway runs connects the current Bangkok Central Station and the Eastern provinces (Figure 7.11.). On the Northern side, the underground MRT Orange line is being constructed where one station is located in this area.

Two modes that run on the primary road are the bus (Figure 7.12.) and local minibus *(kapor)* (Figure 7.13.). The bus is more formal which picks up and drops off passengers at the bus stop. While *kapor* is more informal.

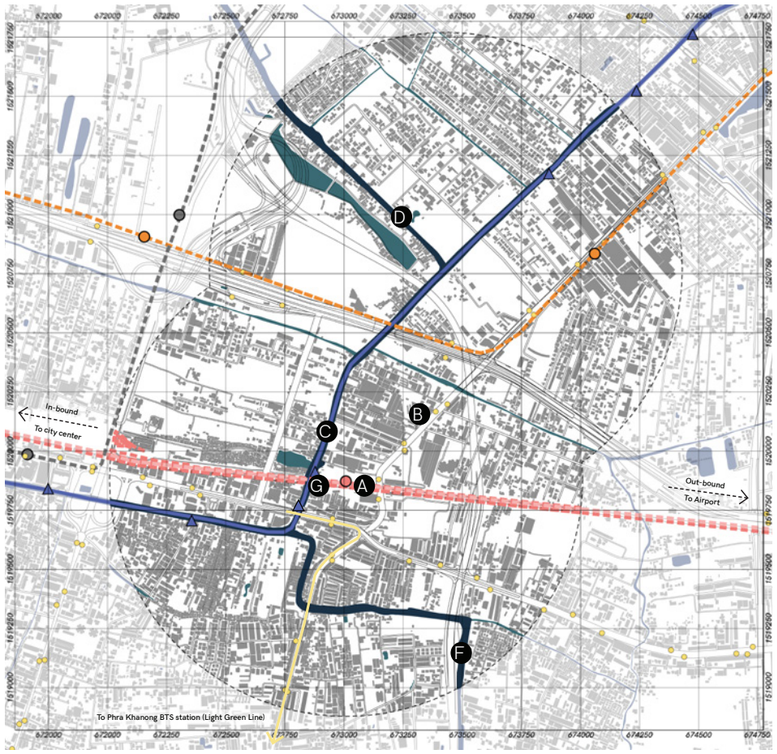
Water-based network is mainly supported by the Saen Saeb Canal Boat (Figure 7.14.). The piers are located near the attractions, for example, the shopping mall and the university. Also, where it crosses with the ARL line, the pier is located, and commuters can transfer between the land-based and water-based network (G in Figure 7.10.).

The other two proposed lines are N1 (Ladprao Canal) (Figure 7.15.) and E2 (Klong Tan Canal) (F in Figure 7.10.). These waterways will provide more choices of transport for commuters and enhance the continuity of mobility to the Northern and Eastern side of Bangkok.

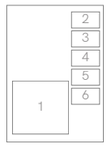
Accessibility

Figure 7.16. illustrates public transport accessibility within walking distance of 500 meters as it is the length that people are willing to walk in the Bangkok context, where there are various hindrances (Pongprasert & Kubota, 2019). As shown in Figure 7.18., many obstacles discourage people from walking both on the primary roads and in the *sois*, whether it is the construction sites, street vendors, the lack of pedestrian path, and parked cars.

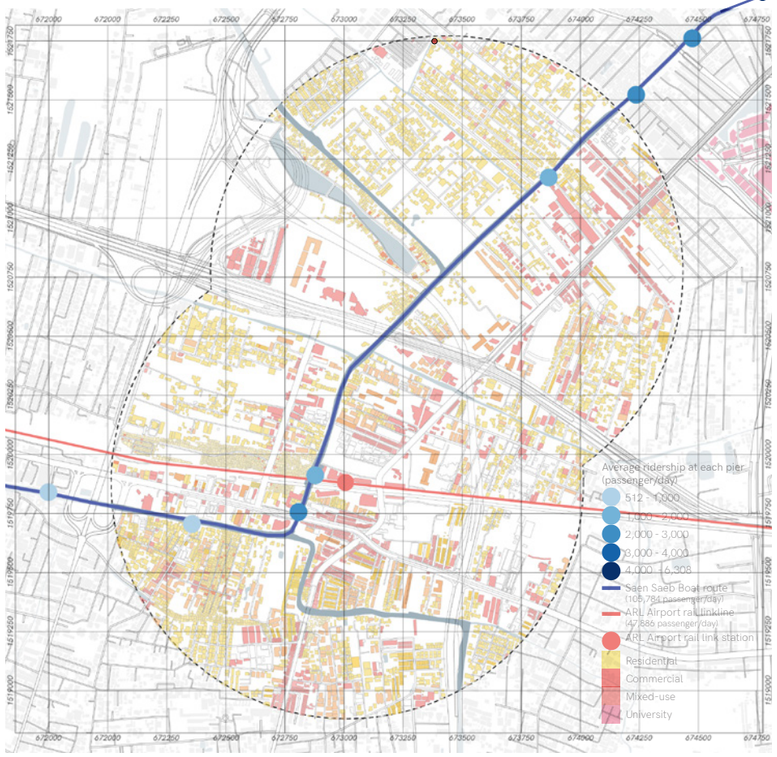
The tool used in this analysis is the attraction reach in Place Syntax Tool, which calculates, for each object in a set of origin objects, the sum of all attractions from a set of attraction objects that can be reached via the network within the defined radius (Stavroulaki et al., 2019).



Legend for the map
- SRT Light red line
- ARL Airport rail link
- ARL Airport rail link station
- MRT Orange line
- MRT Orange line station
- BMA Grey line
- BMA Grey line station
- Bus stop
- Saen Saeb boat route
- Saen Saeb boat pier
- *Kapor* route



1 Figure 7.10. Public transport network in Ramkhamhaeng area
Source: Author, derived information from BMA GIS Center (2020), OpenStreetMap (n.d.), and site observation
2 Figure 7.11. Ramkhamhaeng station
Source: Google (n.d.)
3 Figure 7.12. Bus
Source: Google (n.d.)
4 Figure 7.13. Mini local bus (kapor)
Source: Condotiddoi (2017)
5 Figure 7.14. Saen Saeb Canal
Source: Google (n.d.)
6 Figure 7.15. Ladprao Canal
Source: Google (n.d.)



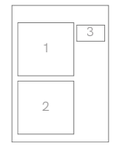
The result shows that the area around Ramkhamhaeng station and MRT Orange line metro station has better accessibility than the area with deep *sois*. This demonstrates why people choose to hail *wins* to reach their destination when people get off the station.

Ridership

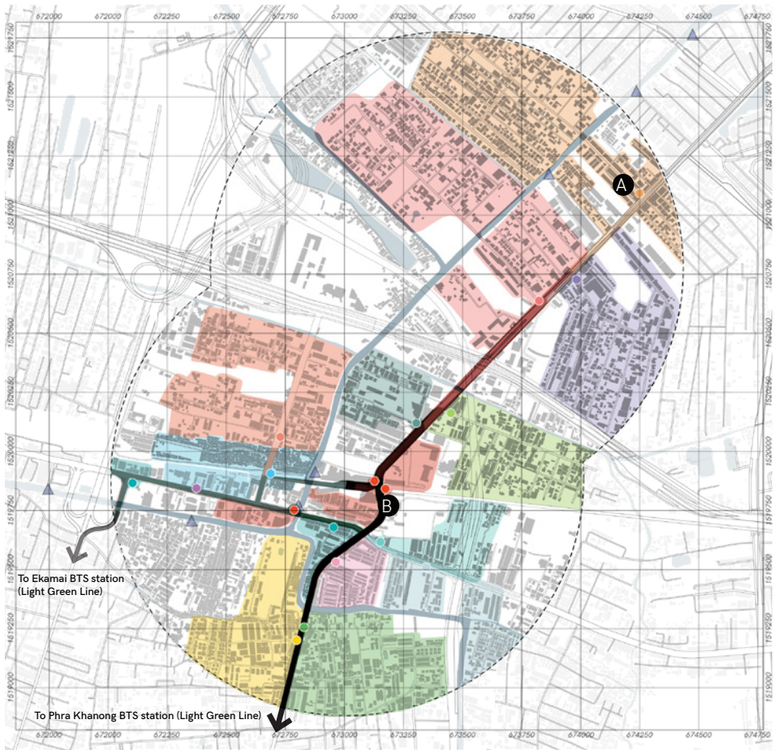
The entire Saen Saeb Canal has the most ridership among all transport routes on the canal. Figure 7.17. analyzes the ridership of each pier showing that the most crowded piers are located outside the spheres.

According to the map, the Northeastern pier supports the accessibility to the university. Simultaneously, the most Western one is intensively used due to the nearby Thonglor (the upper-class residential and commercial area). However, within the sphere, the ridership is lesser, which could mean that there are no anchor points to attract people, even at the pier next to the ARL station has relatively low average use.

These conditions show the opportunities to develop this area to attract more people by providing more anchor points, making the area more concentrated with activities and consequently enhancing public transportation ridership.

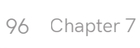


1 Figure 7.16. Public transport accessibility
Source: Author, derived information from BMA GIS Center (2020), OpenStreetMap (n.d.)
2 Figure 7.17. Average ridership of each transport mode
Source: Author, derived information from Marine Department (2019), The Department of City Planning (n.d.)
3 Figure 7.18. Hindrance on the primary road
Source: Google, (n.d.)



Legend for the map

- Motorcycle cluster with its catchment area and plausible routes (color varies)
- Motorcycle cluster that located next to transit station
- ARL Airport rail link station
- MRT Orange line station
- Bus stop
- Saen Saeb boat pier



1 Figure 7.20. Motorcycle taxi cluster at the beginning of soi
Source: Google, (n.d.)
2 Figure 7.19. Motorcycle taxi cluster across Ramkhamhaeng Station
Source: Google, (n.d.)
3 Figure 7.21. Win clusters and their catchment in Ramkhamhaeng area
Source: Author, derived information from site observation

Motorcycle taxi *(Win)*

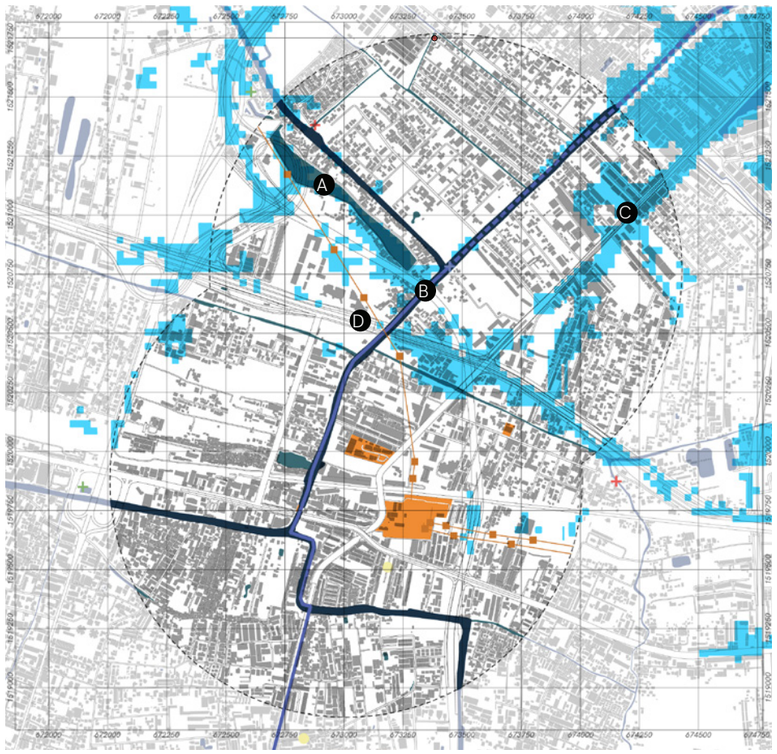
Figure 7.21. illustrates the clusters of *win* based on site observation. Each cluster has its catchment of the customers whom they are relied on. For example, residents in the residential area in the North rely on the clusters would hail the *win* at the cluster at the beginning of *soi* to reach their residences or somewhere else. However, if their houses are located in the deep *soi*, further than the walking distance, they could call *win* to pick them up and go to their destination. Therefore, on the main road (Ramkhamhaeng Rd.), there is a high concentration of *win*'s journeys, especially near Ramkhamhaeng station and further to the South towards the CBD.

Win clusters located at the beginning of *sois* are mostly busier in the morning than in the evening, as people travel from home to work in the morning (Figure 7.20). Whereas, in the evening, they could hire the *win* underneath the station to return home (Figure 7.19).

The fundamental physical condition that needs to be aware of its existence is public utilities. Figure 7.22. illustrates the essential public utilities in the Ramkhamhaeng. There are mainly two networks requiring attention: the water management system and the high voltage electric network.

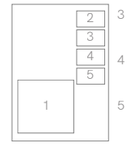
The significant element of the water management is the Rama 9 pond, the aeration pond utilized for wastewater treatment that connects with the Ladprao canal (Figure 7.23.). Moreover, the flood risk is a crucial aspect that has to be tackled. As shown in the map, the flood area in 2011 indicates that the Northern side is vulnerable; even when the high precipitation occurs, water does not drain properly and results in the flash flood (Figure 7.25.). To enhance the performance, the extension of the drainage tunnel is being constructed to accelerat drainage from the canals to the Chao Phraya River (Figure 7.24.).

Another vital element is electricity. The enormous structures of high voltage electric pole and cable passing through the area, which could limit some development (Figure 7.26.).



Legend for the map

- Future drainage tunnel
- Existing drainage tunnel
- Intake structure
- Flood gate
- Flood area in 2011
- Vulnerable area
- Electric utility
- High voltage pole
- High voltage cable
- Telephone exchange station



1 Figure 7.22. Public utilities in Ramkamhaen area
Source: Author, derived information from Bangkok GIS (2019), OpenStreetMap (n.d.)
2 Figure 7.23. Rama 9 Pond
Source: SiamFishing (n.d.)
3 Figure 7.24. Saen Saeb drainage tunnel project
Source: Team Group (n.d.)
4 Figure 7.25. Flash flood on Ramkhamhaeng Road
Source: Thairath (2017)
5 Figure 7.26. High voltage cable in Ramkhamhaeng
Source: Google (n.d.)

07.5. Waterways

07.5.1. Canal embankment types

Figure 7.27. Canal bank types map
Source: Author, derived information from The Department of City Planning (n.d.), site observation

As canals will be more prioritized for public transport, it is crucial to understand their existing conditions. This part analyzes their physical elements and water pollution.

First, the canal edges are investigated to see how they interact with the surroundings. Figure 7.28. - Figure 7.35. illustrate the types of embankments and structures above the waterways, in which there are seven categories, mapped in Figure 7.27. They are analyzed using the indicators of green-grey-blue infrastructure and to what length the embankments and canals interact.

To conclude, there is a scarcity of green infrastructure; most edges are either concrete structures or informal settlements. Moreover, for the interaction, the types with low connection with the water are transport infrastructure and private property, while piers and slums have the highest opportunities to interact with canals.

Canal and transport infrastructure

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

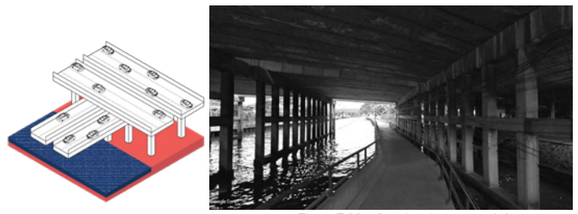


Figure 7.28. Canal and transport infrastructure
Source: Author

Opportunities:
- Restore underpass to be a public space that integrates many leisure activities, and sport facilities.
- Naturalize canal embankment.

Canal and private property

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

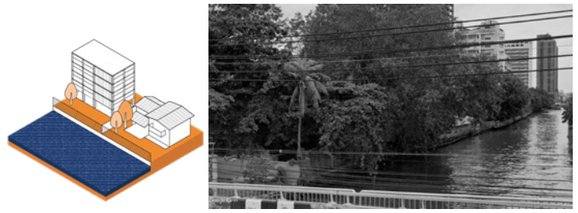


Figure 7.29. Canal and private property
Source: Author

Opportunities:
- Adding and greening paths to enhance accessibility and attractiveness respectively

Canal and concrete path

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

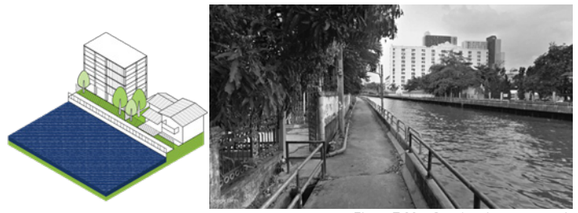


Figure 7.30. Canal and concrete path
Source: Author

Opportunities:
- Revitalise and green the paths to make them more attractive.
- Widen the paths so they can accommodate both cyclists and pedestrians

Canal and pier

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

Figure 7.31. Canal and pier
Source: Author

Opportunities:
- Strengthening the connection between the paths and piers, enhancing smooth transition of journey from slow mobility (walk, cycle) to fast mobility (boat) with, for example, bicycle racks.

Canal and abandoned site

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

Figure 7.34. Canal and abandoned site
Source: Author

Opportunities:
- Abandoned sites are more feasible to be developed as mixed-use project than the occupied ones. Thus, they will activate this strip and enhance the safety

Canal and encroachment

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

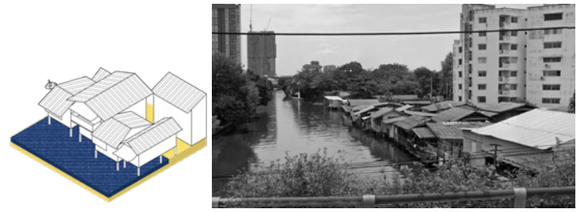


Figure 7.32. Canal and encroachment
Source: Author

Opportunities:
- Organizing the slum and securing housing for them with social housing program

Canal and bridge

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

Figure 7.33. Canal and bridge
Source: Author

Opportunities:
- More gentle slope, taking into account universal design

Canal and watergate

Green-grey-blue infrastructure: Green — Grey — Blue

Interaction: Low — High

Figure 7.35. Canal and watergate
Source: Author

Opportunities:
- Integrating it with paths, beautifying it to soften its look

07.5.2. Water pollution

Figure 7.36. Urgency of canal revitalization in Ramkhamhaeng
Source: Author

The same method to analyze waterways' quality as conducted on the broader scale is applied to the micro-scale. BOD and DO are used as indicators to determine how severe the quality is in this area (appendix 10.3.4. on page 202).

To conclude, Figure 7.36. describes the urgency to execute canal cleaning, based on the BOD and DO numbers. The most urgent ones are Klong Tan Canal (W2) and Ladprao Canal (N1), while Saen Saeb is less urgent. It is essential to clean the canals although they are already applicable to water transport. Since the cleaner the water is, the more pleasurable experience commuters get while traveling on the waterways.

07.6. Built Form
07.6.1. Building height

Since this area needs to be transformed in the future, the current volumes of built form have to be investigated. In this part, the existing building height and built density are analyzed. These analyses will be the fundamental layer that allows the understanding of where transformation should happen.

First, the building height is shown in Figure 7.37., indicating that low-rise buildings take most of this area, except for the strips along the primary roads and intersections, some high-rise buildings are located (Figure 7.38.).

Due to the constraint in the acquisition of spatial data, and to analyze the density as most accurate as possible, the area is divided into zones (Figure 7.37.). These are based on the distinction of urban fabrics. In the next part, floor space index (FSI), ground space index (GSI), and open space ratio (OSR) are analyzed according to these divisions.

1 Figure 7.38. Ramkhamhaeng area's building height
Source: Author, adapted from Google (n.d.)
2 Figure 7.37. Ramkhamhaeng area's building height
Source: Author, derived information from The Department of City Planning (n.d.), site observation

07.6.2. Density

The existing FSI shows that the area next to Ramkhamhaeng station is the densest. Likewise, the density is high along the primary roads due to the regulation that allows taller buildings to be constructed. However, in the residential area further from the main roads, the less dense condition can be seen, especially in the Northern residential zone (Figure 7.39).

Figure 7.40 and Figure 7.41 demonstrate that the area with less open space is the residential area on the East and informal settlements on the West and South of Saen Saeb Canal. While the residential areas with detached houses consist of more open space than others.

To conclude, this analysis sheds light on the possibilities for development. It shows the issues that need to be addressed, such as the less open space that requires public spaces. Also, the opportunities in the less dense area that the densification can happen.

In the next step, the socio-economic aspect is investigated in relation to the building's types and functions to understand who lives and uses this area.

1 Figure 7.39. Floor space index (FSI)
Source: Author, derived information from The Department of City Planning (n.d.), site observation
2 Figure 7.40. Ground space index (GSI)
Source: Author, derived information from The Department of City Planning (n.d.), site observation
3 Figure 7.41. Open space ratio (OSR)
Source: Author, derived information from The Department of City Planning (n.d.), site observation

07.7. Socio-economic

07.7.1. Mapping relationships

Figure 7.42. Land-use in Ramkhamhaeng
Source: Author, derived information from The Department of City Planning (n.d.), site observation

To understand the functions in relation to building types in this area and which group of people they accommodate, provide a place to work, and unwind, the socio-economic study is conducted. In this part, functions are divided into six categories: residential, commercial, and mixed-use, education and healthcare; religious site; industrial site; and lastly, public park and recreation. In each category, building types are visualized in relation to their users based on the site observation and assumption (appendix 10.3.5. on page 203).

Their relationships are mapped in Figure 7.43. Residential areas are the most private places for the local residents, especially the informal settlements that accommodate only low-income residents. While mid-rise apartments and condominiums are more diverse in terms of typology and dwellers.

Whereas the most public places where people gather are shopping mall and market. They are the places where all classes of local residents come for leisure, purchasing, and working purposes.

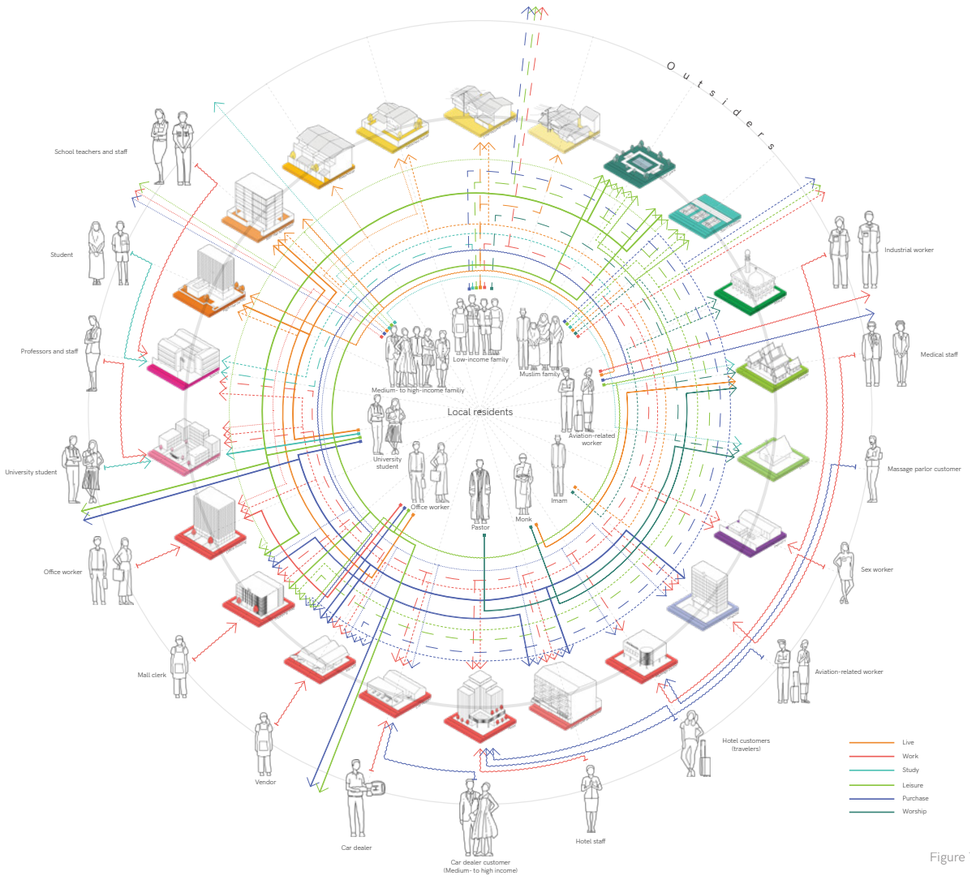
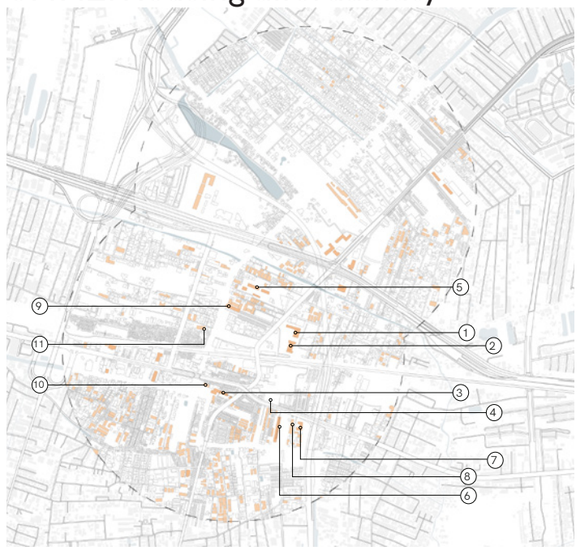


Figure 7.43. Socio-economic relationship
Source: Author

07.7.2. Housing affordability



One of the most principles of TOD is to enable the development of new affordable housing of acceptable standards within the station areas for low-income residents. Thus, the analysis of housing affordability is conducted to comprehend how Ramkhamhaeng is affordable and to search for opportunities to integrate mixed-income housing in this area. The analysis covers the study of rental and selling price of exemplary high-rise and medium rise apartments in Ramkhamhaeng.

Figure 7.46. indicates average housing affordability of Thai people which is between 1 and 2 million THB (MGR Online, 2019). However, the majority of the condominiums is sold at the higher rates, ranging from 2 million THB for the studio and 1-bedroom unit to 7 milion THB for the 2-bedroom unit. Therefore, there is an opportunity to provide more affordable housing units for low- and mid-income people. Also, Ramkhamhaeng is currently situated between suburban and inner-city area, thus, land price is not as high as that of the city center.

Figure 7.45. Exemplary high-rise and medium-rise apartments
Source: Author

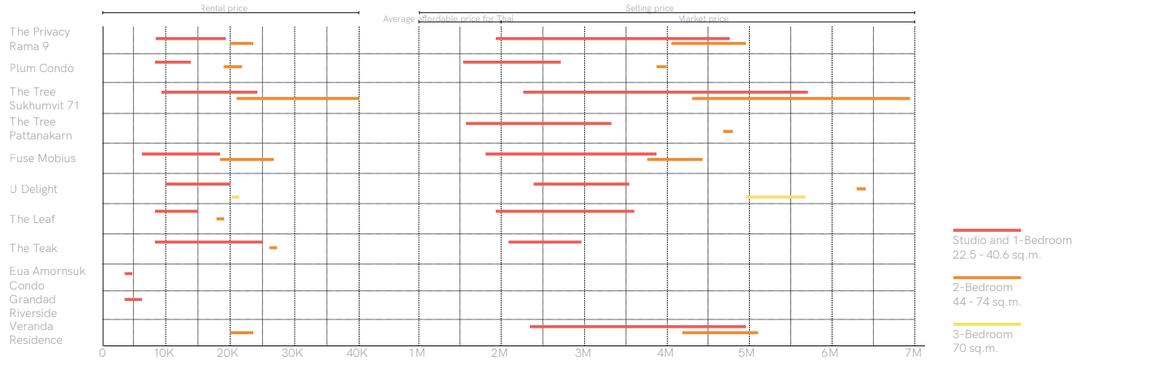


Figure 7.46. Analysis of housing affordability in Ramkhamhaeng
Source: Author

07.8. Opportunities

07.8.1. Static and dynamic

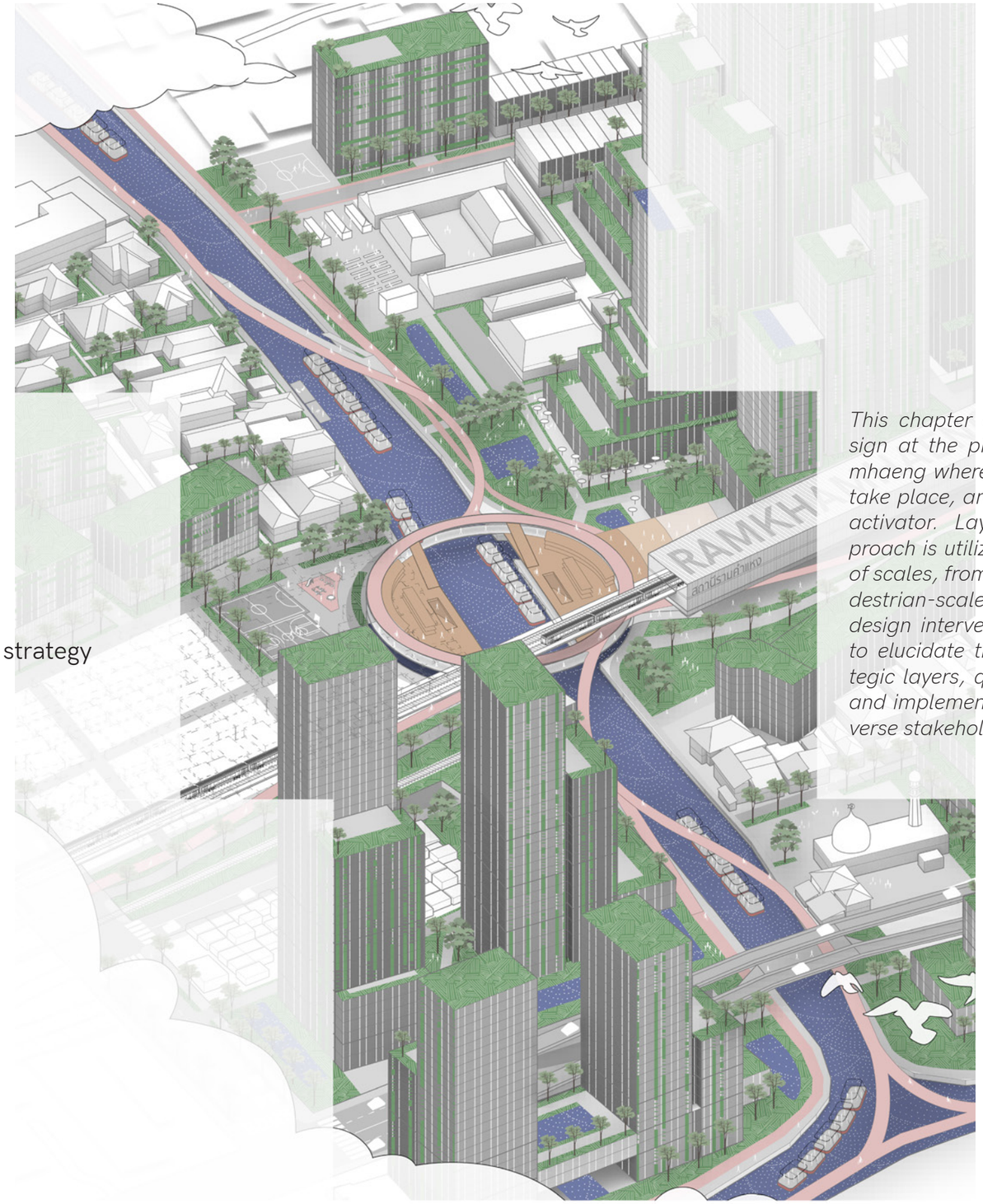
The chapter concludes with the opportunities and limitations for future development. The static and dynamic conditions of spatial elements within the site are mapped in Figure 7.44.

The static components have less or no possibilities to be transformed, such as highways, roads, *sois*, canal, university, and temple. While high-rise condominiums and office towers can be adapted in the future depending on their life cycles. The dynamic elements are the abandoned sites, abandoned buildings, which have high feasibilities to be developed. Whereas privately-owned plots, including private residences and commercial plots, can be bought by real-estate developers and transformed.

Figure 7.44. Static and dynamic elements in Ramkhamhaeng
Source: Author

08. Pilot Project Design

Micro- and nano-scale design intervention and strategy



This chapter elaborates on the design at the pilot location, Ramkhamhaeng where new urban center will take place, and canals are an urban activator. Layer-based design approach is utilized through multiplicity of scales, from micro-, nano- and pedestrian-scale. It concludes with the design intervention at four precincts to elucidate the integration of strategic layers, quality of public space, and implementation that involves diverse stakeholders.

Figure 8.1. The convergence of connecter and node
Source: Author

08.2. Vision

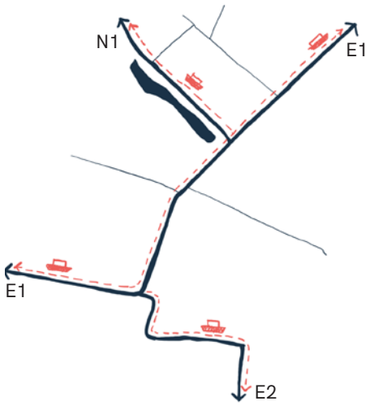
Ramkhamhaeng, the new urban center of Bangkok

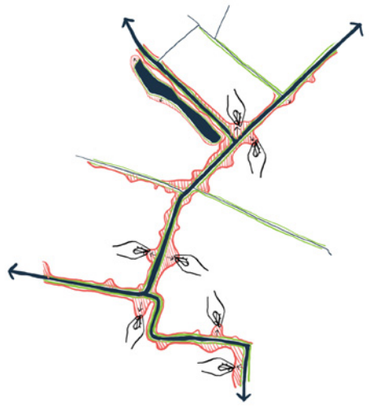
"In 2050, Ramkhamhaeng will become the new center of Bangkok where people are invited to live, work, and play. Canals will be unpolluted and optimized for transport, synergizing with other modes. They will play a vital role as an activator that brings about new economic development which not only benefits newcomers but also local residents."

Figure 8.2. Vision for Ramkhamhaeng
Source: Author

08.3. Concept

Canals as an urban activator





1 Re-establising its importance as a route

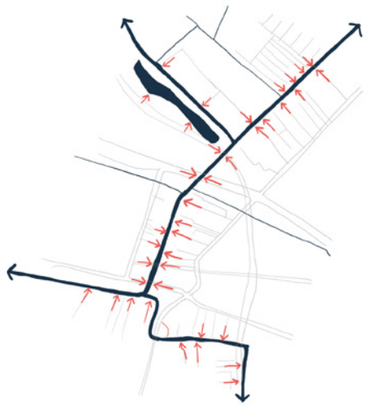
As potential waterways are proposed in chapter 4, In Ramkhamhaeng, there is Saen Saeb canal that has been predominantly used for waterborne transport that connects existing city center and the East. In this strategy, two other canals are introduced for transport to link Ramkhamhaeng to the North and Southeast of Bangkok. These vessels will collaborate and support people to make their journeys more efficient.

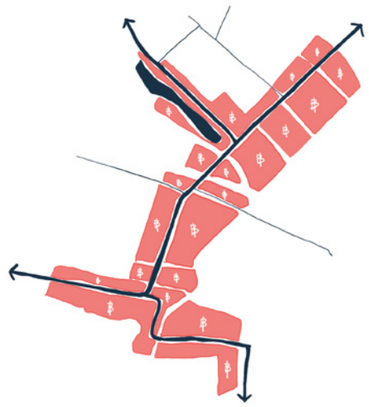
2 Expanding the perceived waterfront

Canals are not only used for fast mobility, but also slow mobility. Imagining them as a road, they also need generous pedestrian paths that allow people to stroll and cycle while enjoying the unique scenery of Bangkok's canalside. The perception of waterfront will be expanded to create more open spaces that invite people to unwind. They will gradually turn form backside to frontside of the developments.

3 Forming loops that enable healthy lifestyles

Ramkhamhaeng sphere will serve as a park in which the canals are active paths that form different loops. These paths will connect the existing parks and streets that will be transformed into an exercise-friendly paths. Residents can start jogging and cycling from their doorstep.





4 Bringing people closer to canal

But what can help canals to attract people? The connection is the key that encourages people to come to these public realms. Existing blocked ends will be opened allowing pedestrians to permeate through to canals.

5 Stimulating local economy

These strengthened connections will stimulate business, ranging from business run by local residents such as grocery stores, food stalls, to the office buildings and malls run by larger real estate developers.

08.4. Design Approach

Layer-based

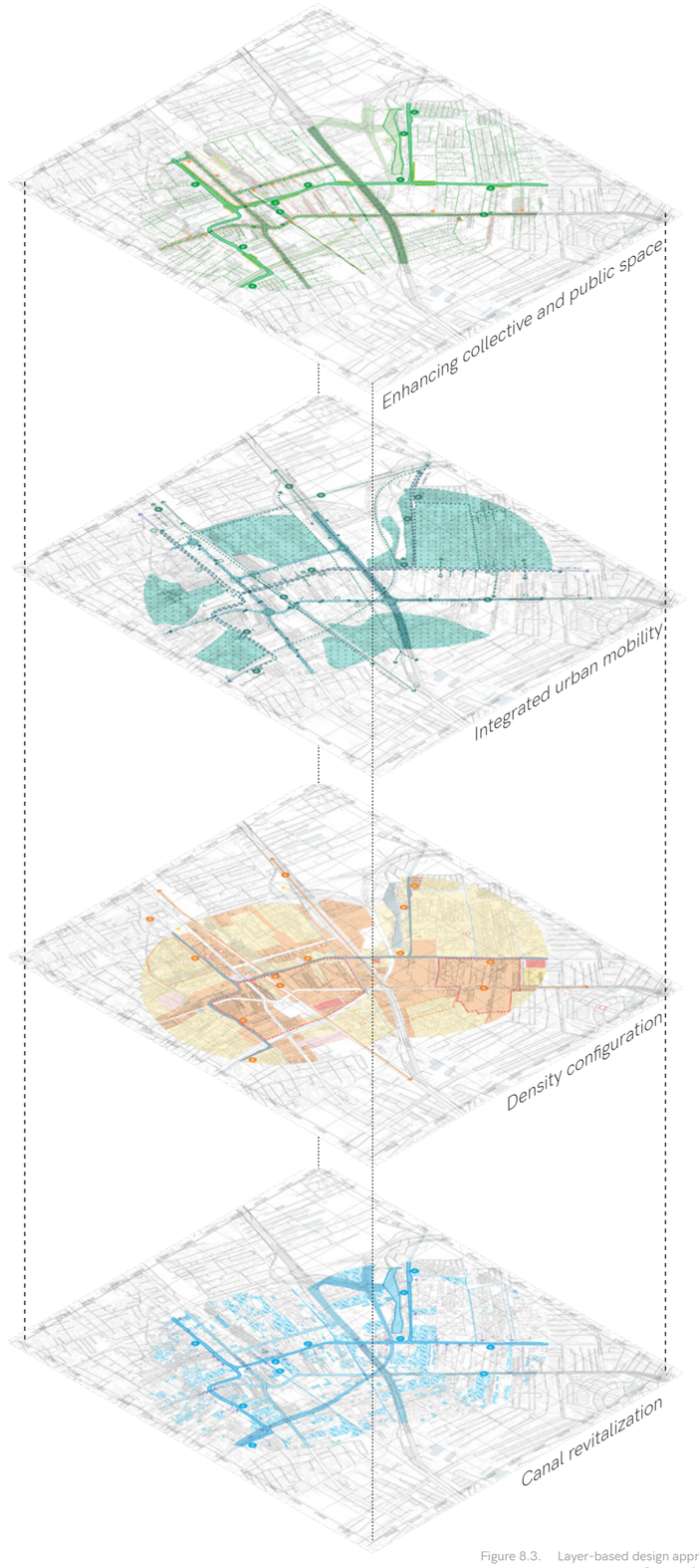


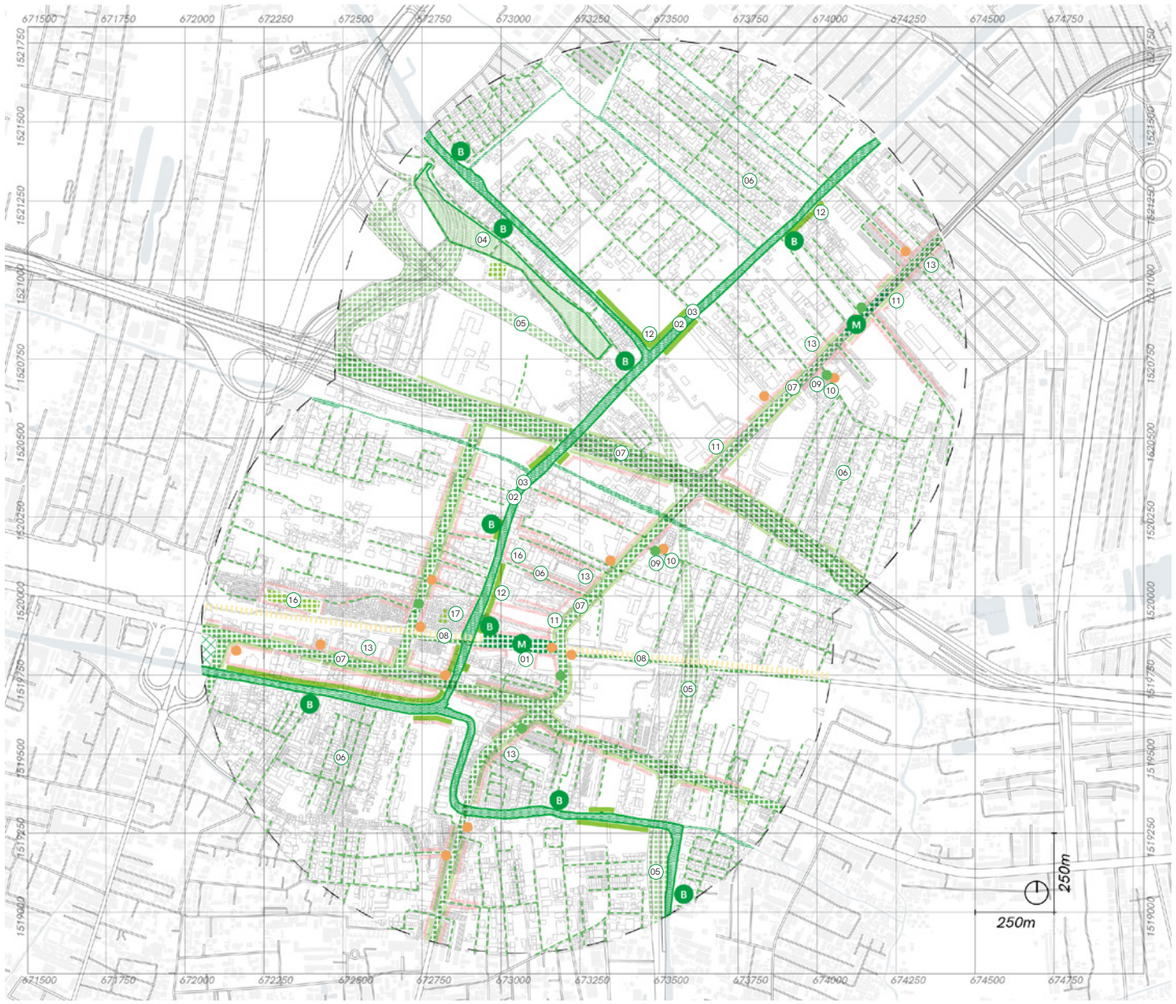
Figure 8.3. Layer-based design approach
Source: Author

To realize the concept of canal as an urban activator, the design intervention is conducted in Ramkhamhaeng area. As the strategy is proposed with four layers in chapter 6 (Figure 6.2 on page 74), and it is translated into patterns that aim to be applied in the micro-scale projects. This layer-based approach is utilized in the design intervention to systematically apply each pattern and ensure that all four aspects are tackled through the design (Figure 8.3).

In the coming part, the micro-scale strategy is proposed through four layers with the application of patterns.

08.5. Design Strategy

08.5.1. Enhancing collective and public space

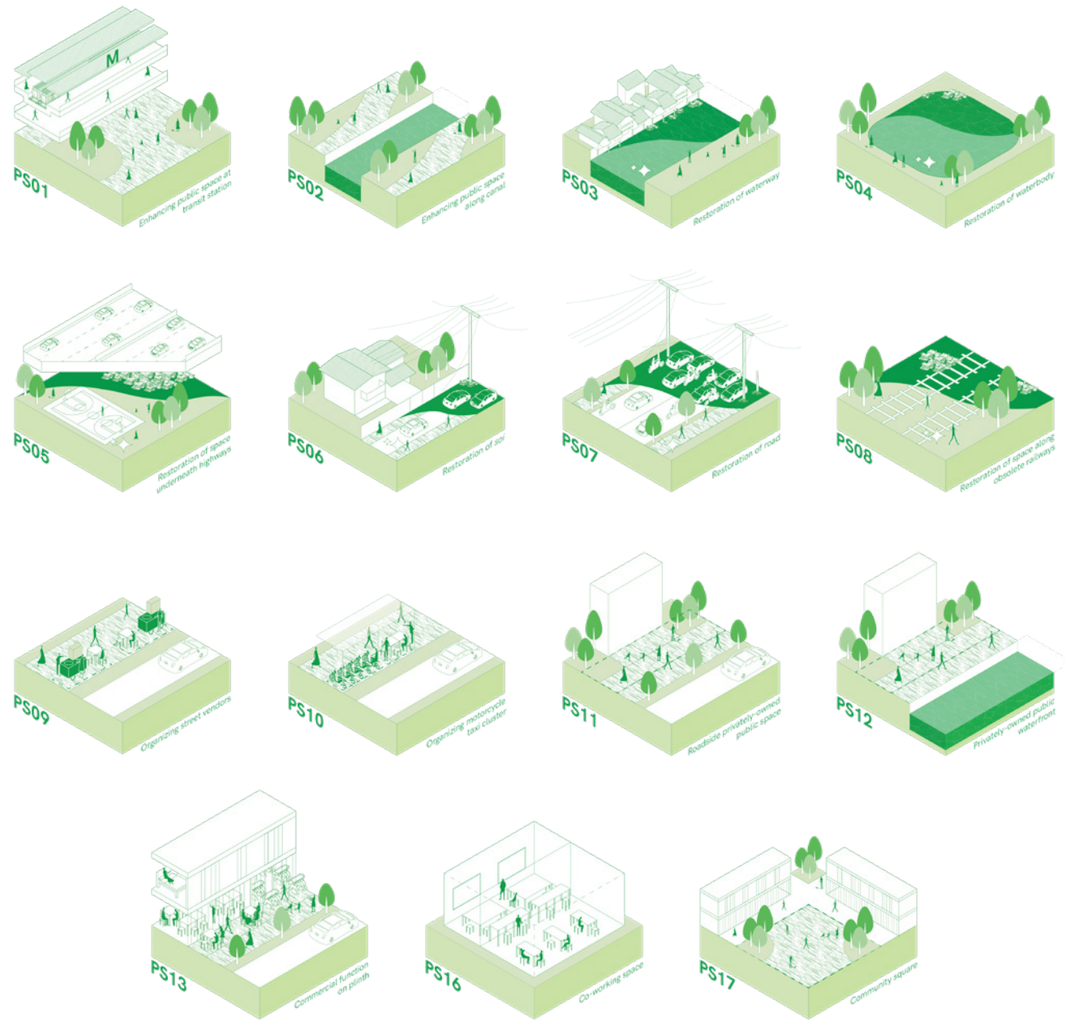


Enhancing public space at transit station
Enhancing public space along canals
Restoration of waterway
Restoration of water body
Restoration of space underneath highways
Restoration of soi
Restoration of road
Restoration of obsolete railway
Community square
Street vendor and encroachment management
Roadside privately-owned public space
Waterfront privately-owned public space
Retail function on plinths (Activity-generating uses)
Organizing motorcycle taxi cluster
Metro station
Pier
Existing public park

First, this layer aims to enlarge perception of public space and revitalize the existing collective space in Bangkok context as shown in Figure 8.4 with the applied patterns in Figure 8.5 on page 111.

The enhancing collective and public space layer can be described through the ownership of spaces. For the spaces that are possessed by public sector such as roads, canals, and spaces under the highways, the restoration will be executed to encourage more people to come and use them. Particularly on the roads where sidewalk is full of hindrances for example the street vendors, and motorcycle taxi clusters. To enhance walkability and provide space for active mobility, this informality needs to be organized.

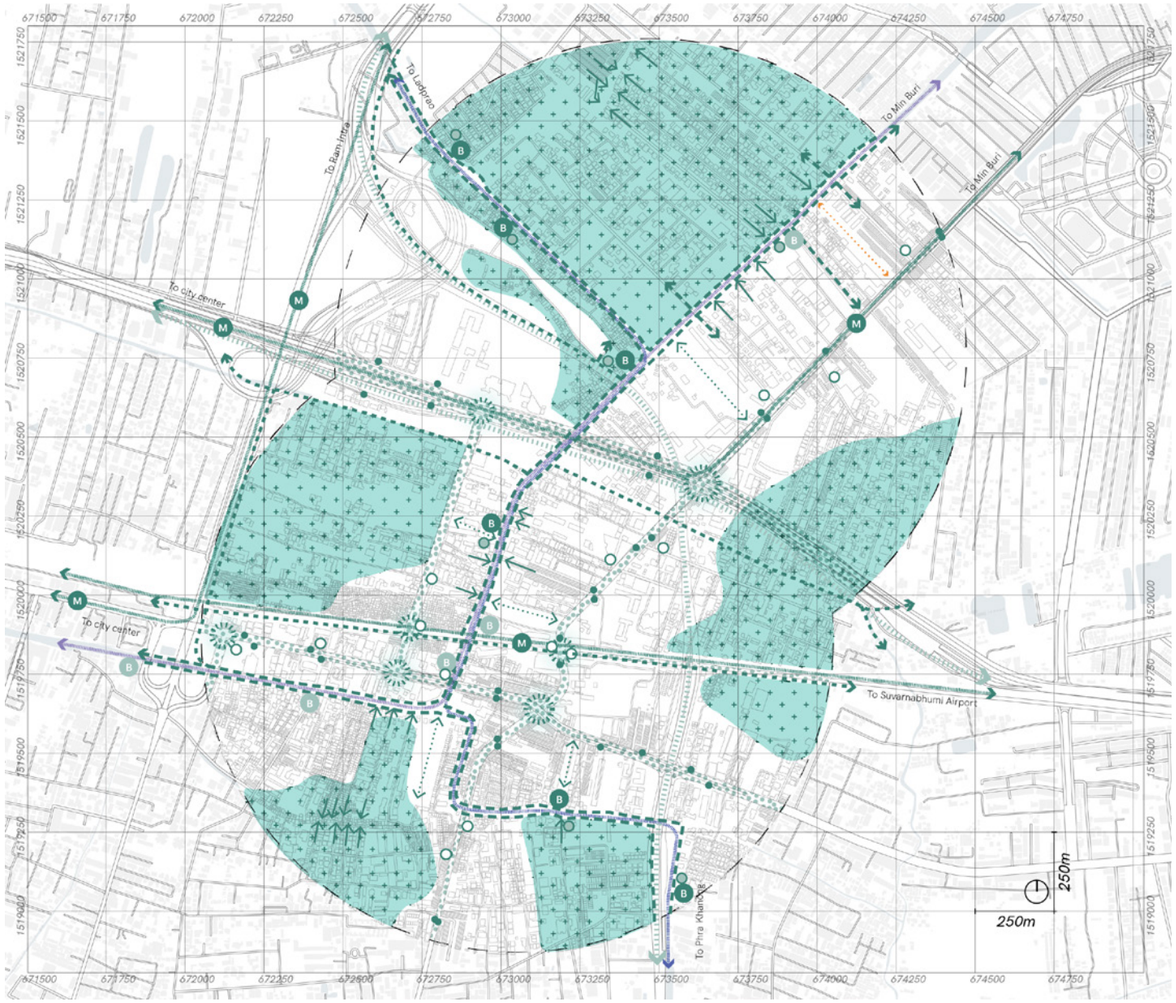
Figure 8.4. Enhancing collective and public space in Ramkhamhaeng
Source: Author



In the private plots, the mechanism of privately-owned public space (POPS) is utilized to enlarge the perception of public space along the roads and canals. However, to attract people to such spaces, commercial functions on the ground level plays a crucial role. Thus, these buildings will be guided to provide retail spaces on the plinths which consequently will enhance liveliness in POPS and generate profit to the estate's owners.

Most importantly, at the metro station where the mobility traffic is high, public space is essential to serve commuters. Notwithstanding, as the majority of spaces are owned by private sectors, POPS will also be applied.

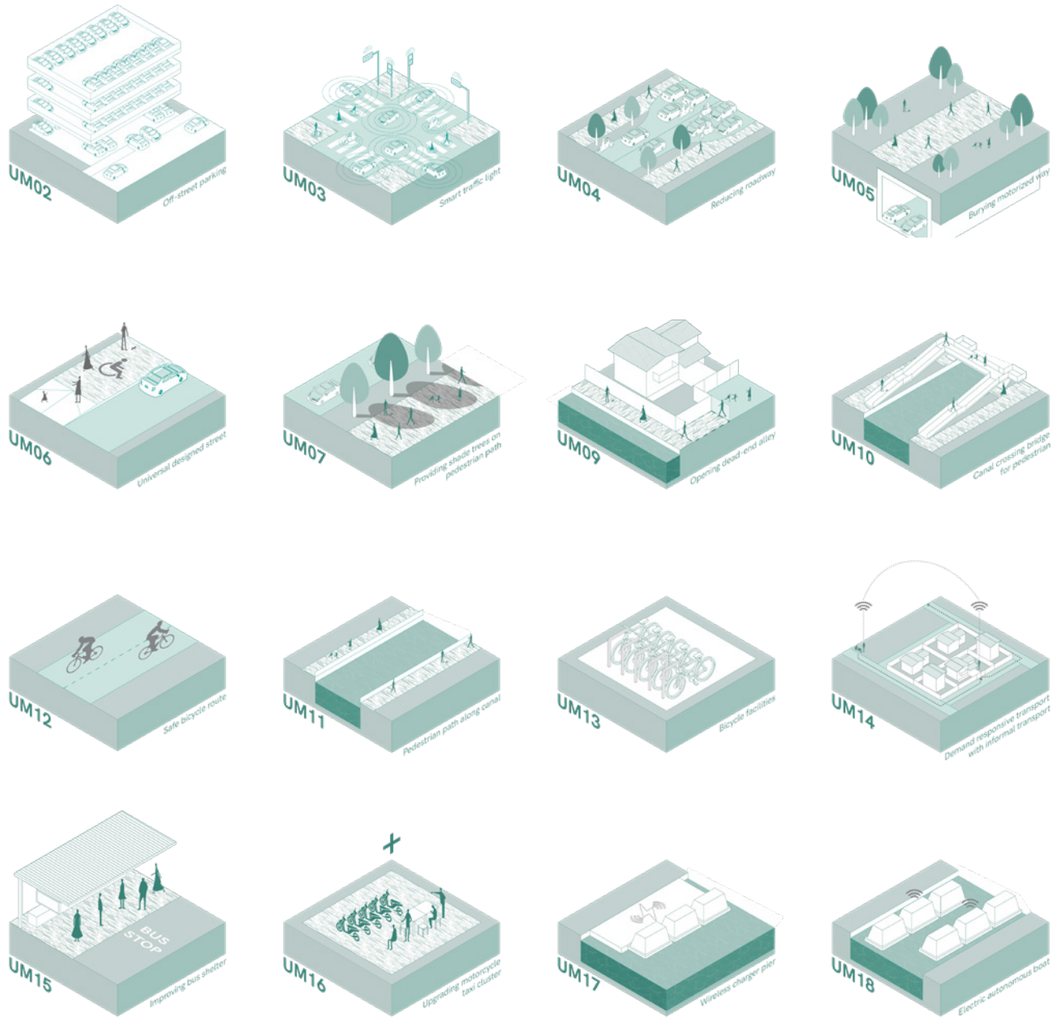
Figure 8.5. Patterns used for Enhancing collective and public space in Ramkhamhaeng
Source: Author



The second layer of integrated urban mobility in Ramkhamhaeng area is shown in Figure 8.6 with the application of patterns in Figure 8.7 on page 113.

The integrated urban mobility can be described through different networks. Beginning with streets, as in the future, private car dependency will reduce, roadways will be decreased to offer more spaces for active mobility. Smart traffic lights will be installed at the main intersections to help decrease the congestion. Regarding the pedestrianism, streets will be universally designed, shaded with tree canopies which makes them more walkable. Also, dead-end blocked by private properties will be opened through negotiation and incentives

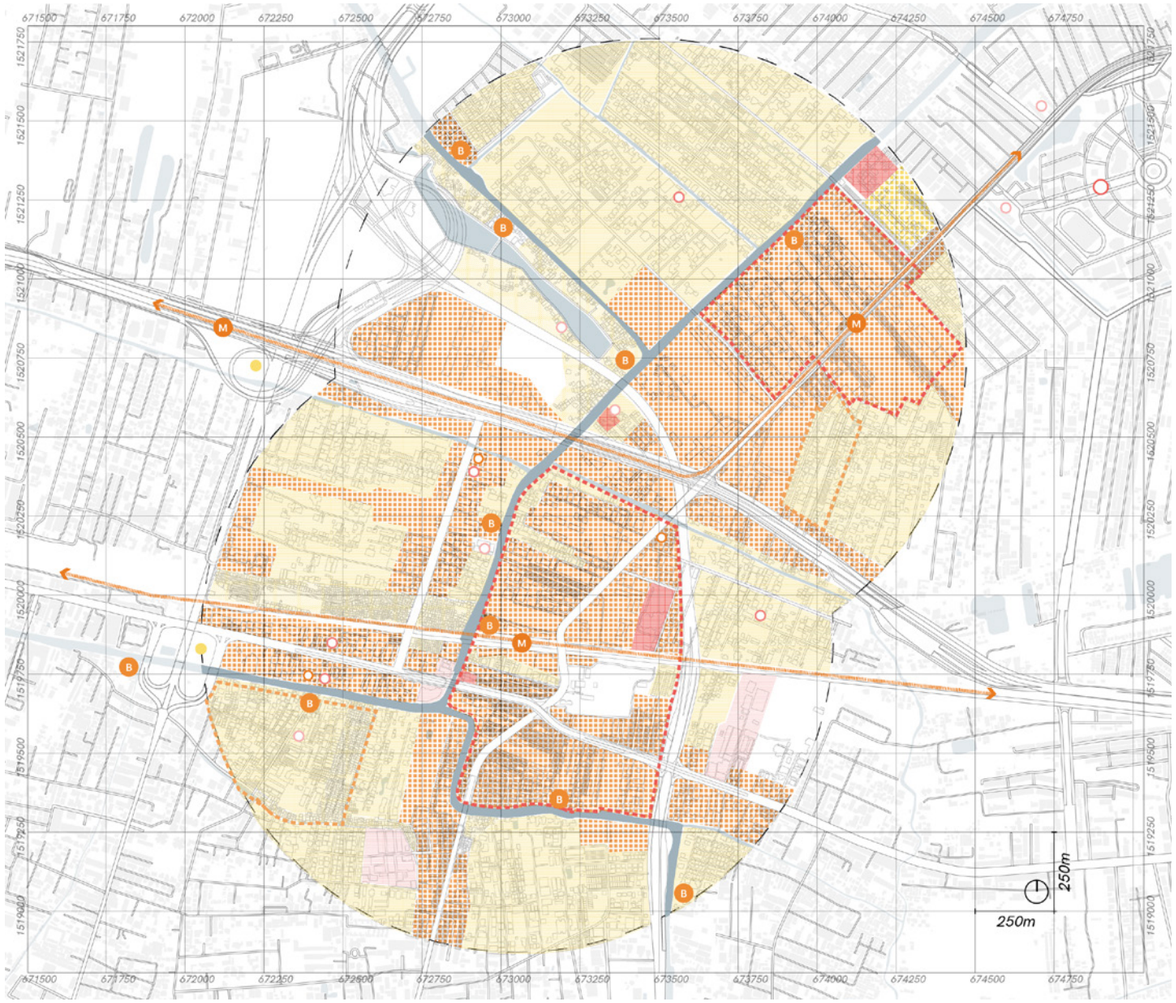
Figure 8.6. Integrated urban mobility in Ramkhamhaeng
Source: Author



which allow people to access developed pedestrian paths along canals.

Likewise, bicycle paths are proposed along the routes that not obstructed by car traffic which are along the canals and under highways. At the interchange stations, bicycle facilities will be provided for the seamless connection with boats, metro, and buses. Also, at the proposed piers, motorcycle taxi cluster will be added and upgraded so that commuters can hail them to access their destination further than walking distance. On the other hand, in the areas where public transport does not reach, the accessibility is enhanced through DRT. By doing so, people who live in such areas can also access the stations and piers within a short time.

Figure 8.7. Patterns used for Integrated urban mobility in Ramkhamhaeng
Source: Author



Mixed-use densification
Preserved local community
Preserved local business
Preserved heritage building
University student housing
Reusing and renovating abandoned building
Reorganizing and preservation of low-income community (social housing)
Proposed more open spaces
High density
Metro station
Metro line
Pier
Existing school
Existing unversity
Existing hospital and medical center
Existing park

Figure 8.8. Density configuration in Ramkhamhaeng
Source: Author

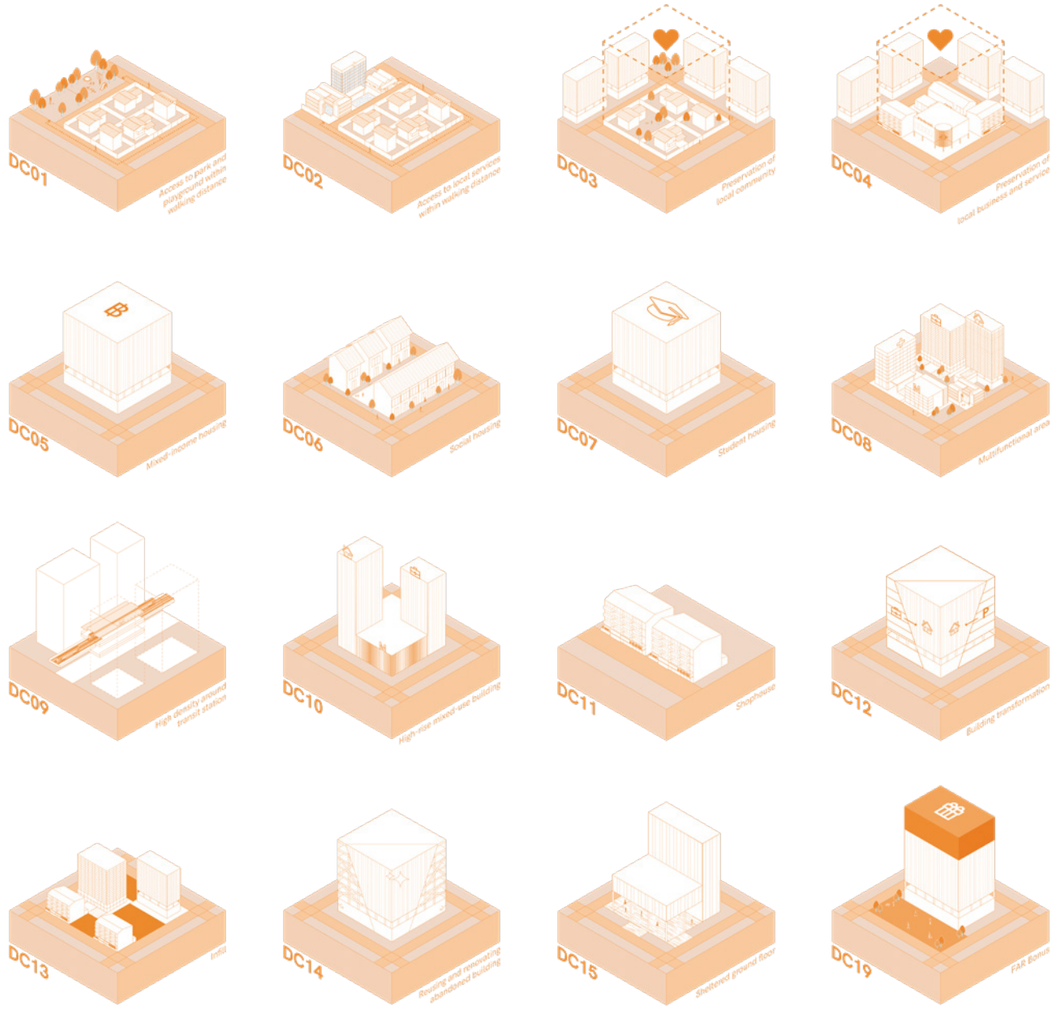


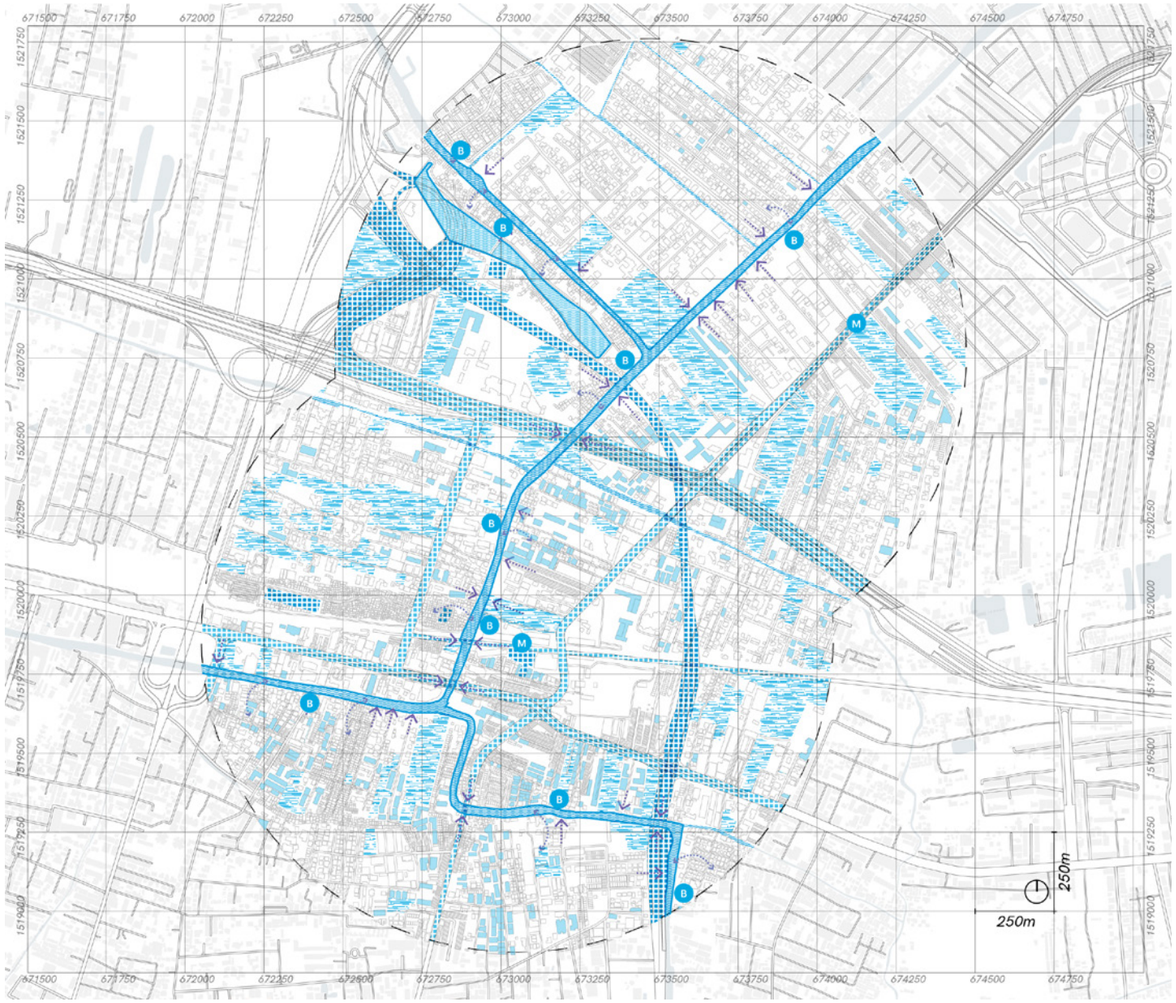
Figure 8.9. Patterns used for Density configuration in Ramkhamhaeng
Source: Author

The third layer of density configuration in Ramkhamhaeng area is shown in Figure 8.8 with the application of patterns in Figure 8.9 on page 115.

In the density configuration layer, mixed-use densification is proposed mainly around the station and along the canals. Whereas, local residents and business are taken into account and preserved in the densification process, including the existing religious sites, namely mosques, churches, and temple, which are the spiritual anchors and the gathering places of the local communities. Regarding the density analysis, some areas are too dense and need more open spaces such as the residential areas in the East and the South (page 101). While around the metro station can be densified with high density to support public transport networks and increase their ridership.

This mixed-use densification also takes into account the value of inclusivity as this area consists of various communities ranging from low-income enclaves to high-income residents, as well as different religions. The local communities and business will be safeguarded within the densification process where new developments emerging and attracting newcomers. Informal settlements will be organized and upgraded, where low-income residents are put as the heart of the development.

As mentioned in the public space layer, private sectors will be incentivized to provide POPS in thier plots. By doing so, FAR bonus will be given to them to compensate the ground-level they sacrifice and build more spaces on the towers.



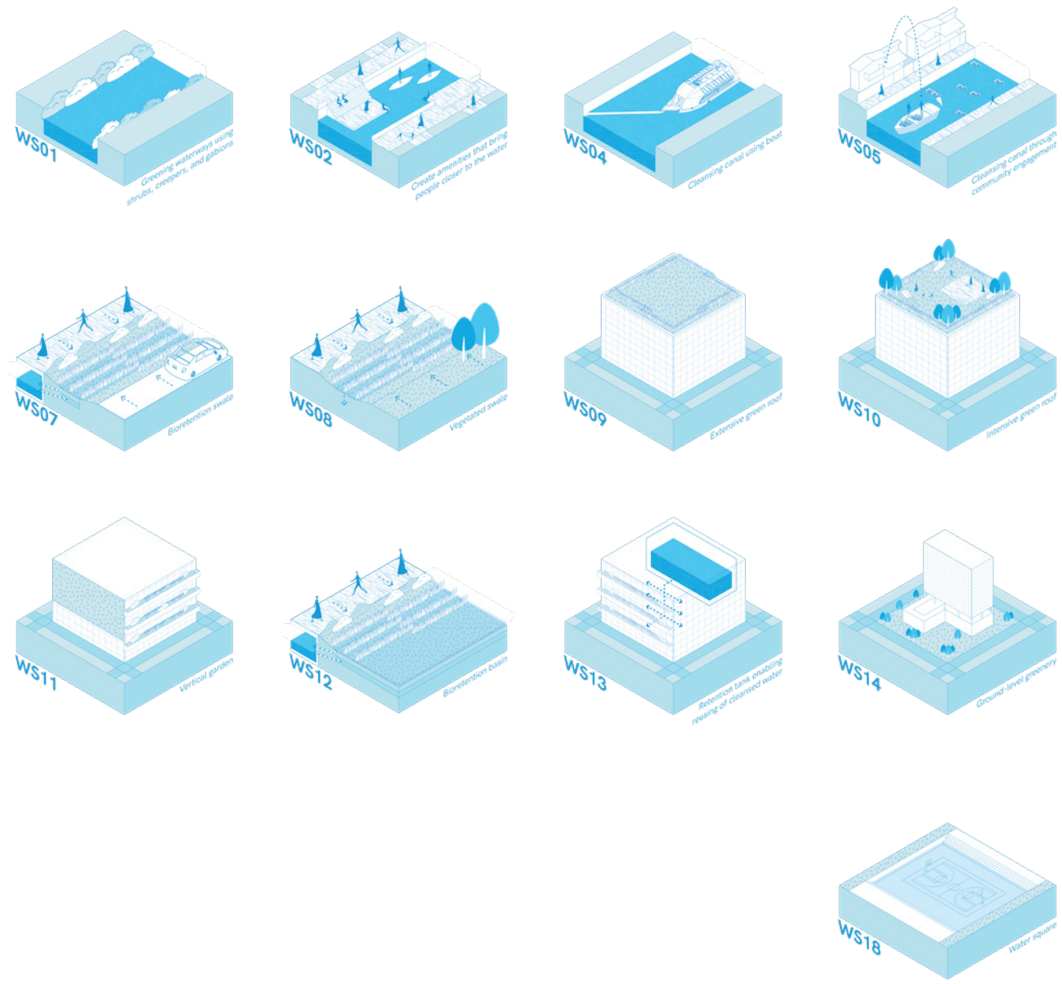
Roadside urban Infiltration strips
Waterway
Water body
Greening embankment
Create amenities bringing people closer to water
Community engagement
Integrating green roof on the existing buildings
On-ground green within privately-owned public space
Spaces that can be integrated with water square
Metro station
Pier

The fourth layer of revitalizing water systems in Ramkhamhaeng area is illustrated in Figure 8.10 with the application of patterns in Figure 8.11 on page 117.

The water system layer covers the design to enhance performance of water management. It can be described through the elements the strategy will be applied, waterways and water bodies, vehicular infrastructures and architecture.

First, as mentioned in the macro-scale strategy in chapter 6, waterways will be cleansed by the engagement of the local community as well as the innovative technology. At the same time, their embankments will be greened and beautified while

Figure 8.10. Revitalizing water systems in Ramhamhaeng
Source: Author



the amenities are added to attract people and increase the uses.

Along the vehicular infrastructures, such as roads and *sois*, urban infiltration strips will be applied to help catch stormwater runoff. Also, within the space where soft surfaces are hard to apply, for example, under highways, water square can be introduced.

As the area is already dense and reclamation of open space is difficult, one way to enhance stormwater water management is to integrate the system into the architecture. The existing high-rise and mid-rise buildings as well as newly developed buildings will be integrated with the rainwater systems such as green roof and vertical gardens to enlarge water catchment and treatment. And to enhance participatory values, waterways and water body will be cleansed through community engagement where they can earn an income from recycling collected waste.

Figure 8.11. Patterns used for Revitalizing water systems in Ramkhamhaeng
Source: Author

In conclusion of the layer-based micro-scale planning and the application of patterns, it is not clear enough whether proposed patterns that are suitable for the more micro scale will work. Thus, there needs to be an intervention in the finer scale to test the patterns.

Figure 8.12 shows the combination of four layers which shows that canal is the critical element that needs to be intervened due to the congregation of strategy proposed there. Therefore, in the next part, the design elaboration will focus on the canals and the surrounding built forms.

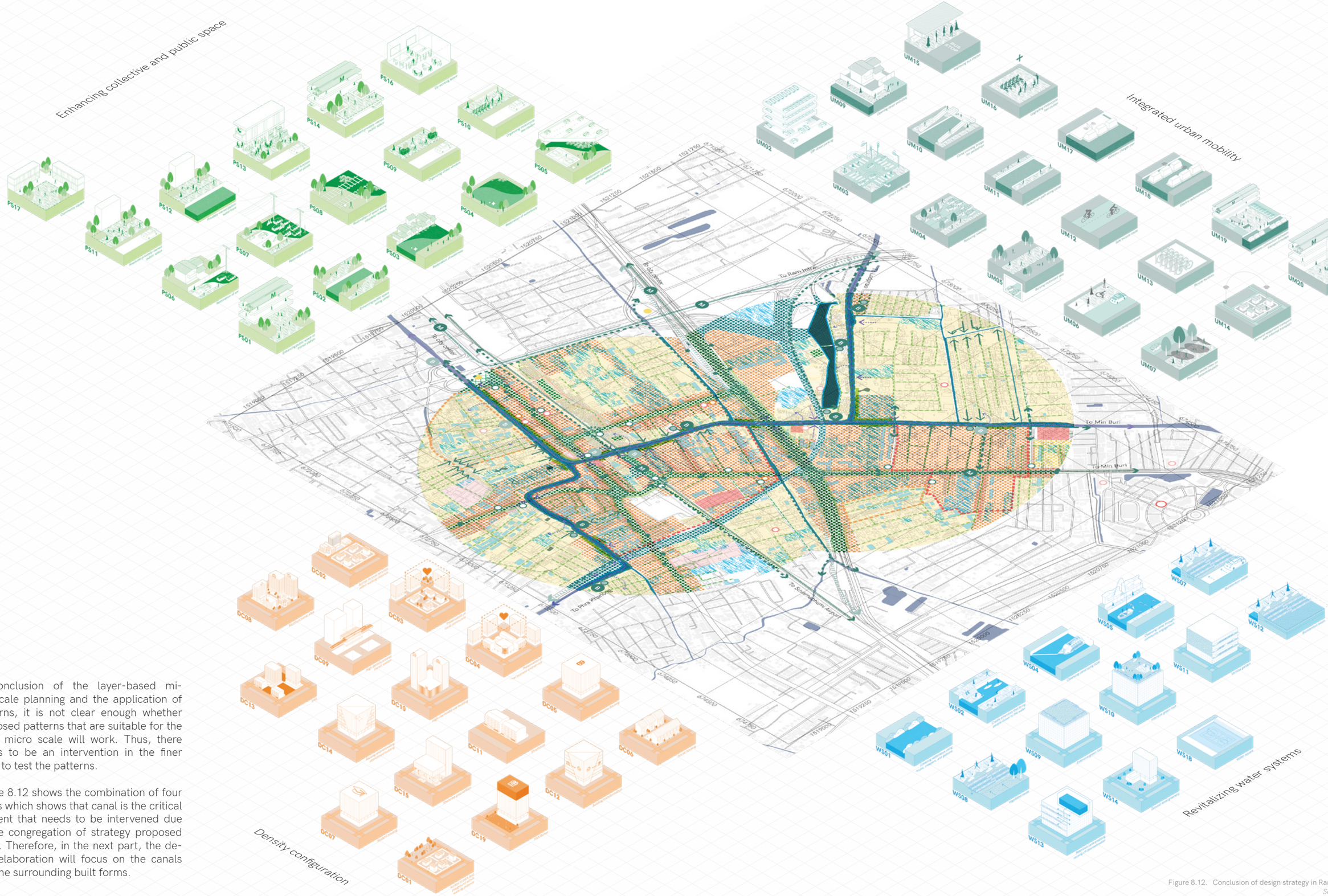


Figure 8.12. Conclusion of design strategy in Ramkhamhaeng
Source: Author

08.6. Design Intervention

08.6.1. Introduction

To elaborate on the design, two components are proposed as a testbed, the canal embankment as a connector, and Ramkhamhaeng Station as a node (Figure 8.33).

Canals are the most critical components where various strategies tackle the issues. However, to visualize how it as a connector work, another location to be experimented is the node which is Ramkhamhaeng station. Also, the addition of canal lines will result in more commuters transferring at this intermodal hub. Therefore, to visualize how this station area can support the mobility networks, the design elaboration of TOD is conducted here.

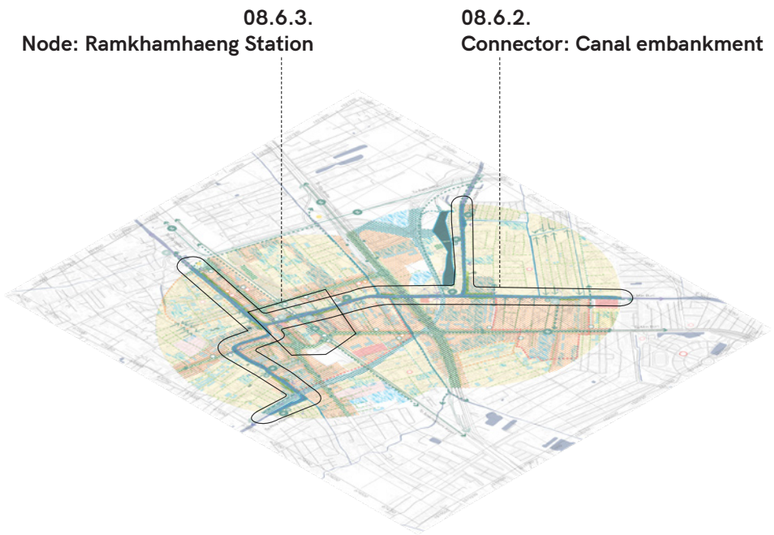


Figure 8.13. Introduction to design interventions of the connector and node in Ramkhamhaeng
Source: Author

08.6.2. Connector: Canal embankment

The canal embankment analysis shows that two major types are the concrete path with private property and abandoned site (Figure 8.15). The current situation of the concrete path does not contribute to a pleasant journey along the canals, since it is too narrow to accommodate both bicycle and pedestrian simultaneously. Moreover, when it passes abandoned sites and highways, the neglected grove woods and dark underpasses pose an unsafe condition to the pedestrian. Also, the fact that canal is seen as a back side of the house results in the decayed fence and unaesthetically pleasing scenery.

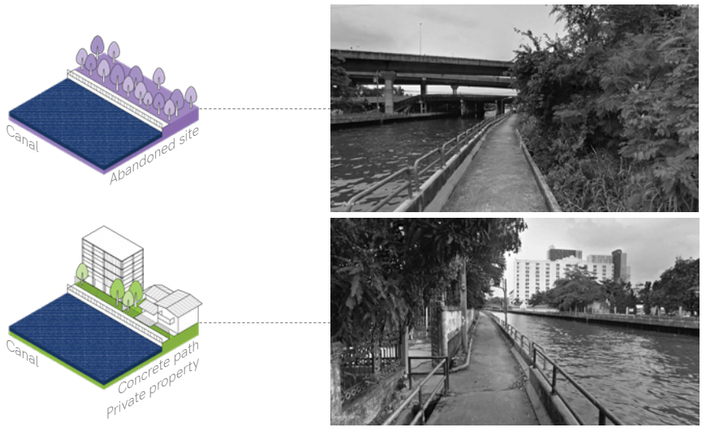


Figure 8.15. Two major canal embankment types in Ramkhamhaeng area
Source: Author

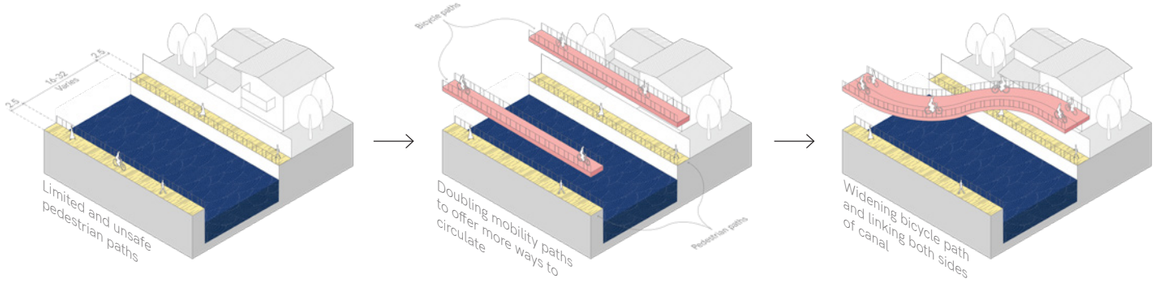


Figure 8.14. Main idea of the connector
Source: Author

08.6.2. Connector: Canal embankment

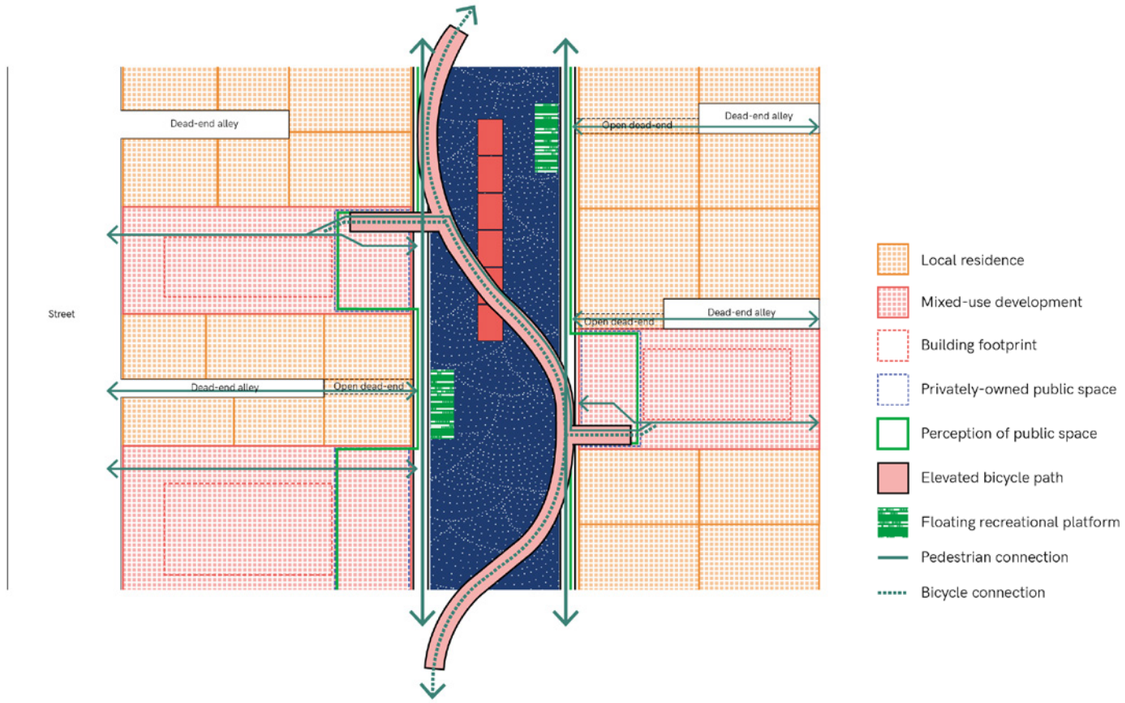


Figure 8.17. Conceptual layout showing connection of the proposed path with the context
Source: Author

Therefore, the main idea is to widen active mobility paths by doubling and separating pedestrian and bicycle paths. Then, the elevated bicycle paths are curved so that both sides can access them (Figure 8.14).

The conceptual layout shows its connection with surrounding developments where there will be local residences and newly developed mixed-use buildings (Figure 8.17). On the ground level, where the path is not connected to POPS. Extended platforms are introduced to enlarge public spaces. Furthermore, this elevated bicycle path will provide shadow for the pedestrian path which is beneficial for the hot-humid weather in Bangkok (Figure 8.16).

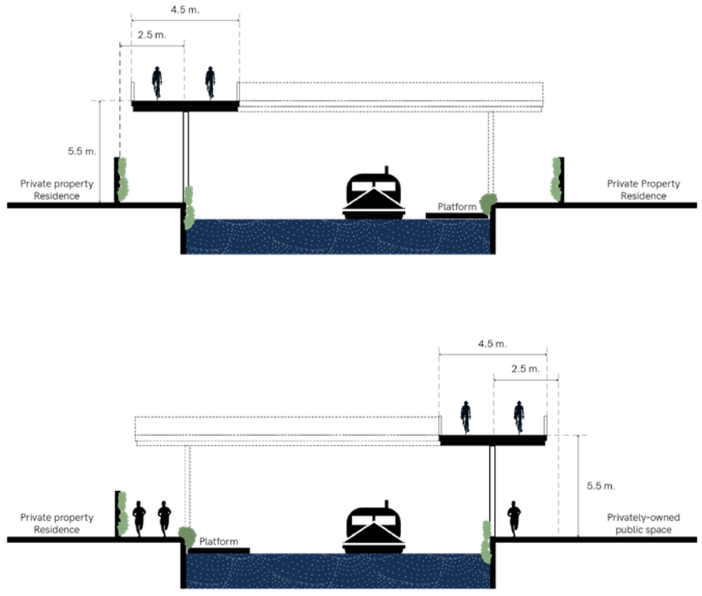


Figure 8.16. Typical sections of the proposed path
Source: Author

08.6. Design Intervention

08.6.2. Connector: Canal embankment

The proposed canal-side bicycle path is a part of the larger bicycle networks (Figure 8.6 on page 112). Figure 8.18 demonstrates the plausible connections between it and the surroundings. In order to elaborate on how it connects with these mentioned elements spatially and socially, and other modes of transport, the design intervention at the node is conducted.

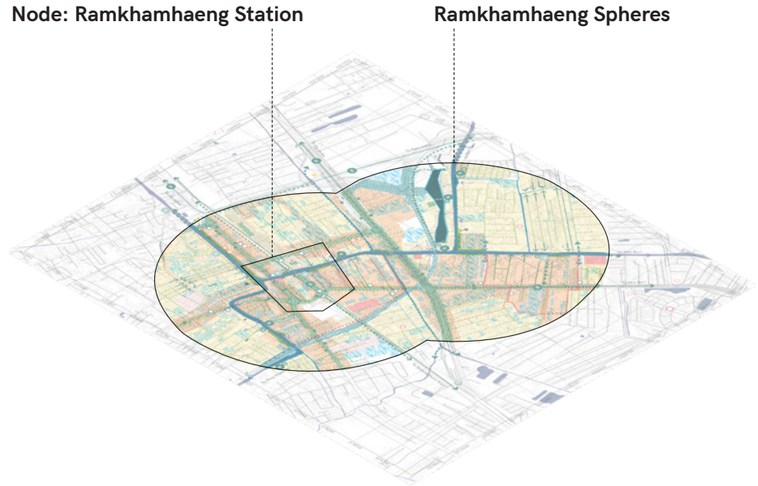
Figure 8.18. Connection strategy
Source: Author

08.6.3. Node: Ramkhamhaeng Station

08.6.3.1. Finding potentialities

In chapter 7, the spatial conditions of the entire Ramkhamhaeng sphere are investigated. Although, to elaborate on the design on the scale of node, finer parameter is needed for the more thorough analysis (Figure 8.20).

To find development potentialities, plot ownership around the station is investigated which shows that the majority of plots are owned by private sectors. While public spaces are along the railways and slums which are owned by State Railway of Thailand (Figure 8.19).



Legend for the map
Privately-owned
Publicly-owned

1 Figure 8.20. Macro-scale strategy with the location of node
Source: Author
2 Figure 8.19. Plot ownership around Ramkhamhaeng Station
Source: Author, derived information from Department of Lands (n.d.)

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.1. Finding potentialities

Since the residents, workers, and visitors in Ramkhamhaeng area are analyzed in Figure 7.43 on page 102. To be more precise, the users, functions, and their relationships particularly at the node are highlighted in Figure 8.21. It indicates that this area is diverse in terms of socio-economic and religious status. These people and valuable elements will be considered in the design intervention, for example, the low-income residents and local business. Figure 8.22, shows the elements that have to be preserved, such as the mosque (E) and two associations of Chinese family (D) along the Sean Saeb canal, since they act as the gathering place and the center of soul and spirit of residents. Furthermore, there are some local communities along the canal, one is the middle- to high-income community (A). The next one is the smaller community that clusters the several detached houses and mid-rise apartments, situated next to the mosque (F). These mentioned neighborhoods will be preserved in the design intervention.

One of the local business in this area is the massage parlor, in which two of them are located along the canal (C). Regardless their controversial issues and negative reputation, they provide job opportunities for low-income residents. Thus the design intervention aims to embrace them. While the potential plots to be developed by private developers are located next to the main roads and not blocked by the existing buildings. The buildings that will be constructed on these plots have to be guided, considering their anticipated externalities for example the size, environmental impacts, and functions that would detrimental affect surroundings. Therefore, design intervention takes into account these elements and will propose the guidelines for the compromising built forms.

In the next part, four layers of design interventions at the node, namely public space, mobility, density and water systems are proposed.

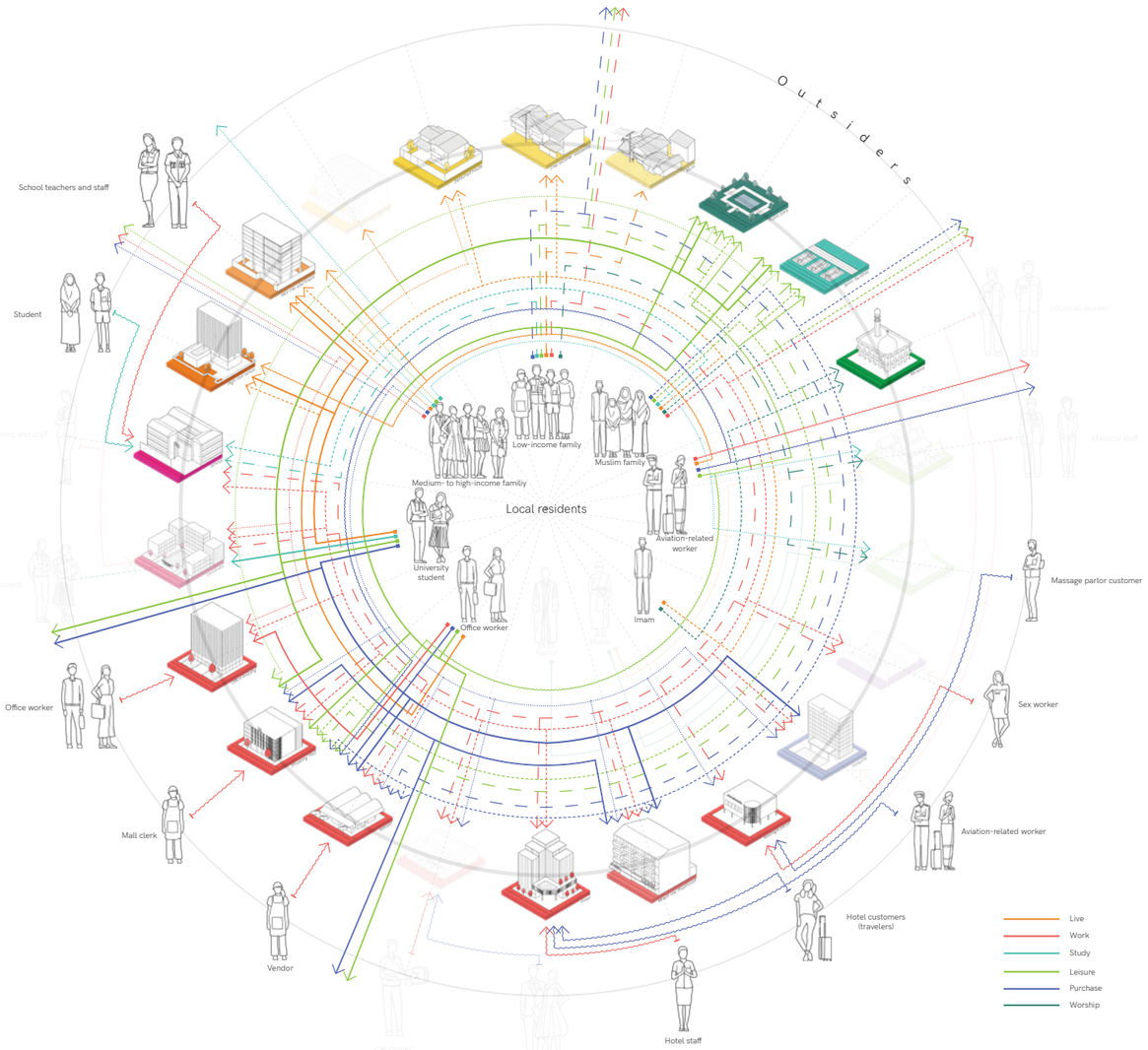


Figure 8.21. Socio-economic study at the node
Source: Author

Legend for the map

- Publicly-owned
- Slums needed organization
- Preserved detached houses
- Preserved religious building
- Transformable building
- High potential plot
- Low potential plot
- Preserved local business
- School
- Public transportation

1 Figure 8.22. Elements to be preserved and developed around Ramkhaemhaeng Station
Source: Author
2 Figure 8.24. Detached houses
Source: Google (n.d.)
3 Figure 8.25. Shophouses
Source: Google (n.d.)
4 Figure 8.26. Massage parlor
Source: Nancy Soapy Massage (n.d.)
5 Figure 8.27. Chinese family association
Source: Maps123 (n.d.)
6 Figure 8.23. Mosque
Source: มัสยิดคลองจั่น - ยามีอุลอัสลาม (n.d.)
7 Figure 8.28. Detached houses
Source: Nancy Soapy Massage (n.d.)
8 Figure 8.29. Overpass
Source: Google (n.d.)
9 Figure 8.30. Decayed shophouses
Source: Google (n.d.)

As the strategy is proposed in the larger scale in Figure 8.4, this part elaborates on the scale of node. Figure 8.31 illustrates the public space, and POPS to be intevened using the patterns in Figure 8.32 on page 127.

The built forms shown in the above map are the result of the density configuration layer (section 08.6.3.4.). Since built form is the factor that determines the amount of on-ground space that allows people to permeate through, these open spaces will allow for more walkable connection between places, for example the connection through blocks from the South to the station (A in Figure 8.31).

Moreover, waterfront is the crucial area to enhance public space, and the potential space, apart from the POPS, is the parking lots of the Chinese family associations which could be negotiated to open for public use for the better connection from the pier to the Northern part (B in Figure 8.31).

Legend for the map

- Pedestrian connection
- Outdoor commercial area (al-fresco dining)
- Multipurpose square
- Sport field
- Playground
- Community center
- (M) Existing fresh market
- Preserved religious site

Figure 8.31. Enhancing collective and public space at the node
Source: Author

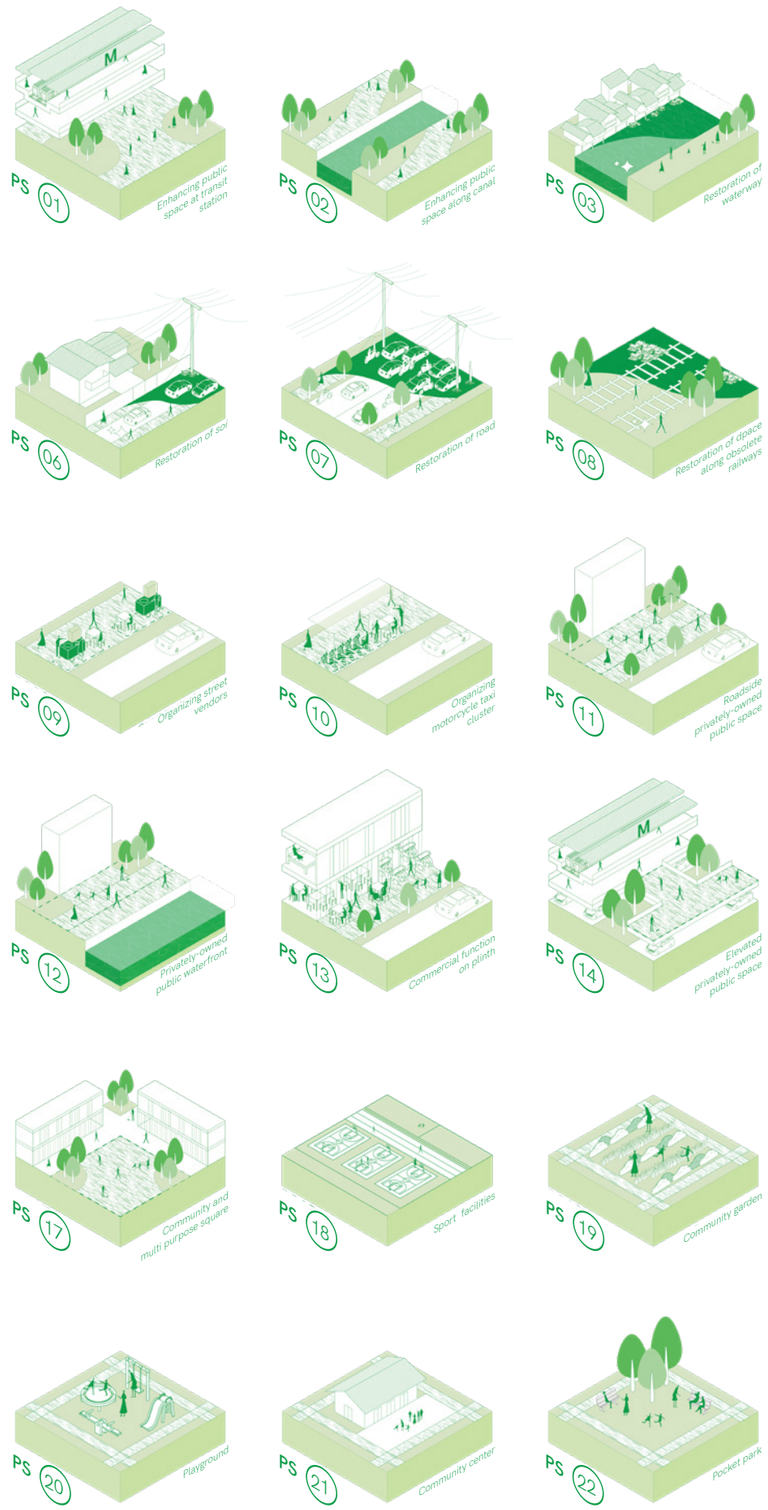
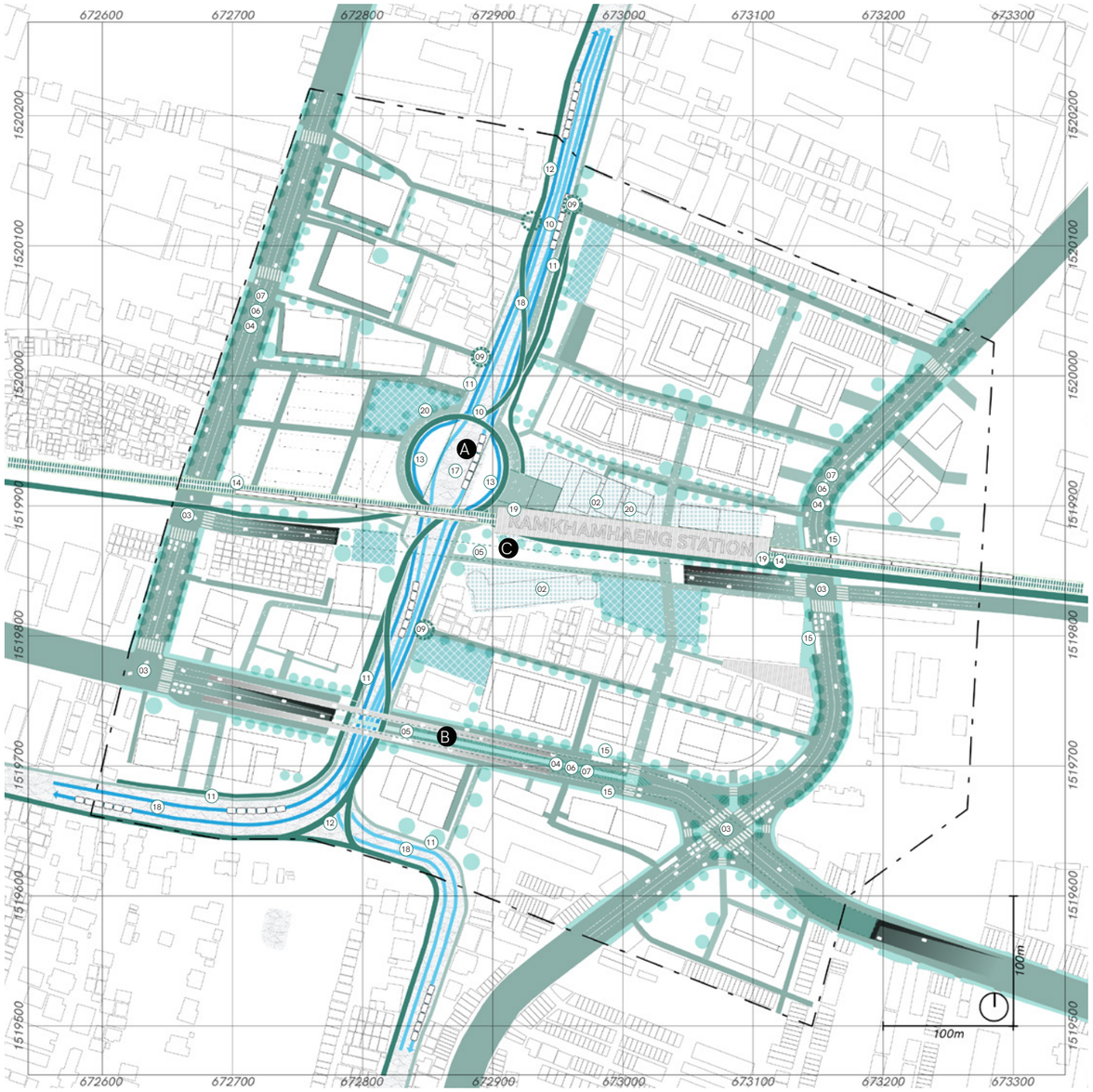


Figure 8.32. Patterns used for Enhancing collective and public space at the node
Source: Author



Similarly to the prior layer, Figure 8.33 elaborates on the integrated urban mobility at the node. Due to the anticipated heavier traffic of boats in the canal and the current condition where there is only a pier on one side, canal will be widened to accommodate the new boat routes and equipped with double-sided piers at the Ramkhamhaeng intermodal hub (A in Figure 8.33). This enlargement of canal will also offer more spaces for the transition between modes for example bicycle parking above the interchange piers.

For the street network, the overpass will be buried to give open space on ground (B in Figure 8.33), as well as the road next to the railway which will also be underground and underpass the canal to the West side (C in Figure 8.33). This offers open public space above and new pedestrian connection can be added.

Legend for the map

- Pedestrian connection
- Opening dead-end
- Bicycle path
- E1 boat line
- N1-E2 boat line
- Car access
- Tunnel
- Underground car parking at station

Figure 8.33. Integrated urban mobility at the node
Source: Author

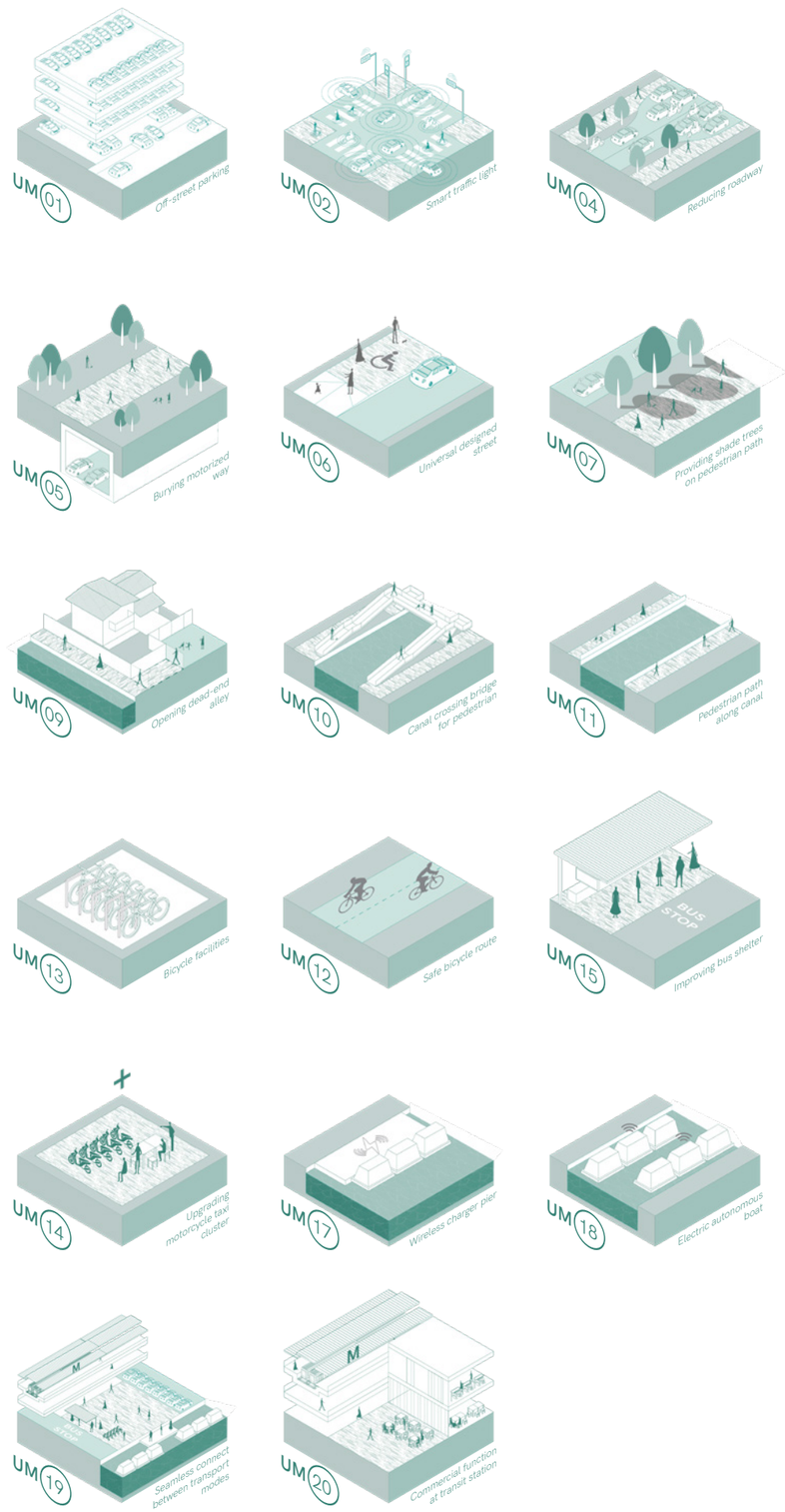


Figure 8.34. Patterns used for integrated urban mobility at the node
Source: Author

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

Existing situation

In the previous chapter, the built form is studied in the broader scale to understand the current volume in Ramkhamhaeng. In this part, the more smaller scale of density is comprehended through modeling.

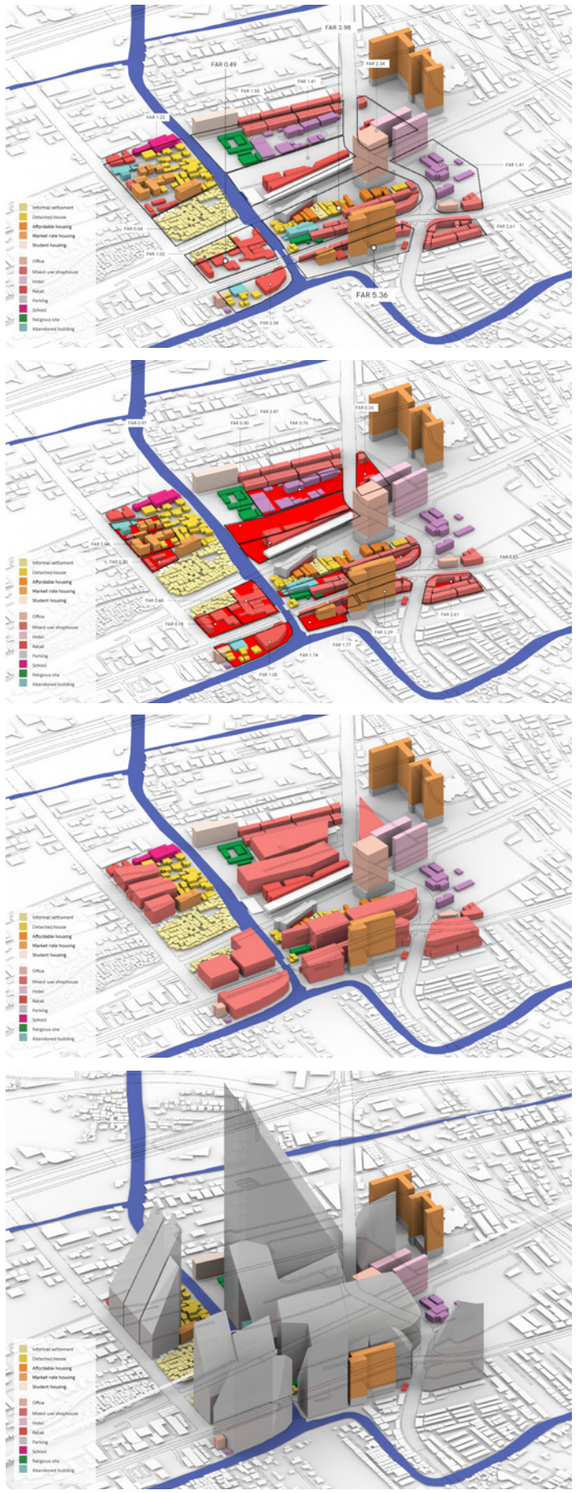
Figure 8.38 visualizes the existing FAR around Ramkhamhaeng Station which ranges from 0.49 on the West side of Saen Saeb Canal, to 5.36 on the opposite side. Next, the potential plots derived from the previous analysis shown in Figure 8.22 on page 125 are highlighted in Figure 8.37. Then the existing building regulation that restricts the buildings to be built within 6 meters along site boundary and the aiming FAR of 5.50 and 7.00, are modelled in the Figure 8.36. Regarding the height limitation, building could not be built taller than the diagonal line drawn from the opposite side on the road to the vertical line of twice the width of the road at the site boundary (ASA, 2021) (Figure 8.35).

These permitted building envelopes deducted from building regulation will be taken into account in the exploration of density configuration.

Exploring plausible density configurations

Four configurations are explored to find the most suitable density that brings qualities in the densification (Figure 8.39 - Figure 8.42). FAR figure is refered to the aimed one by BMA which are 7.00 and 5.50 (Plan4Bangkok, 2020). Thus, the first two configurations apply the average FAR of 7.00, while the last two configurations apply the average FAR of 5.50, throughout the area. Configuration 1 and 3 are experimented using high-rise type of building. Whereas configuration 2 and 4 utilize the type of podium on the lower floors. Moreover, patterns that proposed previously are tested in all options (Figure 8.43).

All geometries are evaluated in different aspects, such as social and economic performances through the amount of function offerred, environmental impact namely shadow and wind measured at pedestrian level (Berghauser Pont & Haupt, 2021). Besides, contributions to other layers of public space, urban mobility, and water systems are argued, to understand their supportive qualities which resulting in the concluded compromising configuration.



1 Figure 8.38. Existing density
Source: Author

2 Figure 8.37. Potential plots to be densified
Source: Author

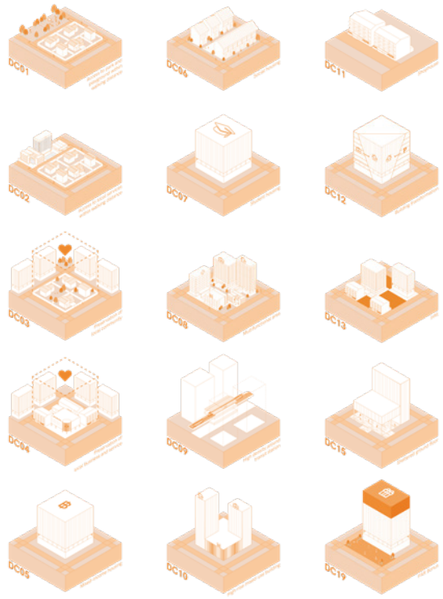
3 Figure 8.36. Aiming density by BMA with setback accounted
Source: Author

4 Figure 8.35. Existing height limitation
Source: Author

Since the aim of this research is to create design intervention that enables livable environments. Therefore, shadow and wind is analyzed within each configuration.

Since shadows are needed in the public space particularly in the hot-humid country, while they are not desirable for the residential neighborhood. Therefore, specific parameters along the canal are set for the accurate simulation which are the POPS on the East side (PS1), the residential neighborhood on the West side (NH1), and another POPS on the West side (PS2). In addition, different periods of time are essential factors that determine the amount of required shadow. Thus, the simulations are conducted in the morning and afternoon scenarios.

Also, the pedestrian-level wind field of the winter and monsoon seasons is simulated to understand how the wind changes its direction through different geometries (Berghauser Pont & Haupt, 2021).



1 Figure 8.43. Applied density configuration patterns at the node
Source: Author

2 Figure 8.42. Configuration 1
Source: Author

3 Figure 8.41. Configuration 2
Source: Author

4 Figure 8.40. Configuration 3
Source: Author

5 Figure 8.39. Configuration 4
Source: Author

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

08.6.3.4.1. Configuration 1

Figure 8.44. Configuration 1
Source: Author

Density

Average FSI: 7.00
Average GSI: 0.23
Average OSR: 0.11
Building type: High-rise

Functions

Mixed-income housing
Market-rate housing:
Number of Apartments: 15,790
Number of Residents: 31,581
Affordable housing:
Number of Apartments: 4,728
Number of Residents: 4,728
Offices
Number of Offices: 1,212.40
Number of Employees: 24,248
Retail spaces
GFA: 99,733.93 m2
Hotel
GFA: 89,134.29 m2
Parking
Number of Parking Spaces: 4,500

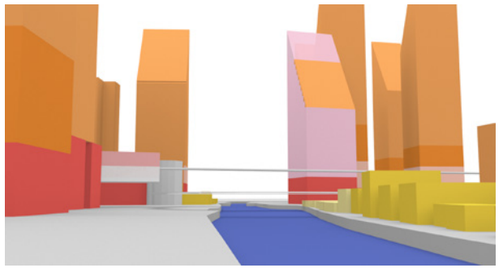


Figure 8.47. Eye-level view 1
Source: Author

Figure 8.46. Eye-level view 2
Source: Author

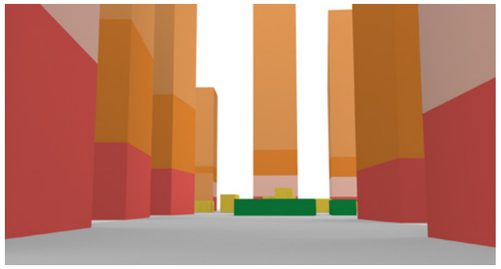


Figure 8.45. Eye-level view 3
Source: Author

Eye-level view

Due to the tallest buildings among all configurations, the cluster of towers on the West side of the canal creates the cityscape that gives the urban feeling (Figure 8.47). However, it gives contradictory with the surrounding detached houses. Moreover, on the road and POPS, high-rise buildings offer more on-ground space which allow for the broader public spaces (Figure 8.45 and Figure 8.46).

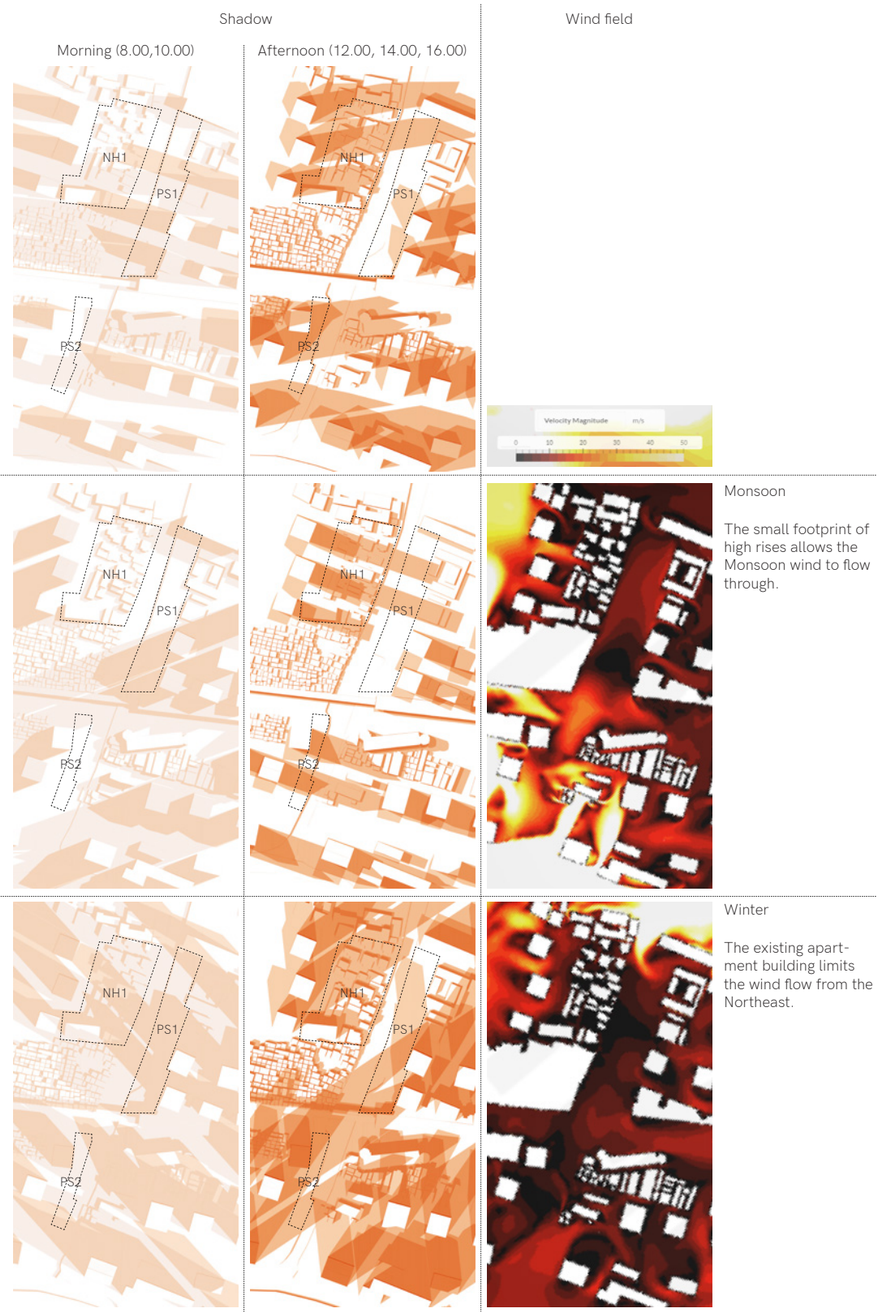


Figure 8.48. Environmental analysis of configuration 1
Source: Author, shadow simulated by Archicad, and wind simulated by Simscale

Contribution to other layers

Enhancing collective and public spaces
High-rise buildings offer more on-ground open spaces which corresponds to the higher residential density which can be used publicly for recreation

Integrated urban mobility
These open spaces allow more connection through the plots where POPS offers a way through from the road to the canal, increasing active mobility. Also, higher density plays a crucial role in increasing ridership of public transport (Houston, Boarnet, Ferguson, & Spears, 2015). Thus, this configuration will most support public transport systems. Moreover, most of the studies claim that car usage decreases when density increases (Berghauser Pont & Haupt, 2021). Therefore, this option will result in the less dependancy on private automobiles and support sustainable urban development.

Revitalizing water systems
In consideration of GSI of 0.23, it is lower compared to configuration 2 and 4, which means that higher impervious surfaces and the amount of surface runoff on-ground are positive.

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

08.6.3.4.2. Configuration 2

Figure 8.49. Configuration 2
Source: Author

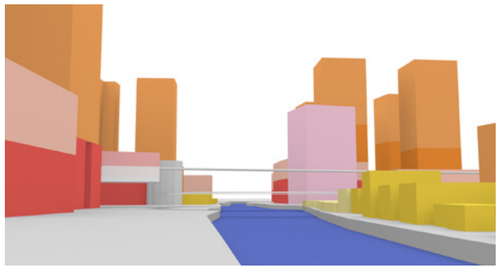


Figure 8.52. Eye-level view 1
Source: Author

Figure 8.51. Eye-level view 2
Source: Author

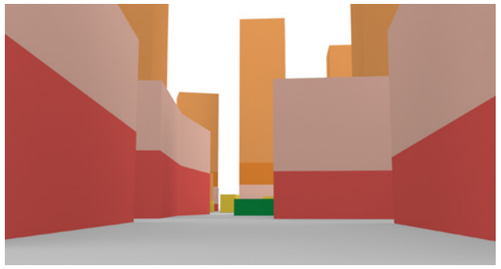


Figure 8.50. Eye-level view 3
Source: Author

Density

Average FSI: 7.00
Average GSI: 0.42
Average OSR: 0.08
Building type: High-rise, podium

Functions

Mixed-income housing
Market-rate housing:
Number of Apartments: 13,013
Number of Residents: 26,028
Affordable housing:
Number of Apartments: 5,000
Number of Residents: 5,000
Offices
Number of Offices: 1,586
Number of Employees: 31,721
Retail spaces
GFA: 125,086.83 m2
Hotel
GFA: 87,394.29 m2
Parking
Number of Parking Spaces: 4,424

Eye-level view

Comparing the first view with the first configuration, the towers are shorter yet still give an urban feeling (Figure 8.52). The podiums give the step to the buildings and allow pedestrians to feel more comfortable and less overwhelming by the row of tall built forms (Figure 8.50 and Figure 8.51).

Figure 8.53. Environmental analysis of configuration 2
Author, shadow simulated by Archicad, and wind simulated by Simscale

Contribution to other layers

Enhancing collective and public spaces
Comparing with the first configuration, which has less GSI, open spaces are more provided than in this configuration. However, they are compensated on the rooftop of the podium, allowing only the tenants of such building to use.

Integrated urban mobility
As discussed in configuration 1, large footprints can reduce the possibility for shorter connection, for example the connection from the road to canal. Also, when comparing the aspects of the ability to increase ridership and decrease the private car dependency with the first configuration, this configuration performs less effectively due to less density.

Revitalizing water systems
Since this configuration consists of higher GSI than the last configuration, it performs less effectively on the stormwater management systems. Notwithstanding, stormwater systems can be integrated into the buildings, for example green roof and vertical garden, to compensate the performance loss on the ground level.

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

08.6.3.4.3. Configuration 3

Figure 8.54. Configuration 3
Source: Author

Density
Average FSI: 5.50
Average GSI: 0.23
Average OSR: 0.14
Building type: High-rise

Functions
Mixed-income housing
Market-rate housing:
Number of Apartments: 12,760
Number of Residents: 25,521
Affordable housing:
Number of Apartments: 4222
Number of Residents: 4222
Offices
Number of Offices: 1,051
Number of Employees: 21,019
Retail spaces
GFA: 92,037.93 m2
Hotel
GFA: 77,494.29 m2
Parking
Number of Parking Spaces: 4,017

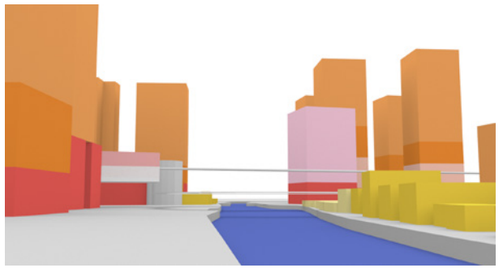


Figure 8.57. Eye-level view 1
Source: Author

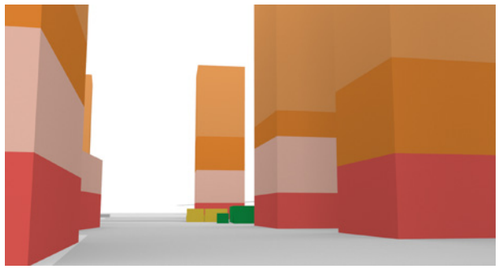


Figure 8.56. Eye-level view 2
Source: Author

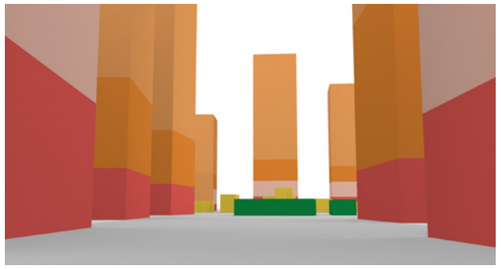


Figure 8.55. Eye-level view 3
Source: Author

Eye-level view
The canal-side view is similar to configuration 2, due to the building height is almost the same (Figure 8.57). While the second and third view are similar to the configuration 1 where towers cover the same amount of footprint area (Figure 8.55 and Figure 8.56).

Figure 8.58. Environmental analysis of configuration 3
Author, shadow simulated by Archicad, and wind simulated by Simscale

Contribution to other layers

Enhancing collective and public spaces
Similar to configuration 1, this configuration provides almost the same amount of open space, according to the identical GSI. However, this configuration consists of lesser gross floor area, meaning that the proportion open space per capita is higher.

Integrated urban mobility
As discussed in configuration 1, having large footprints can reduce the possibility for shorter connection. Also, when comparing the aspects of the ability to increase ridership and decrease the private car dependency with the first and second configuration, this configuration performs less effectively due to less density.

Revitalizing water systems
Since this configuration consists of identical GSI with the first configuration, it performs as effectively as configuration 1 on the stormwater management systems.

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

08.6.3.4.4. Configuration 4

Figure 8.59. Configuration 4
Source: Author

Density

Average FSI: 5.50
Average GSI: 0.42
Average OSR: 0.11
Building type: High-rise, podium

Functions

Mixed-income housing
Market-rate housing:
Number of Apartments: 11,413
Number of Residents: 22,826
Affordable housing:
Number of Apartments: 4,177
Number of Residents: 4,177
Offices
Number of Offices: 1,290
Number of Employees: 25,811
Retail spaces
GFA: 101,637.62 m2
Hotel
GFA: 76,594.29 m2
Parking
Number of Parking Spaces: 4,134

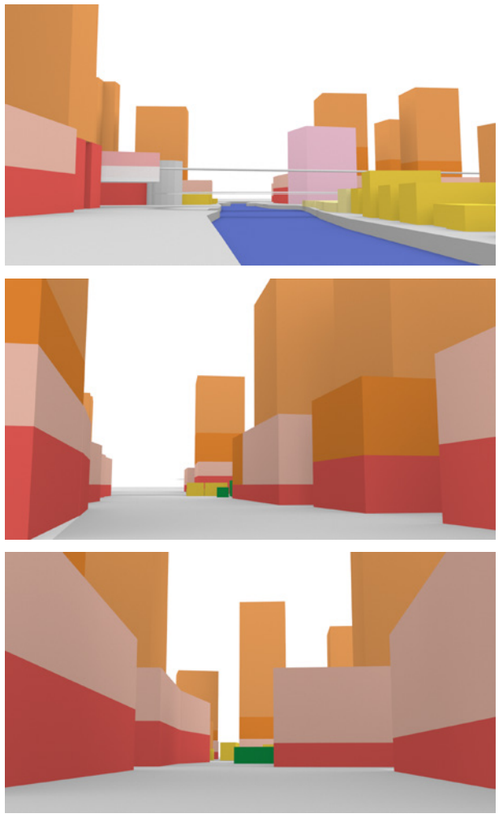


Figure 8.62. Eye-level view 1
Source: Author

❷

Figure 8.61. Eye-level view 2
Source: Author

❸

Figure 8.60. Eye-level view 3
Source: Author

Eye-level view

Among all configurations, this one consists of the shortest high-rise buildings, therefore, when looking at the towers cluster and compare it with the surround neighborhood, it shows less contradictory (Figure 8.62). Moreover, the podiums give the step to the buildings and allow pedestrians to feel more comfortable and less overwhelming by the row of tall built forms (Figure 8.60 and Figure 8.61).

Figure 8.63. Environmental analysis of configuration 4
Source: Author, shadow simulated by Archicad, and wind simulated by Simscale

Contribution to other layers

Enhancing collective and public spaces
In comparison with the first configuration, which has less GSI, open spaces therefore are more provided than in this configuration. However, the open spaces are compensated on the rooftop of the podium, allowing only the tenants to use.

Integrated urban mobility
As discussed in configuration 1, large footprints can reduce the possibility for shorter connection. Also, when comparing the aspects of the ability to increase ridership and decrease the private car dependency with the first configuration, this configuration performs less effectively due to less density.

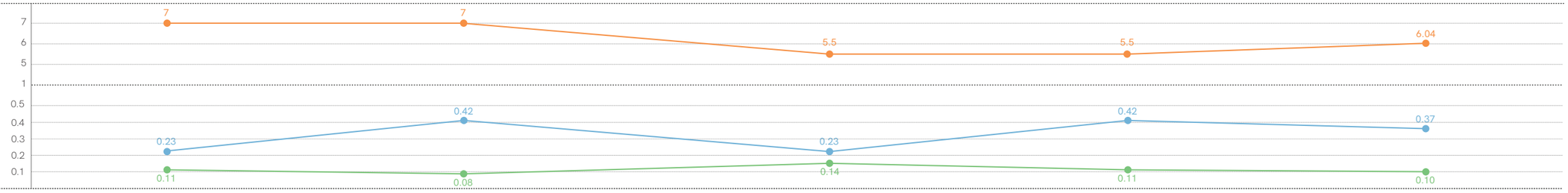
Revitalizing water systems
Since this configuration comprises higher GSI than the last configuration, it therefore performs less effectively on the stormwater management systems. Notwithstanding, stormwater systems can be integrated into the buildings to compensate the performance loss on the ground level.

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

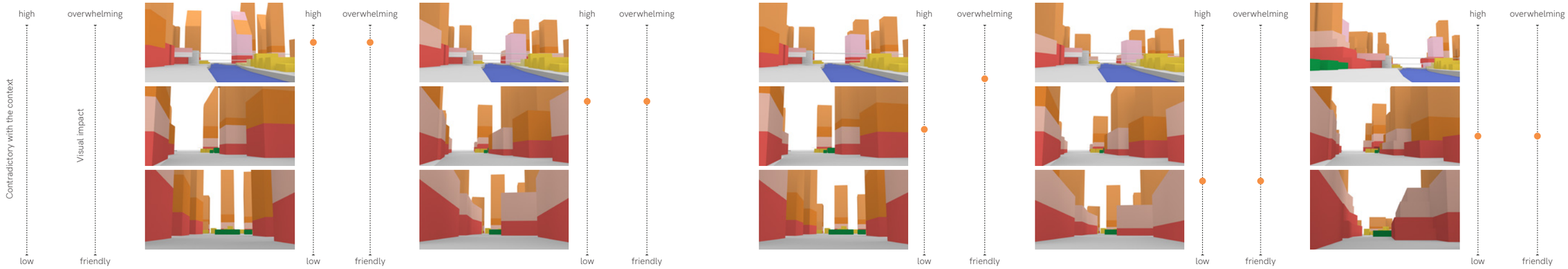
08.6.3.4.5. Evaluation of 4 configurations

	Configuration 1	Configuration 2	Configuration 3	Configuration 4	Conclusion
					

Density



Eye-level views



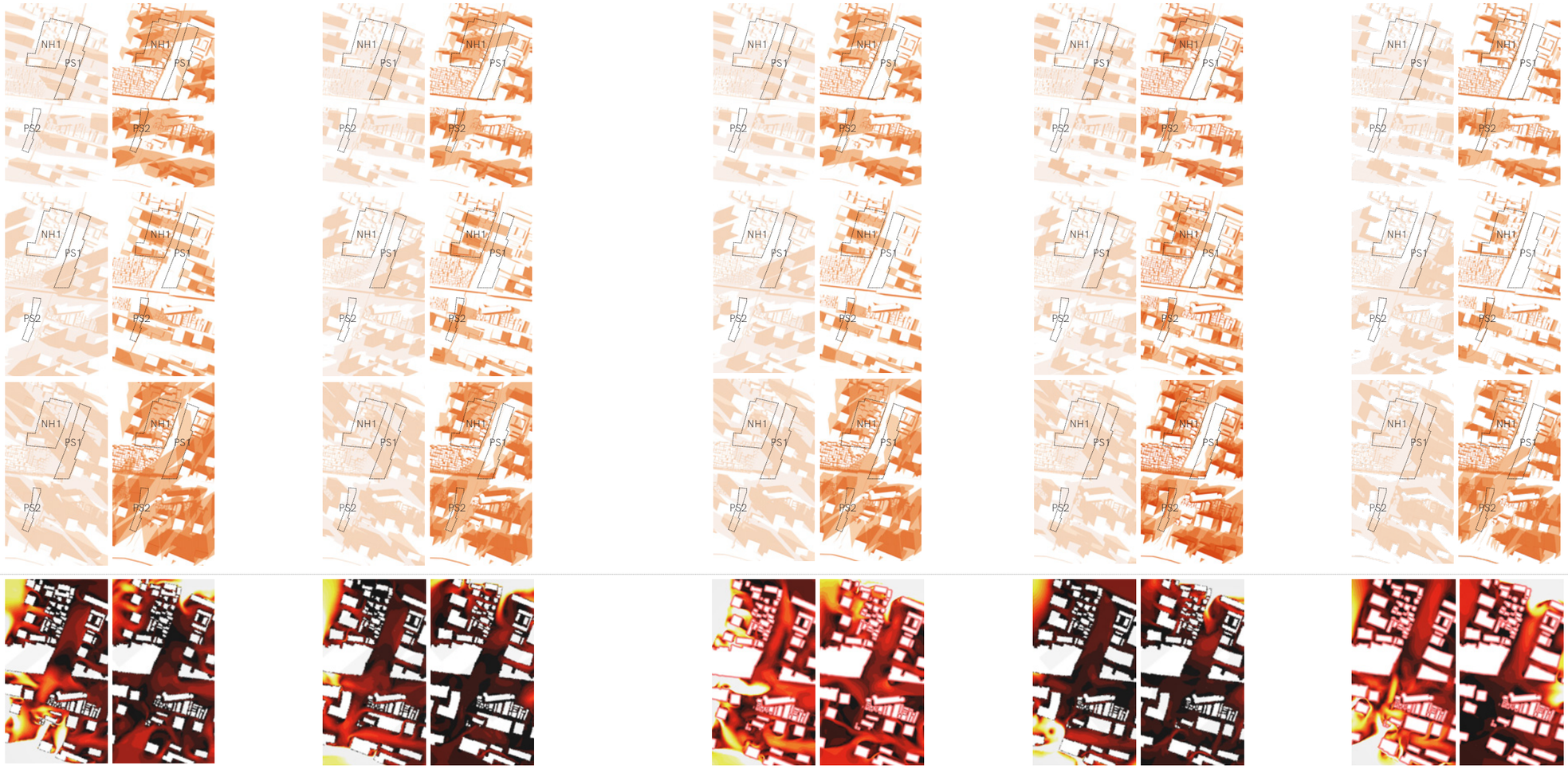
Functions

	Configuration 1	Configuration 2	Configuration 3	Configuration 4	Conclusion
Mixed-income housing					
Market-rate housing:					
Number of Apartments:	15,790	13,013	12,760	11,413	12,411
Number of Residents:	31,581	26,028	25,521	22,826	24,822
Affordable housing:					
Number of Apartments:	4,728	5,000	4222	4,177	4,069
Number of Residents:	4,728	5,000	4222	4,177	4,069
Offices					
Number of Offices:	1,212.40	1,586	1,051	1,290	1,188
Number of Employees:	24,248	31,721	21,019	25,811	23,760
Retail spaces					
GFA:	99,733.93 m2	125,086.83 m2	92,037.93 m2	101,637.62 m2	113,459.58 m2
Hotel					
GFA:	89,134.29 m2	87,394.29 m2	77,494.29 m2	76,594.29 m2	90,845.68 m2
Parking					
Number of Parking Spaces:	4,500	4,424	4,017	4,134	4,221

08.6. Design Intervention
08.6.3. Node: Ramkhamhaeng Station
08.6.3.4. Density configuration

08.6.3.4.5. Evaluation of 4 configurations

Configuration 1 | Configuration 2 | Configuration 3 | Configuration 4 | Conclusion



Environmental impact

Shade

PS1 needs shadows in the afternoon to encourage people to come and use the area. The majority of shadows is casted by the Western towers, however, NH1 is also shaded by these high-rise buildings. Thus, there is a dilemma that NH1 does not need shadow but PS1 does. In this case, the local community is prioritized by restricting the height of the Western towers so that they cast shorter shadow in the shorter time. While PS1 can be provided with the canopy trees and covered shelters.

Wind field

All four configurations can be grouped based on the results and building types, the first group is the high-rise buildings (configuration 1 and 3), and the second one is the group with podium type (configuration 2 and 4). Wind velocity in Bangkok is not as high as in the Netherlands. Thus, the strong wind is not the main concern but what is more important is the ventilation. Considering hot-humid climate, built form should allow wind to flow through. Therefore, the configurations that are suitable for Bangkok are 1 and 3.

Contribution to other layers

Enhancing collective and public space

On-ground open spaces

Integrated urban mobility

Connection through blocks

Increasing the ridership

Reducing private car dependency

Revitalizing water systems

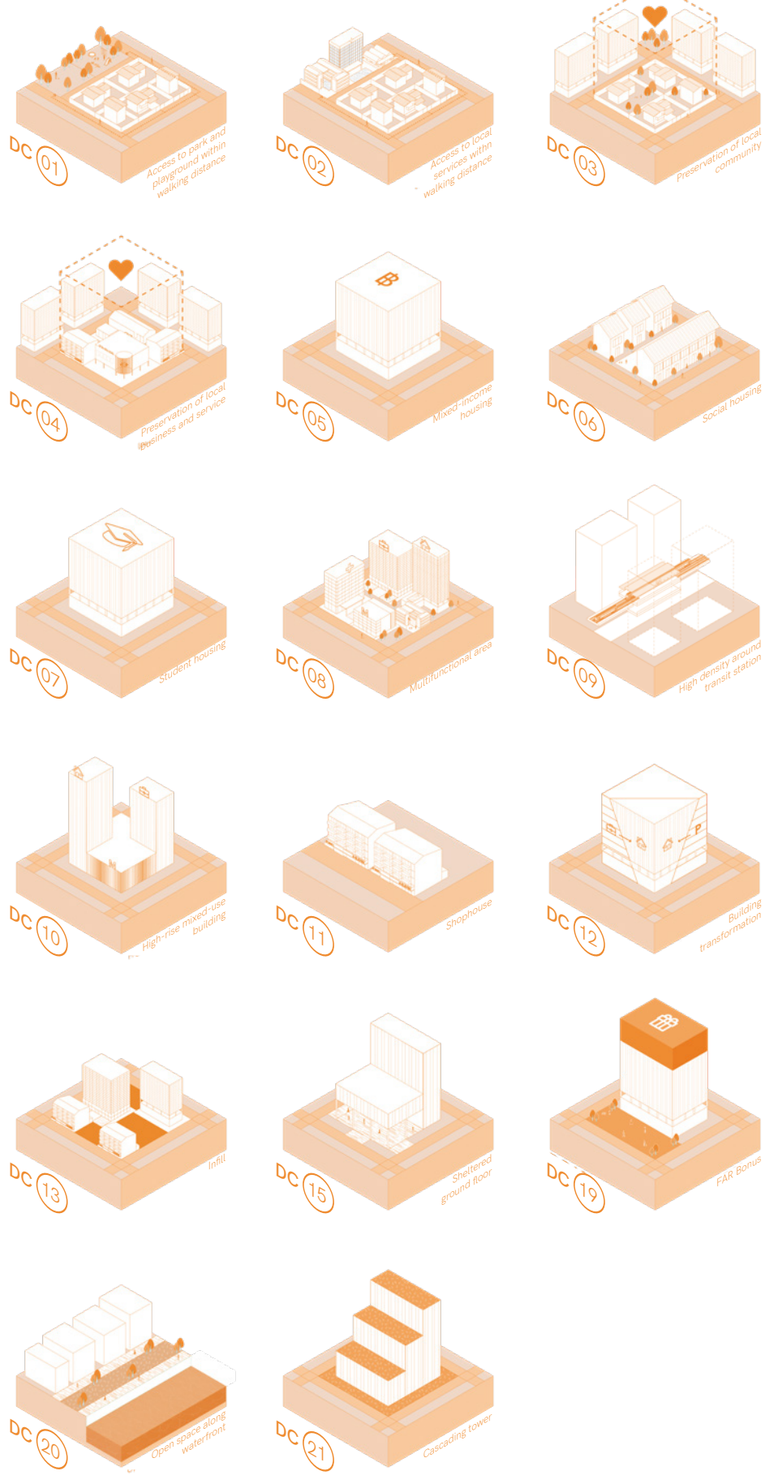
Stormwater management

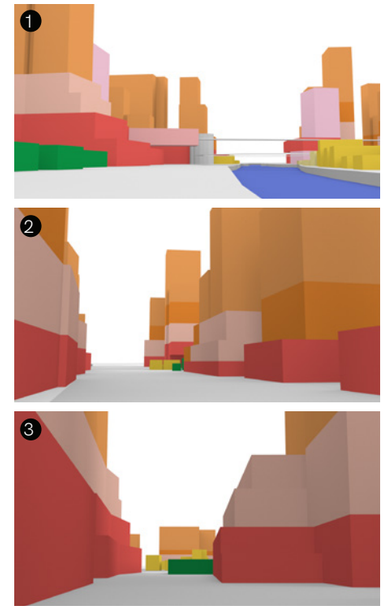
The conclusion of the density configuration is demonstrated in Figure 8.64. The proposed built forms are aimed to comprise the highest density, also compromise to the surroundings. For example, the Western buildings' height (A) is restricted to reduce the possibility that the shadow is casted on the adjacent community. Moreover, building typology that suits Bangkok's climate is high-rise building, however. While, podium houses more retail and office functions on the lower floors but it blocks the wind. Therefore, the sheltered ground floor is proposed to allow ventilation while office function can be located above (B). Besides, this space provides the shade and create the semi-outdoor space for people to escape from the harsh sunlight.

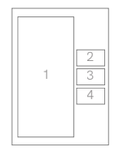
Alongside the canal, open space is maximized, as seen at C where some parts of existing apartment building is cut out to open for the connection to the North. High rises are oriented to the canal with the cascading shape, making the canal, accentuating its role as a central piece (Figure 8.66). These stacks provide benefits for the mobility layer as a connection from the pier to the station (D). Also, these terraces can accommodate green roofs which is advantageous for the water systems.

- Affordable housing
- Market-rate housing
- Student housing
- Office
- Hotel
- Retail
- Existing building
- New development
- Transformed existing building

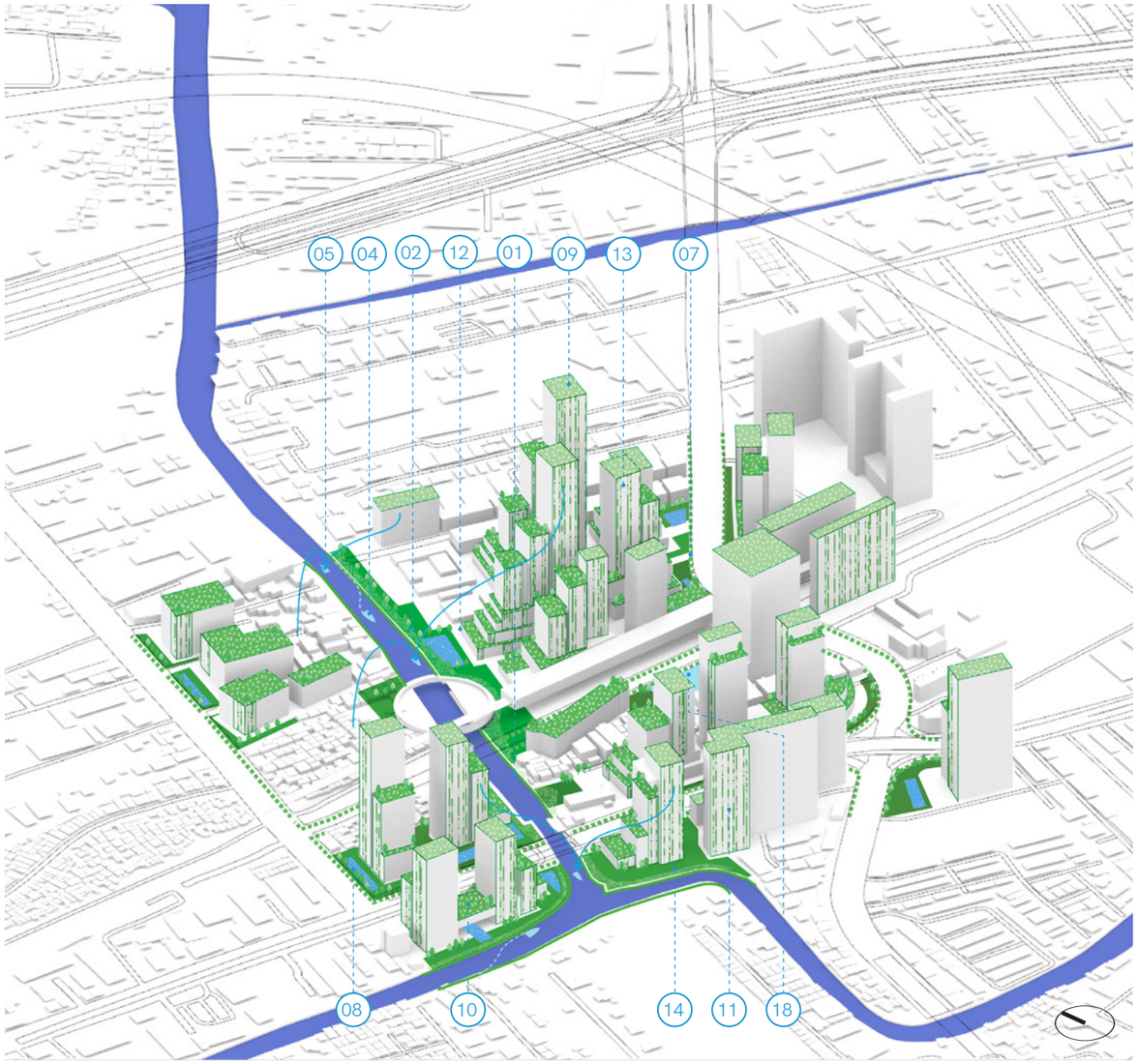
Figure 8.64. Density configuration at the node
Source: Author







1 Figure 8.65. Patterns used for revitalizing water systems at the node
Source: Author
2 Figure 8.66. Eye-level view 1
Source: Author
3 Figure 8.67. Eye-level view 2
Source:Author
4 Figure 8.68. Eye-level view 3
Source: Author

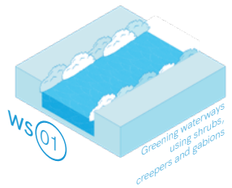


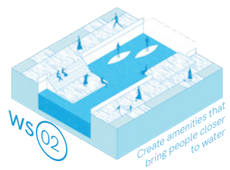
The revitalization of water systems is visualized in Figure 8.69. It takes into account the strategy and patterns, proposed in chapter 6 (Figure 8.70 and Figure 8.71).

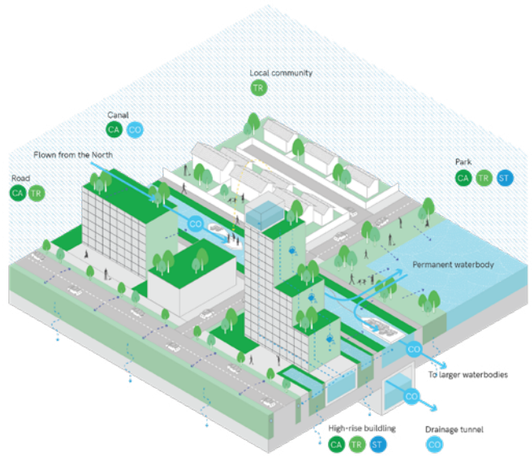
As mentioned earlier, the cascading type of building allows for the application of the green roofs to capture and treat stormwater before it is collected in building's retention tanks for reuse and gravitically discharging to the ground-level treatment elements such as bioretention basin and the outlet drain. Moreover, along the public street, infiltration strips are applied to catch runoff from the pavement.

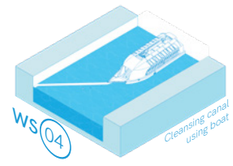
- Intensive green roof
- Extensive green roof
- Vertical garden
- Vegetated and bioretention swale
- Ground-level greenery
- Water square
- Cleansing canal through community engagement
- Cleansing canal using boat

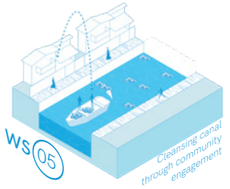
Figure 8.69. Revitalizing water systems at the node
Source: Author

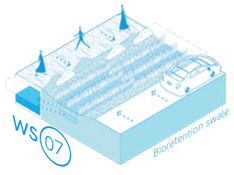


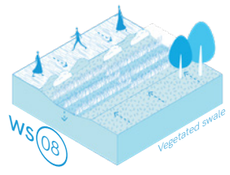


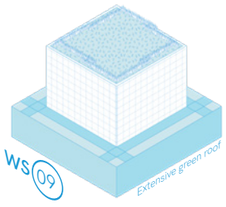


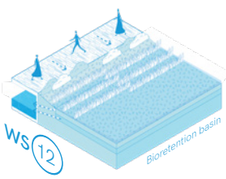


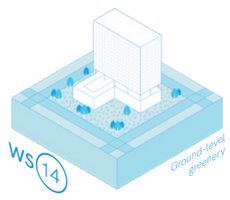


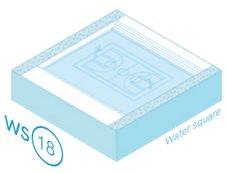


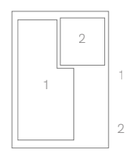




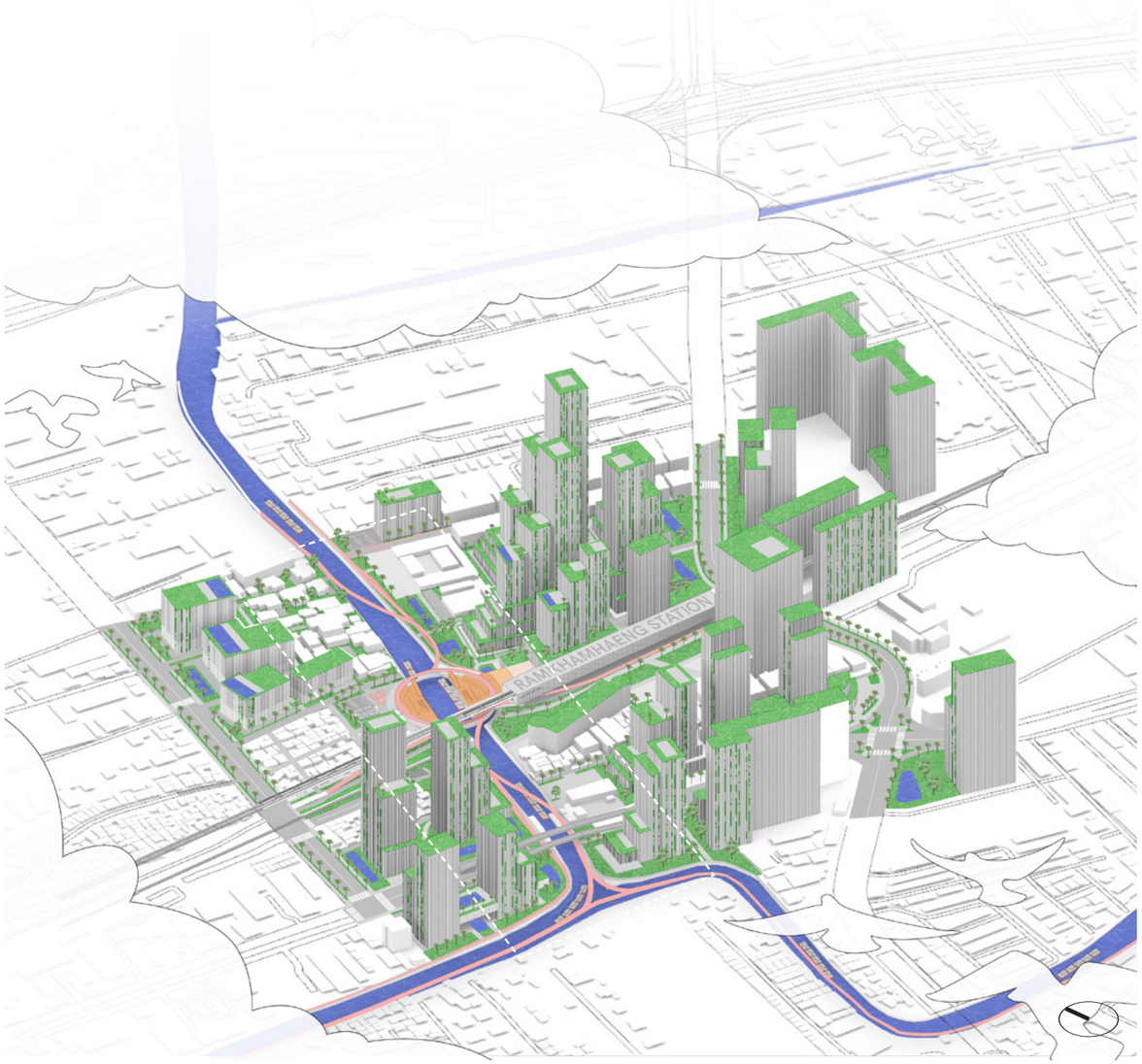






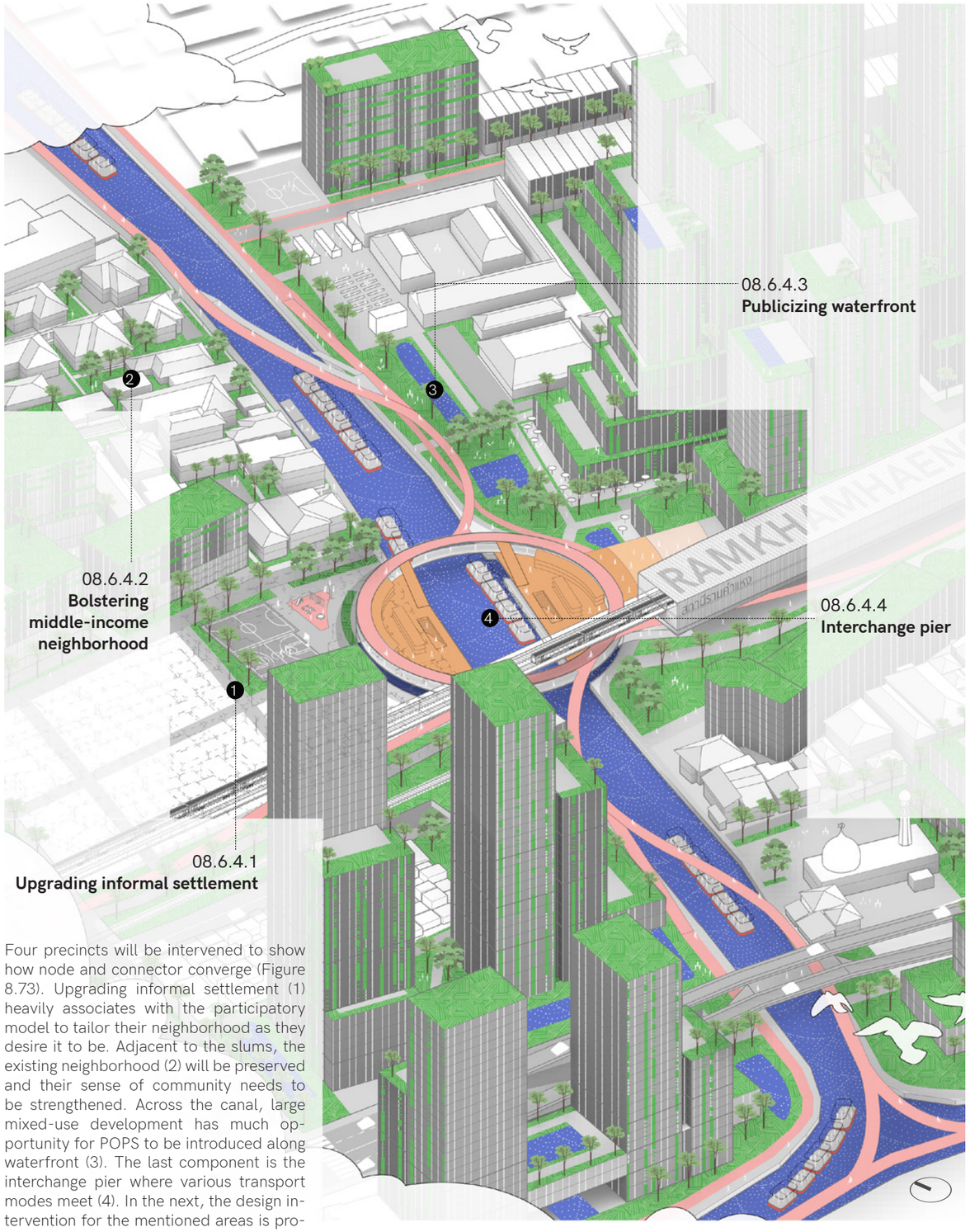


1 Figure 8.70. Patterns used for revitalizing water systems at the node
Source: Author
2 Figure 8.71. Suburban water system
Source: Author



Since all four layers of design intervention are proposed for the node (Figure 8.72). There needs to be an elaboration of how these layers integrated and collaborate. Also, the canal as a connector with the elevated bicycle paths that link with the surroundings will be elaborated in the convergence of node and connector.

Figure 8.72. Conclusion of 4 layers at the node
Source: Author



Four precincts will be intervened to show how node and connector converge (Figure 8.73). Upgrading informal settlement (1) heavily associates with the participatory model to tailor their neighborhood as they desire it to be. Adjacent to the slums, the existing neighborhood (2) will be preserved and their sense of community needs to be strengthened. Across the canal, large mixed-use development has much opportunity for POPS to be introduced along waterfront (3). The last component is the interchange pier where various transport modes meet (4). In the next, the design intervention for the mentioned areas is proposed.

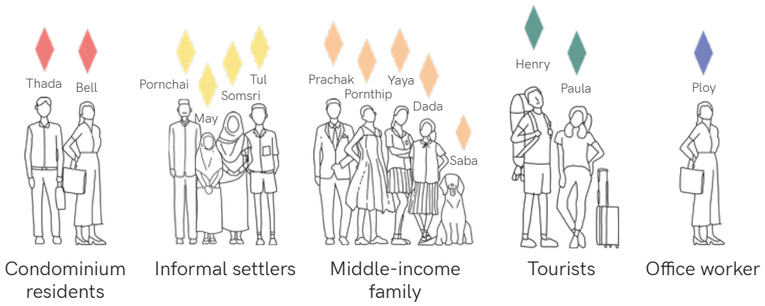
Figure 8.73. Introduction to design interventions of the connector and node in Ramkhamhaeng
Source: Author

08.6. Design Intervention

08.6.4. The Convergence of Connector and Node

08.6.4.1. Personas

In Ramkhamhaeng, diverse groups of people converge, from residents to office workers and tourists. Figure 8.74 shows exemplary groups that will be illustrated in the proposed design and highlight how Ramkhamhaeng can be a place where socially diverse and livable environments occur.



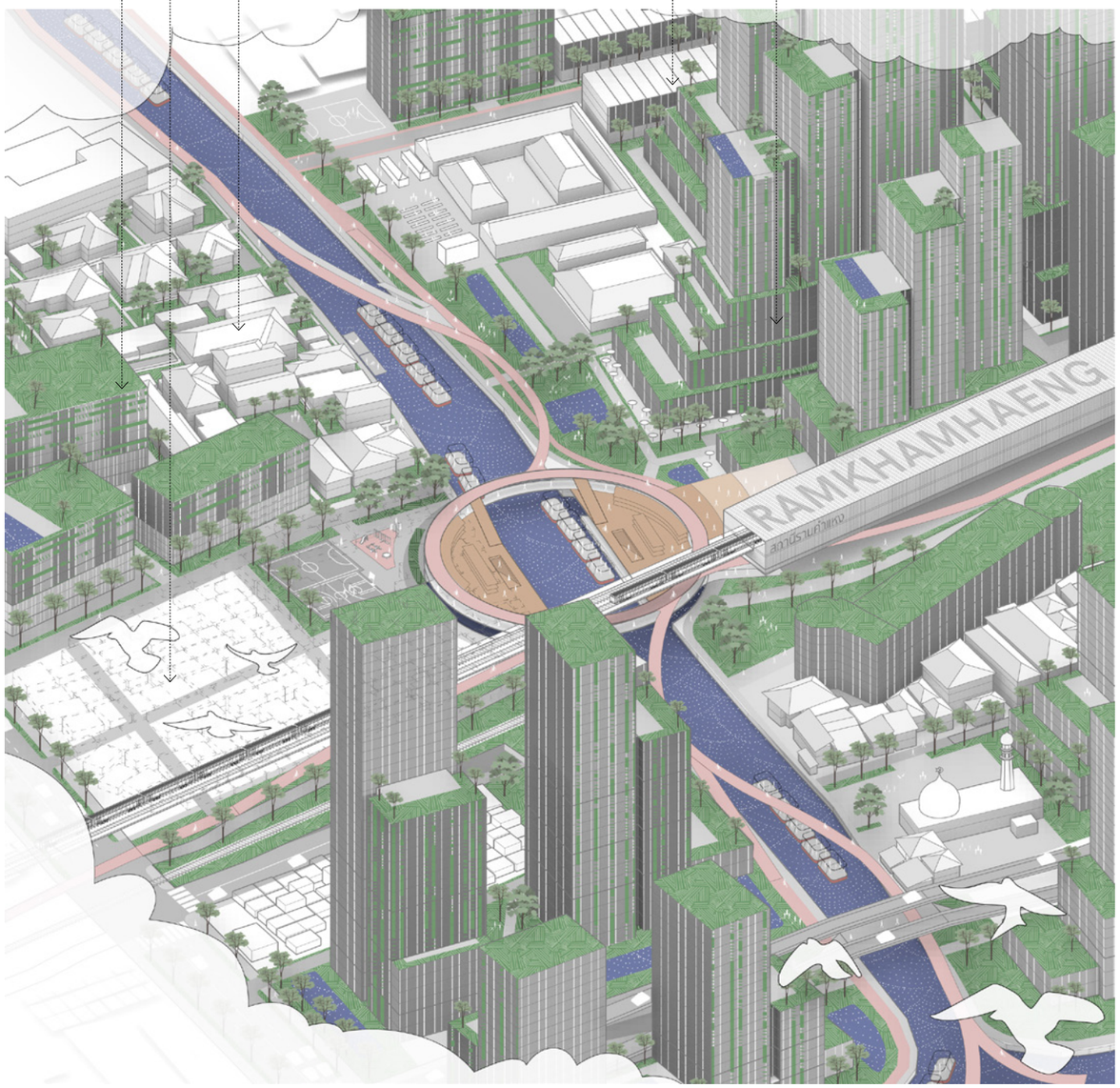


Figure 8.74. Residents and visitors in the Convergence of Connector and Node
Source: Author

08.6.4.2. Upgrading informal settlements

The informal settlement next to Sean Seab canal will be formalized. The process considers the local inhabitants and engages them to voice their opinions. In this part, the guidelines for the upgrading slums is proposed. The strategy is to promote bottom-up approach through design workshops where toolbox plays an essential role as a tool for the communication between designers and dwellers. Also, informal settllers have to establish the initiative for community engagement projects, for example fishing waste on the canal, upgrading public space within the neighborhood such as community garden (Figure 8.76).

Figure 8.76. Strategy for upgrading informal settlements
Source: Author

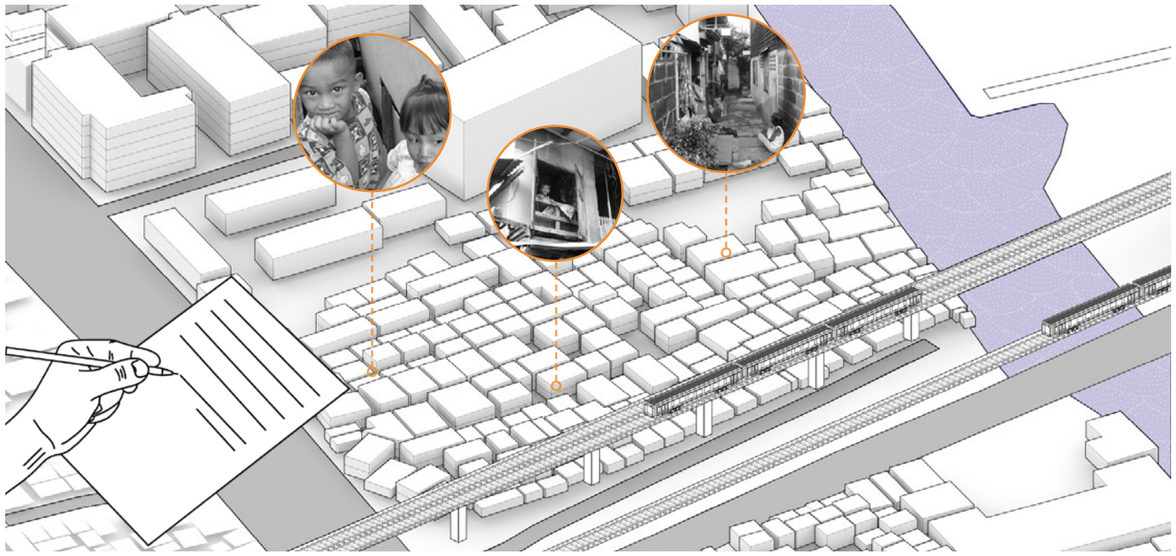


Figure 8.77. Spatial and social survey the existing informal settlements
Source: Author

The process starts with the staffs from CODI and urban designers surveying the neighborhood and collecting data about demographic and built forms, to understand the existing social and spatial conditions in relation to the surroundings (Figure 8.77). Moreover, CODI is the actor who organizes the public consultation; therefore, they have to comprehend who will be involved and serve which roles in the project (Figure 8.75). By doing this, designers can propose the first draft of strategy and zoning plan and present to the locals and allow them to make an alteration using provided patterns within the design workshops (Figure 8.78). Therefore, the outcomes of design are determined by the residents whether they desire to live in the apartments or rowhouses, designers will be the one who guide them with the specialties and actualize their dreams.

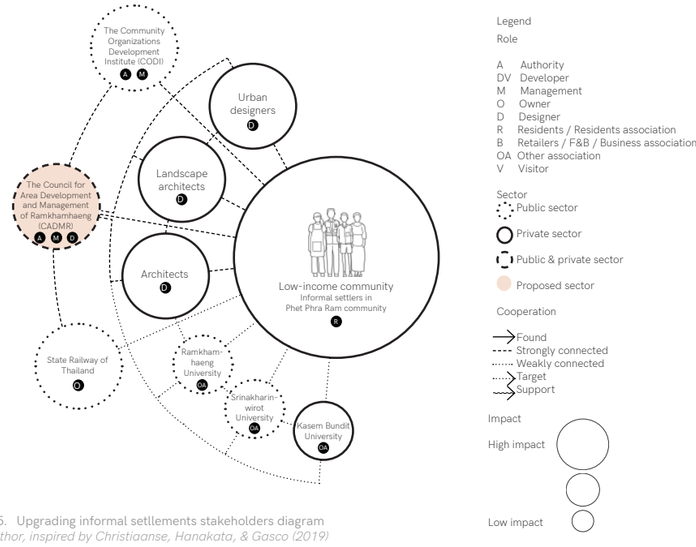


Figure 8.75. Upgrading informal setllements stakeholders diagram
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

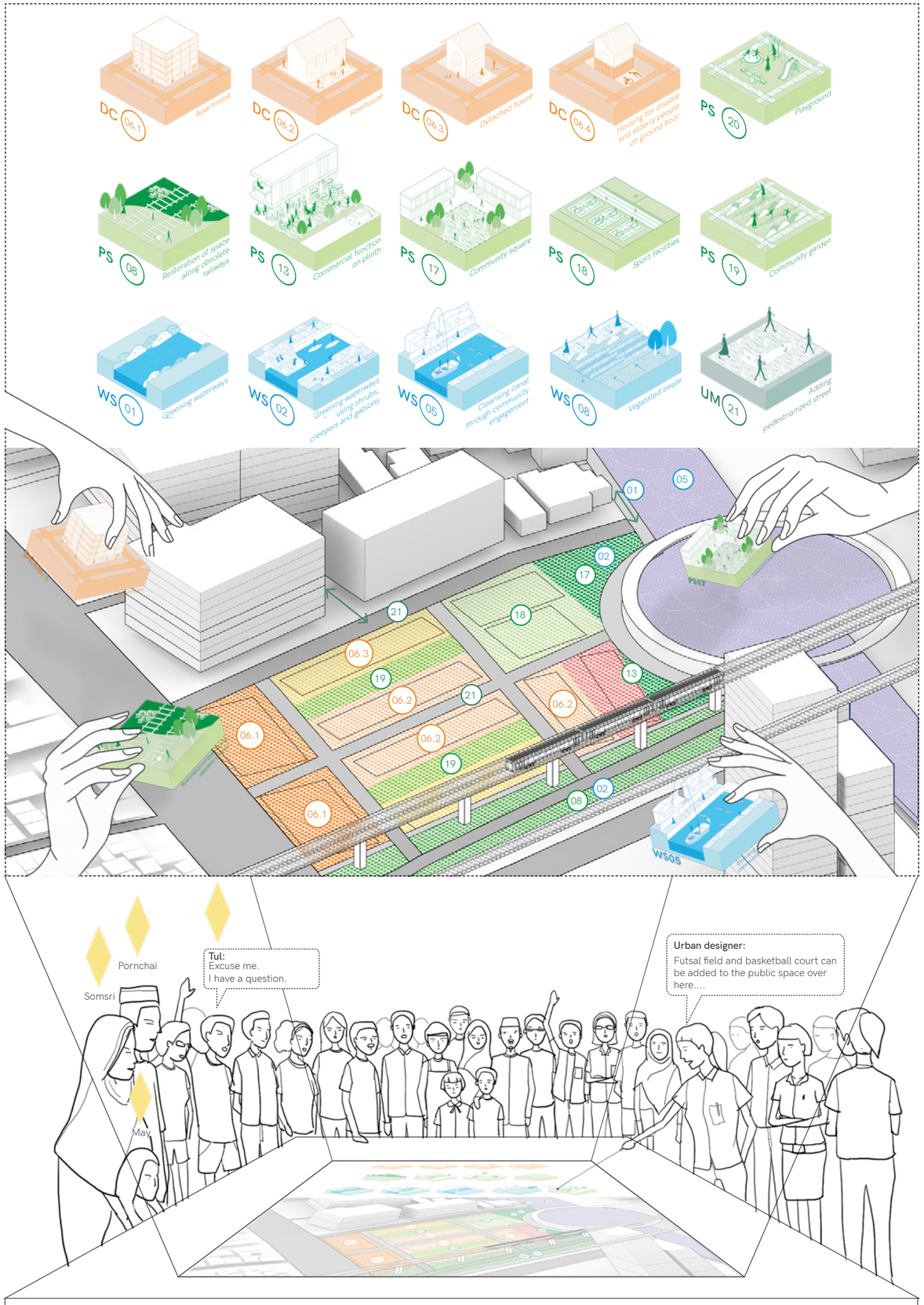


Figure 8.78. Example of design workshop within the process and applicable patterns
Source: Author

08.6. Design Intervention
08.6.4. The Convergence of Connector and Node
08.6.4.3. Bolstering middle-income community

Since the roadside plots have higher opportunities to be taken over by real estate developers. The middle-income neighborhood at the end of *sois* and along the canal will have to confront with the externalities that new development creates. The built forms that proposed previously restrict developers not to build their buildings too tall and overwhelming to the neighborhood. However, the inhabitants also have rights to oppose this emergence. Figure 8.79 illustrates the plausible conditions of this neighborhood in the coming 30 years.

As currently people live separately and are not aware of who their neighbors are. The way to trigger sense of community is to establish the association that allows inhabitants to meet and organizes the sessions that engage people to make contribution to their community (Figure 8.80). The representatives are chosen to participate in the public consultation within the surrounding development projects where they can speak for their fellow neighbors what they want and do not want to be built next doors. Also, this association leads to the sessions that allow residents to participate, for example plastic fishing and greening canal projects which can be collaborative with residents from the adjacent community.

The element that provide opportunities for residents to meet is the public space. Within this area, the spaces that need to be developed are *sois*. Active mobility is promoted by opening dead-end *soi* to the

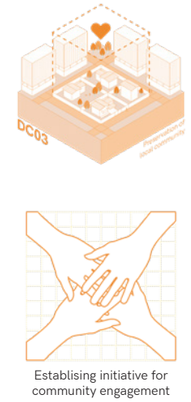


Figure 8.80. Overview impression of bolstering middle-income community
Source: Author

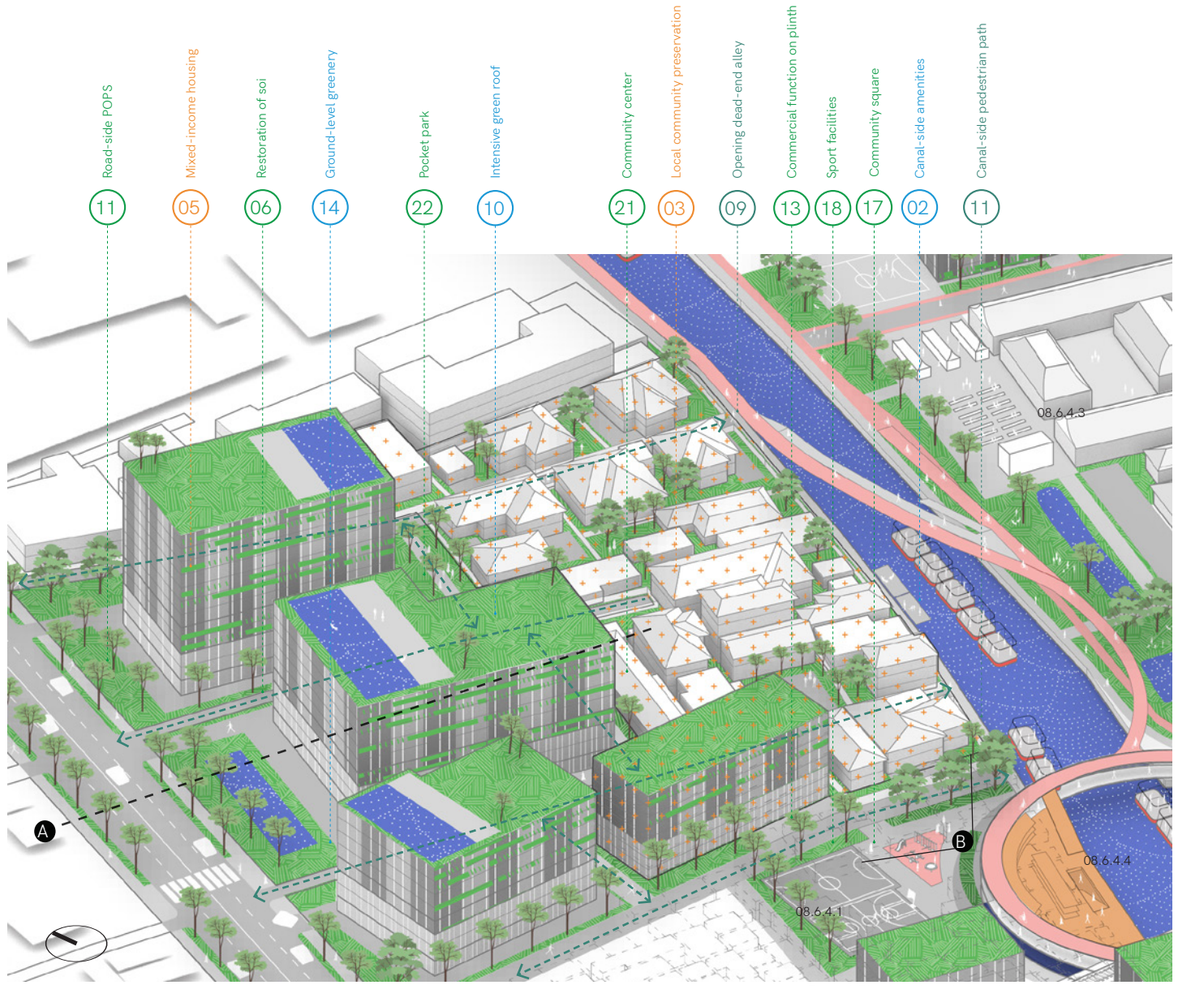


Figure 8.79. Overview of bolstering middle-income community
Source: Author

08.6. Design Intervention
08.6.4. The Convergence of Connector and Node
08.6.4.3. Bolstering middle-income community

canal-side paths, this will be done through the negotiation with the residents. Moreover, POPS within new developments can invite residents to use and act as a pocket park of the neighborhood. These buildings will house various functions ranging from retail spaces and office on the lower floors, to create active streets, to the mixed-income housing on the higher floors (Figure 8.81).

The in-between space plays a crucial role as a mingling space for people from two communities which creates a socially diverse environments (Figure 8.82).

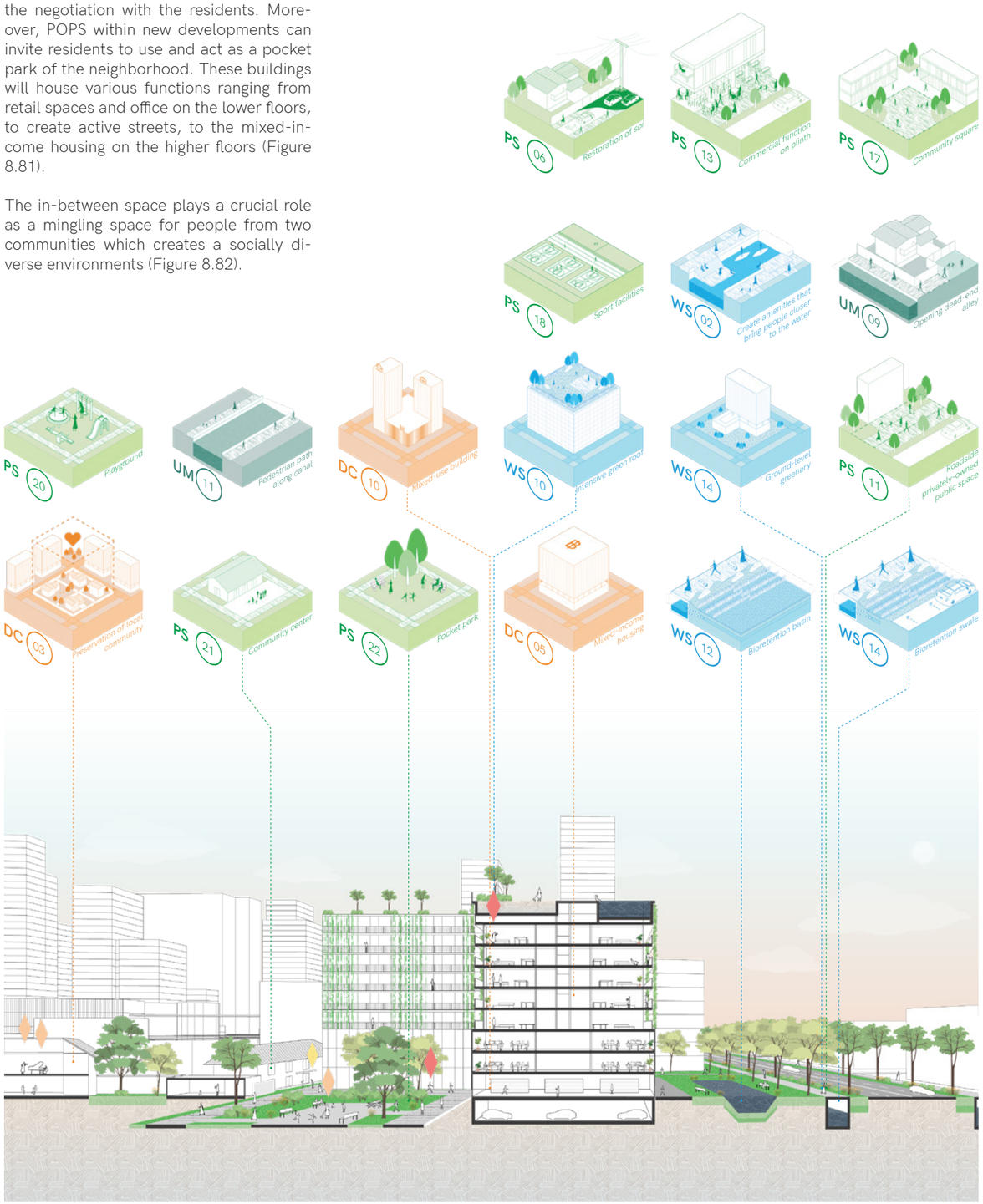


Figure 8.81. Section of mixed-use building, pocket park, and local community
Source: Author

Ⓐ in Figure 8.79

Stakeholder that has highest impact in this project is the middle- to high-income communities as they possess most areas and have rights to oppose to the adjacent developments. While real estate developers play a crucial role in dedicating POPS that surrounding residents can use (Figure 8.83).

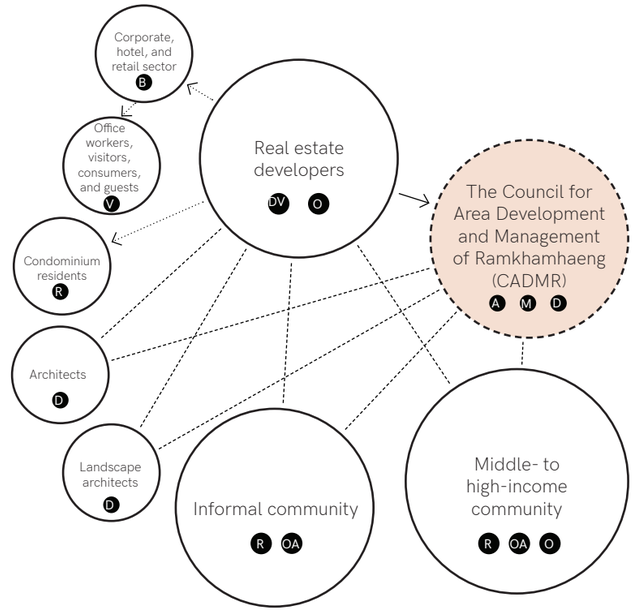


Figure 8.83. Bolstering middle-income community stakeholders diagram
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

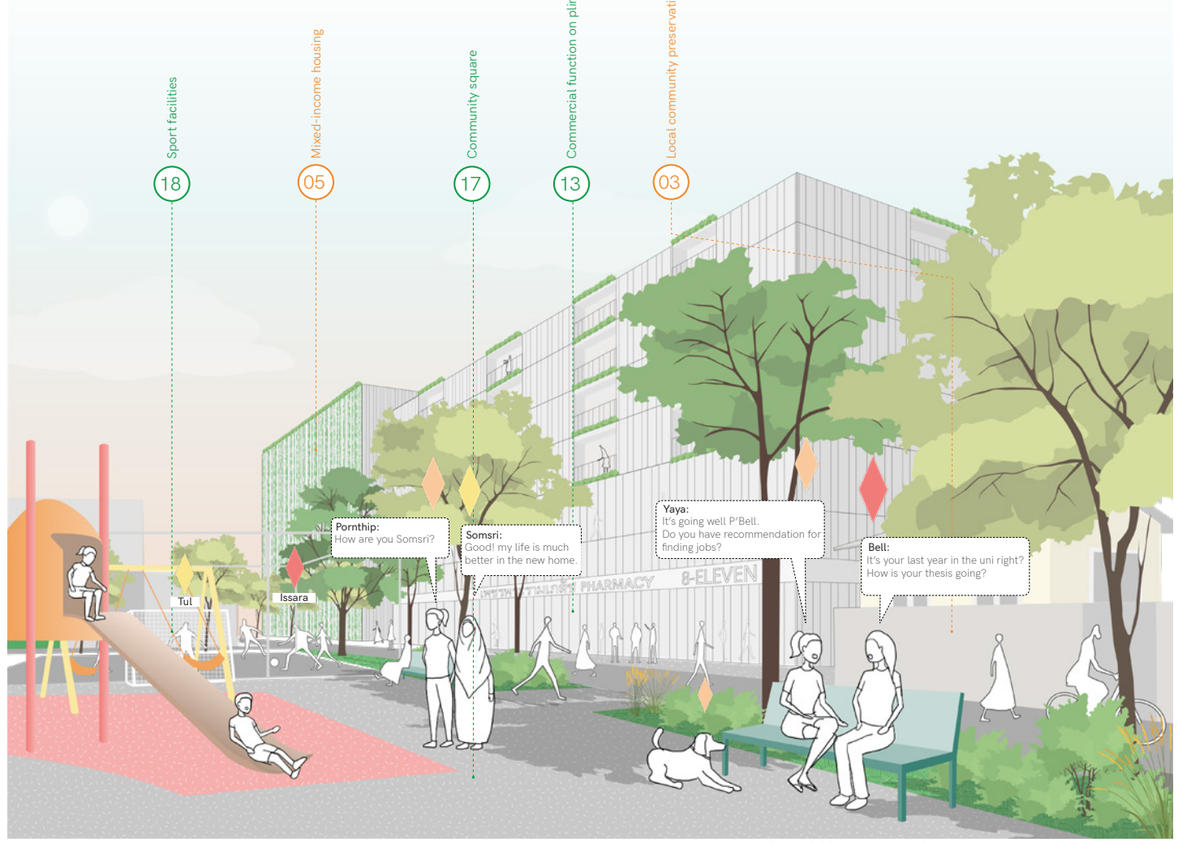


Figure 8.82. Impression of community square and applicable patterns
Source: Author

Ⓑ in Figure 8.79

08.6. Design Intervention
08.6.4. The Convergence of Connector and Node
08.6.4.4. Publicizing waterfront

Across the canal, large plots allow for large-scale mixed-use developments offering opportunities for the application of POPS at the waterfront. Figure 8.84 demonstrates the overview of how POPS and surrounding built forms support each other and create livable and socially diverse environments.

On the embankment, the strip of open spaces is maximized and built forms are oriented to it. Some parts of the existing apartment building is cut out to open for the North-South connection and allow more wind ventilation (1). Adjacent to it, two Chinese family associations will be negotiated to open their parking lots for public use where cultural and recreational events can be held, for example Chinese opera, and weekly market (Figure 8.85). These events activate POPS and invite people including surrounding residents, office workers and visitors. Residents across the canal can access this space via pedestrian crossing bridge that attached to the curve of the elevated bicycle path, connecting both sides of the waterway.

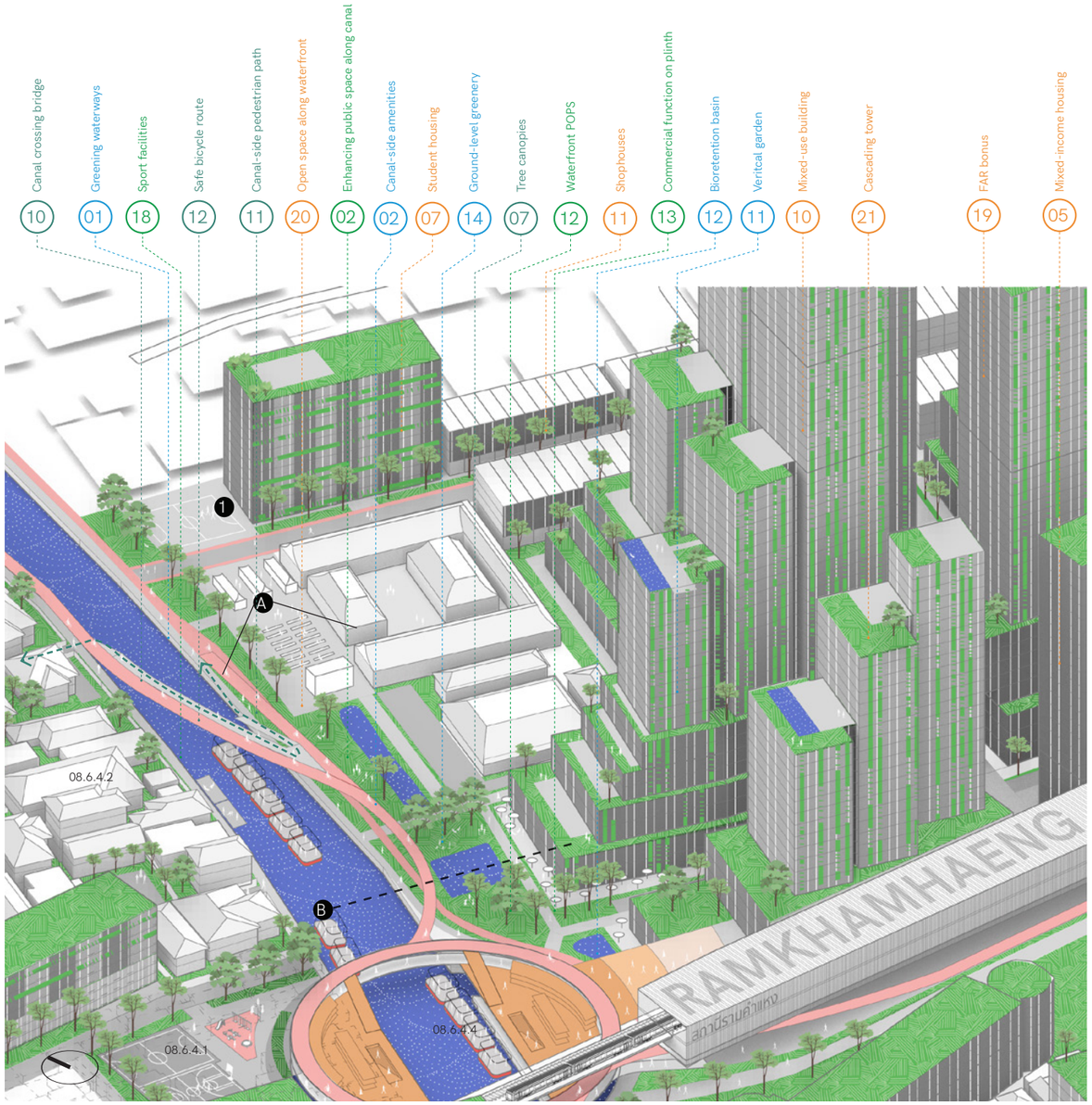
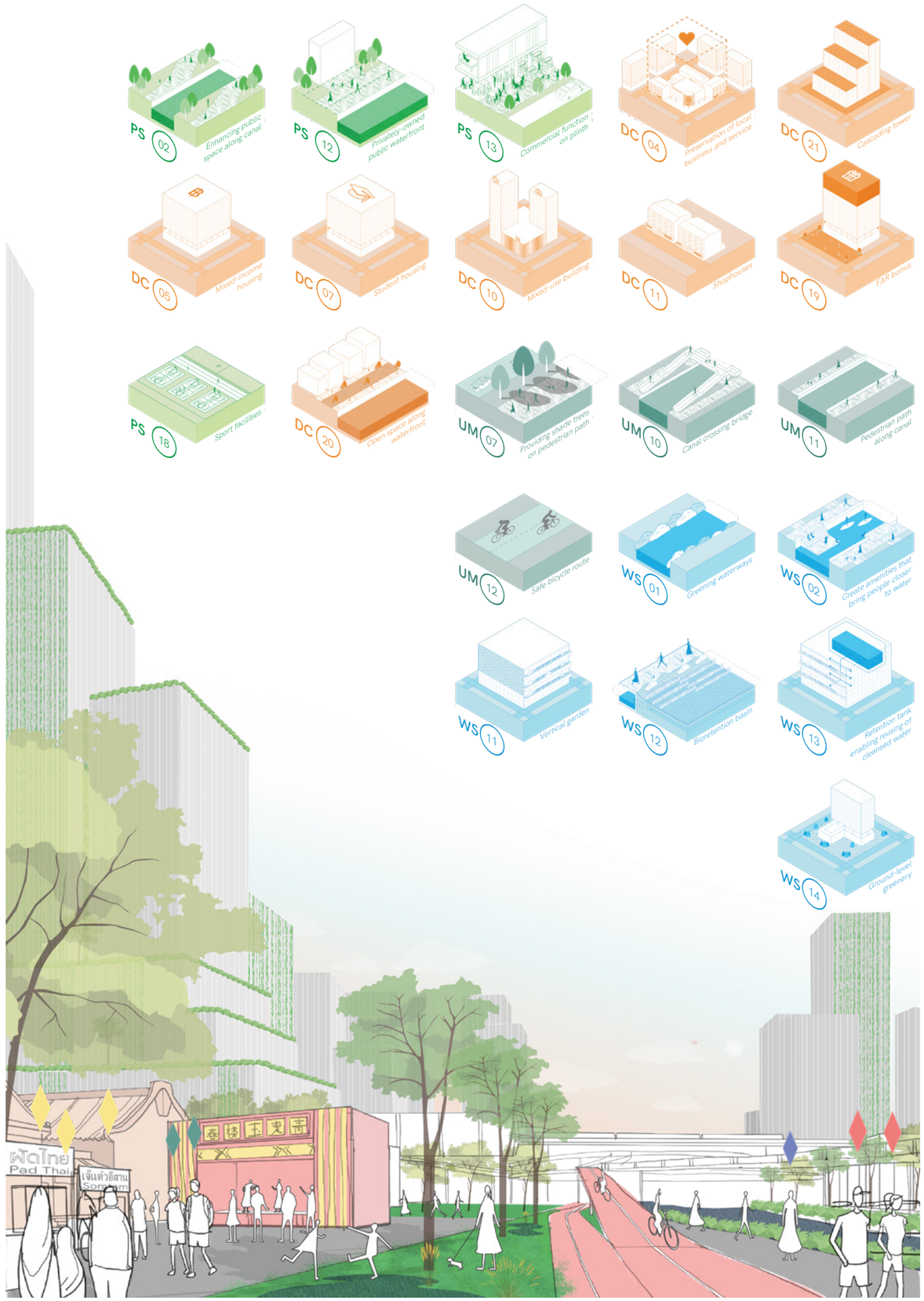


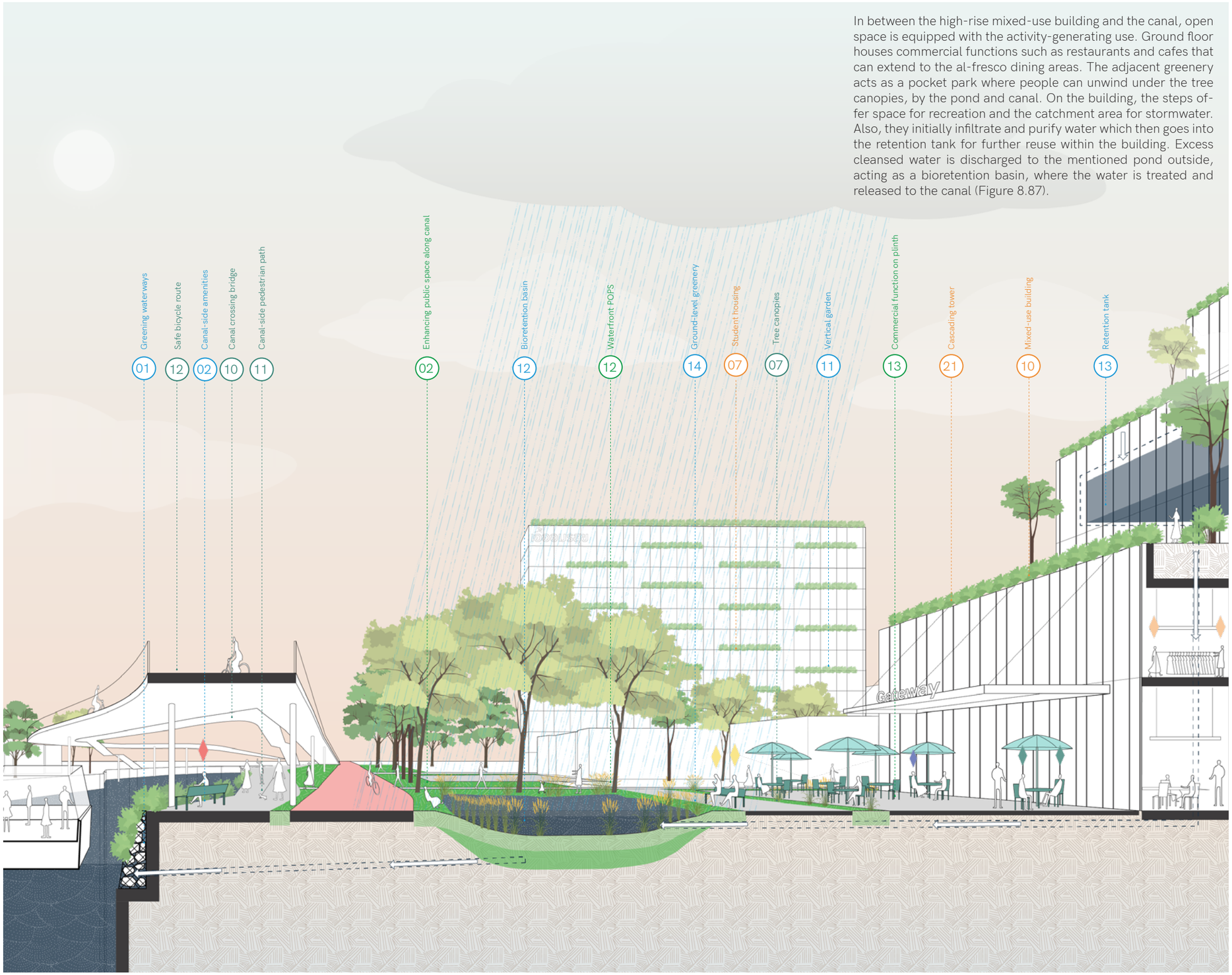
Figure 8.84. Overview of publicizing waterfront
Source: Author



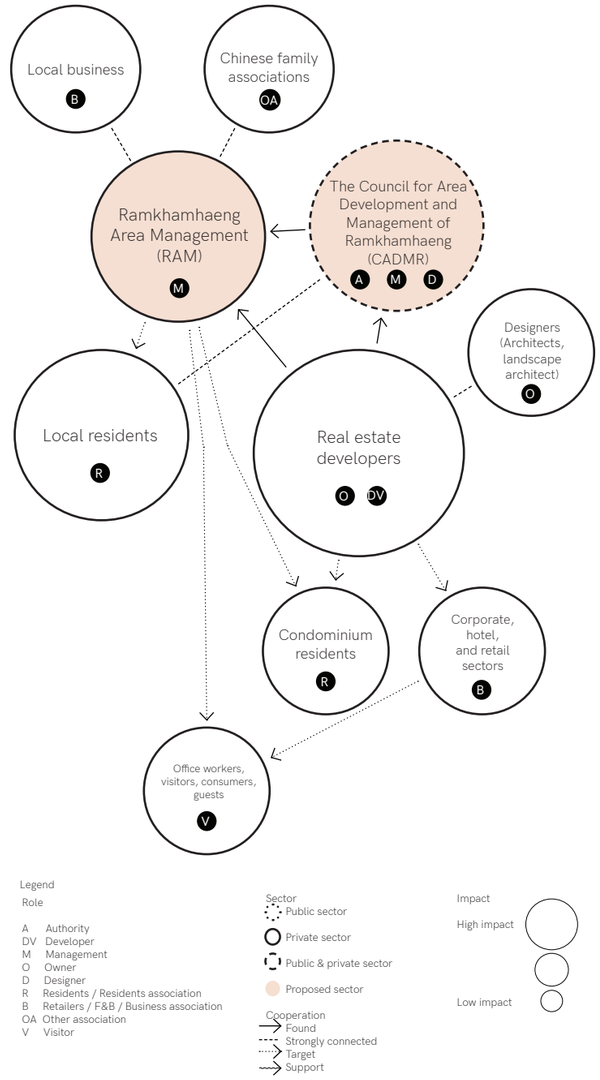
A in Figure 8.84

Figure 8.85. Impression of privately-owned public space and applicable patterns
Source: Author

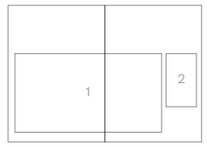
In between the high-rise mixed-use building and the canal, open space is equipped with the activity-generating use. Ground floor houses commercial functions such as restaurants and cafes that can extend to the al-fresco dining areas. The adjacent greenery acts as a pocket park where people can unwind under the tree canopies, by the pond and canal. On the building, the steps offer space for recreation and the catchment area for stormwater. Also, they initially infiltrate and purify water which then goes into the retention tank for further reuse within the building. Excess cleansed water is discharged to the mentioned pond outside, acting as a bioretention basin, where the water is treated and released to the canal (Figure 8.87).



B in Figure 8.84



To actualize this design intention, real estate developers play a vital role. They are the one who was incentivized to provide POPS. While residents from surrounding neighborhoods can oppose the developments through public participation, therefore they also have high impact in the project (Figure 8.86).



1 Figure 8.87. Impression of privately-owned public space
Source: Author

2 Figure 8.86. Publicizing waterfront stakeholders diagram
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

A in Figure 8.89

Figure 8.88. Impression of the interchange pier
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

08.6. Design Intervention
08.6.4. The Convergence of Connector and Node
08.6.4.5. Interchange pier

The last precinct for the design intervention is the interchange pier. It is the transition point where commuters transfer between land-based networks and water-based networks, also between fast mobility and active mobility. Figure 8.89 illustrates the overview of the piers where all transport elements converge. On the ground level, double-sided piers with separated platforms are proposed to accommodate two waterborne routes (Figure 8.90). The covered circular-shaped structure acts as a concourse, equipped with bi-cycle parking racks, and pedestrian crossing bridge that links with surroundings and other transport modes. On the highest level, the curve facilitates the gentle turn of the bicycle paths. Cyclists can conveniently travel to and fro their home and workplace through the elevated paths, and make a smooth transfer to the boat.

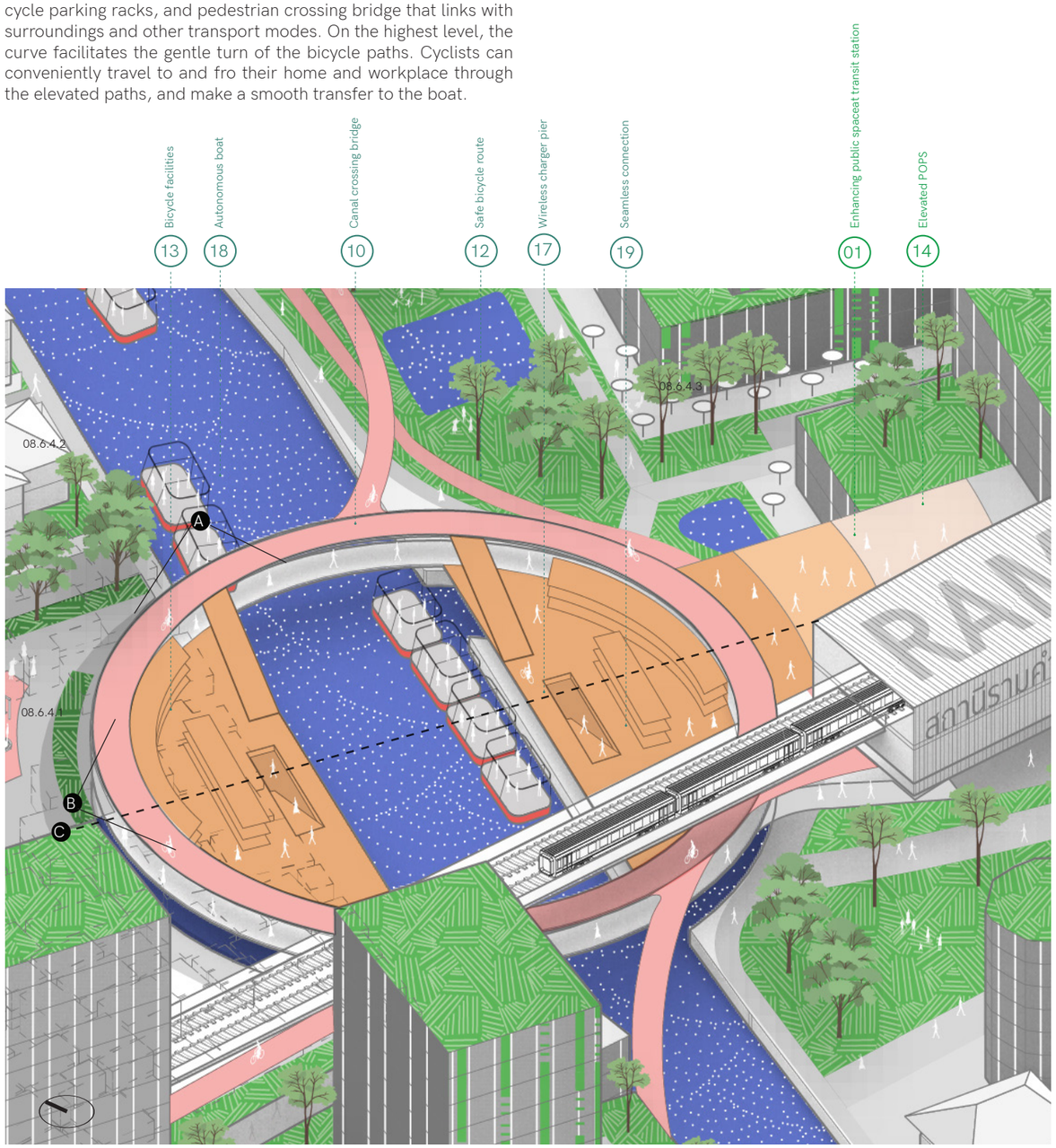
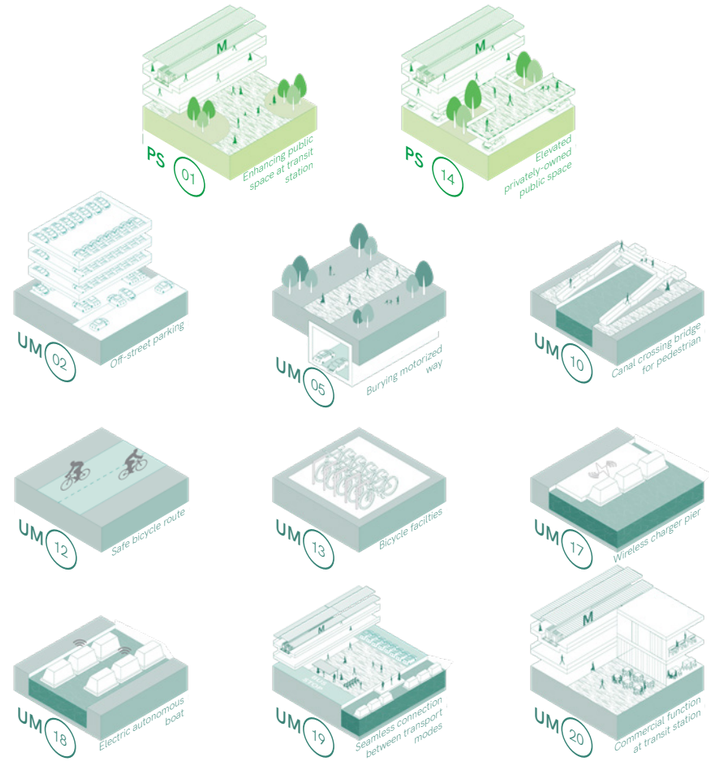
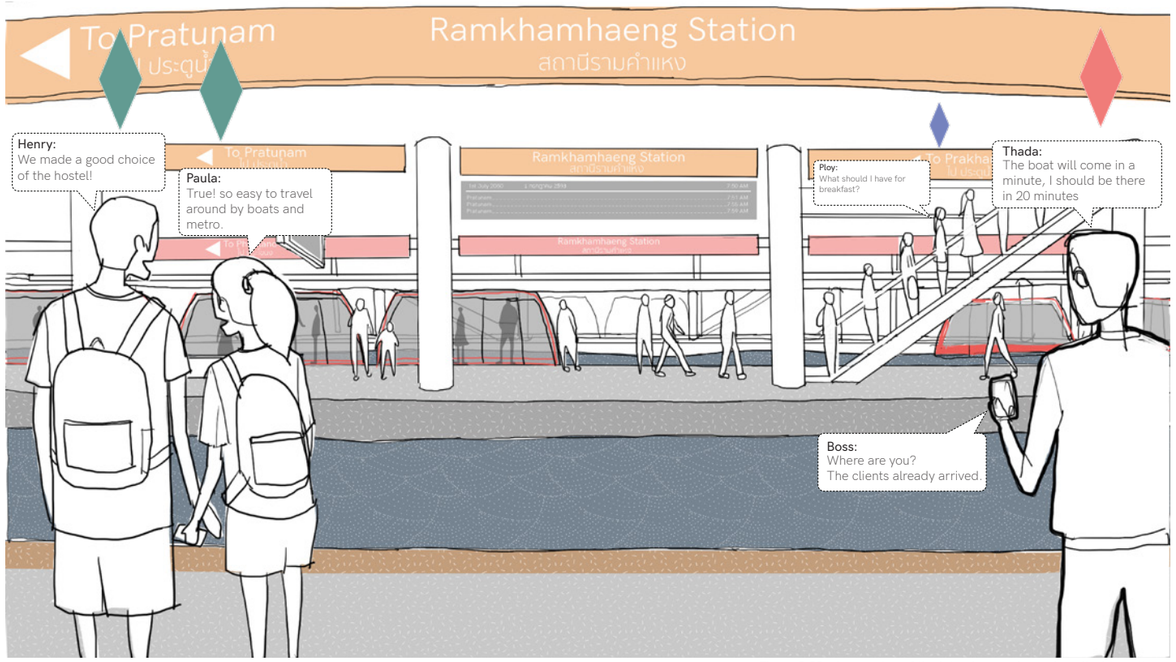


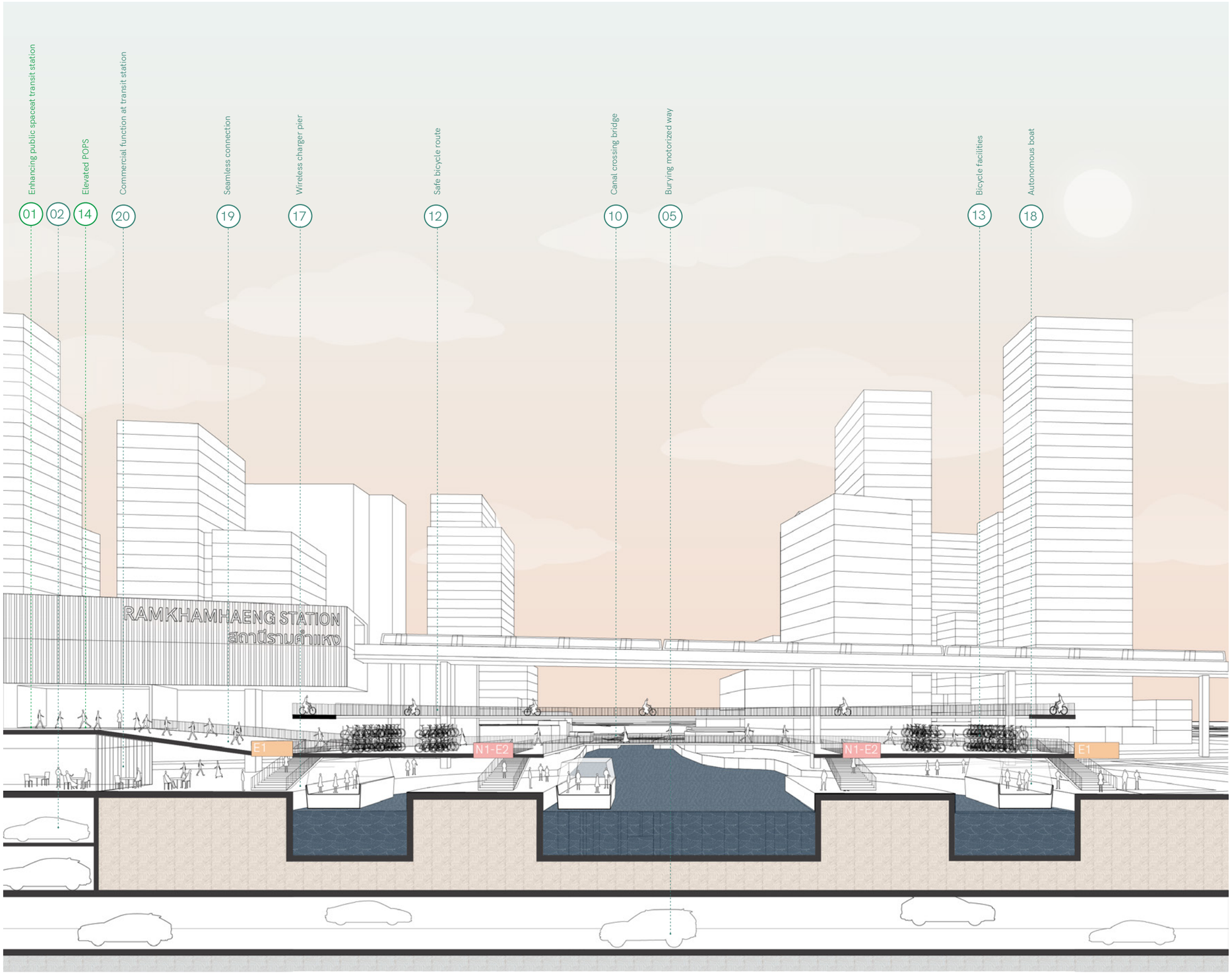
Figure 8.89. Overview of the interchange pier
Source: Author



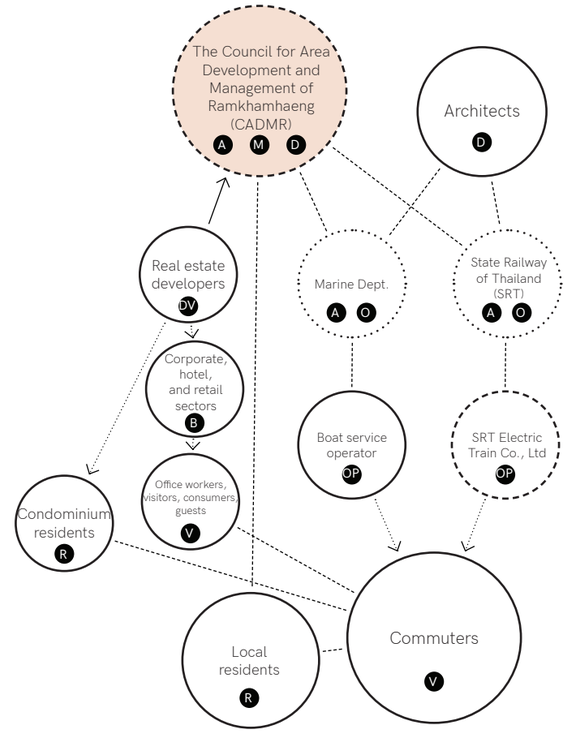


B in Figure 8.89

Figure 8.90. Impression of the interchange pier and applicable patterns
Source: Author



© in Figure 8.89



Legend

Role
A Authority
DV Developer
M Management
O Owner
D Designer
R Residents / Residents association
B Retailers / F&B / Business association
OA Other association
V Visitor

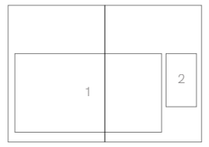
Sector
Public sector
Private sector
Public & private sector
Proposed sector

Cooperation
Found
Strongly connected
Target
Support

Impact
High impact
Low impact

Figure 8.92 demonstrates the section that elucidates the different levels of the interchange pier. The existing street that overpasses the canal will be buried, connecting with off-street parking spaces, to make rooms for the public transport above the ground.

Actors who make this project happens are the Marine Department which is the owner of Sean Saeb Canal and the architects who will design this pier in detail to serve the commuters and residents in this area (Figure 8.91).



1 Figure 8.92. Impression of interchange pier
Source: Author

2 Figure 8.91. Interchange pier's stakeholders diagram
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

08.7. Operation
08.7.1. Stakeholders and power relations

As discussed in chapter 6, Bangkok TOD is established to work on the metropolitan-scale urban development, while at Ramkhamhaeng, the Council for Area Development and Management of Ramkhamhaeng (CADMR) is established to manage and give permission to all the projects in this area. They consist of representatives from different departments, developers, and the local community. This is to ensure that the development is inclusive where all actors participate and their voices matter. Moreover, Ramkhamhaeng Area Management Association (RAM) is in charge of the soft management and programming of the public space and POPS. It curates events, whether cultural events and weekly markets, to enhance attractiveness to the area (Christiaanse, Hanakata, & Gasco, 2019). They have to work with the developers, local businesses, and Chinese family associations closely (Figure 8.93).

The phasing strategy in Figure 8.94 elucidates when the actions should be taken in the coming thirty years. Between 2021 and 2030 is considered the development phase. In the informal settlements project, the workshops are held regularly in the planning and design process. Then the construction is divided into two phases; the first phase showcases the prototypes to the residents and assesses the outcome for the improvement in phase 2. In the bolstering middle-income neighborhood project, the phasing of mixed-use developments is planned to not overlap with each other to reduce the externalities from the construction to the surroundings, similar to those across the waterfront. Public hearings are operated in every project, including the interchange pier development, to engage various people. After the development phase, the years from 2030 to 2050 are for redevelopment and maintenance, ensuring the adaptation to respond to the future economic growth.

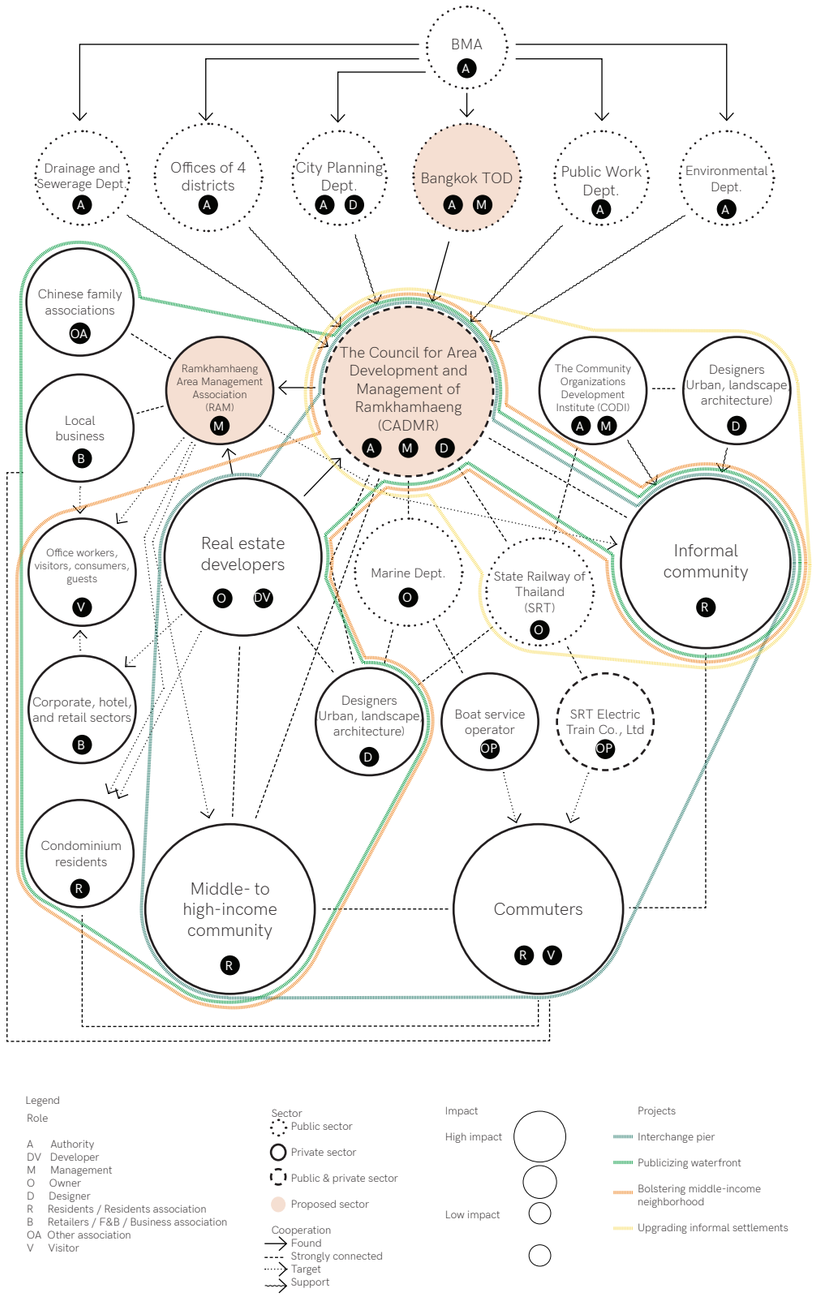


Figure 8.93. Involved stakeholders in Ramkhamhaeng
Source: Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

08.8. Implementation
08.8.1. Phasing strategy

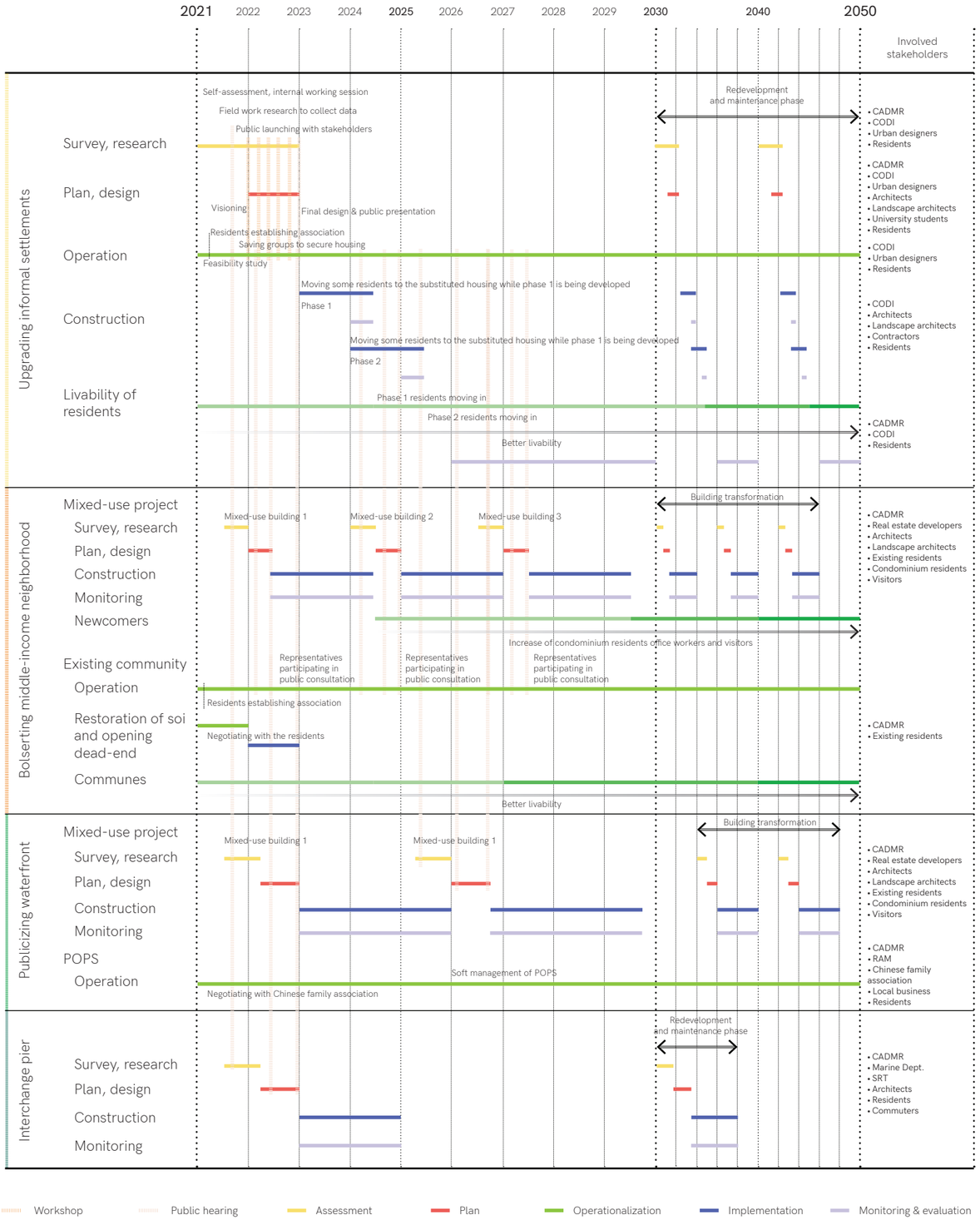
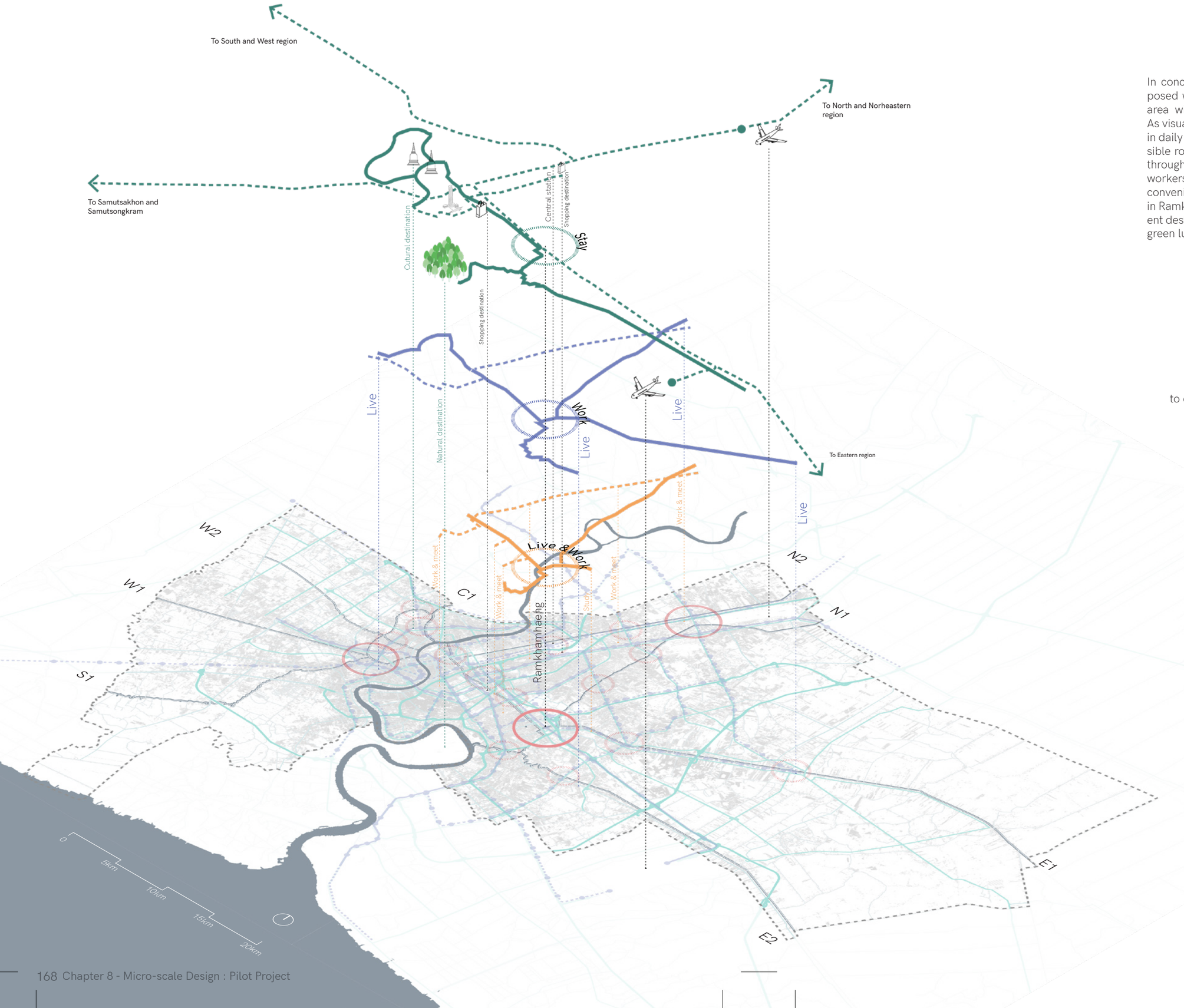


Figure 8.94. Phasing table
Source: Author

08.9. Metropolitan-wide Connection



In conclusion, the development of Ramkhamhaeng and the proposed waterways will offer convenience in transit, connecting the area with other TOD nodes and creating a complete network. As visualized previously, the design intervention facilitates the ease in daily lifestyles of various groups. Figure 8.95 illustrates the plausible routes that people could travel to and from Ramkhamhaeng through proposed canals and metro lines. For example, office workers who reside in other areas along the proposed canals can conveniently commute every day. In comparison, tourists who stay in Ramkhamhaeng can easily travel to and from airports and different destinations, whether the old town, Siam and Bangkrachao, the green lung of Bangkok.

Scan here
to experience the project through resident's perspectives.

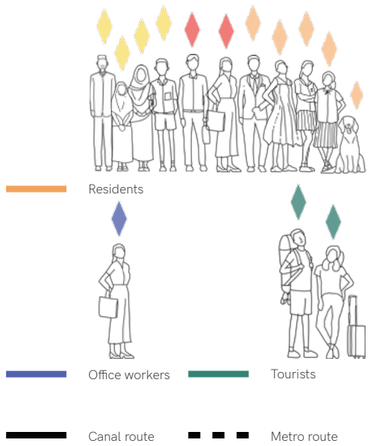


Figure 8.95. Metropolitan-wide connection
Source: Author

09. Conclusion and Reflection

Figure 9.1. Aerial shot of road and buildings
Source: Joseph (2018)

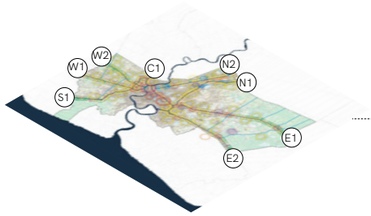
09.1. Introduction

This last chapter concludes the research, answering the main- and sub-questions which were used throughout the process. Following with the general reflection on the relation between the project and studio and track, the chosen methodology, societal and scientific relevance, ethical considerations, and the value of project's transferability.

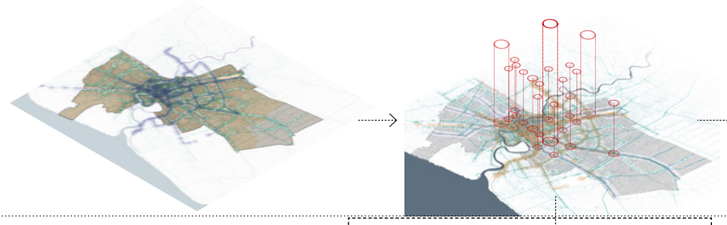
Respondence to the research question

How can Transit-Oriented Development transform the area surrounding emerging intermodal nodes in Bangkok and integrate with the water-based transport, in order to achieve the more compact city, where livable and socially diverse environments, are provided?

SQ3
Which waterways have potential to be developed for daily commute transport?



SQ2
Which station area could serve as a pilot project?

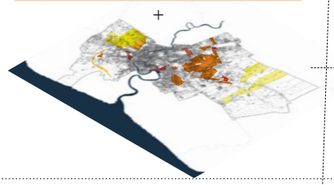


SQ1
Which aspects of Transit-Oriented Development are specifically applicable to Bangkok?

TOD
+
Case study
Theory essay
(AR3U023)

SQ5
What does the concept of compact city mean in the context of Bangkok?

Compact City
+

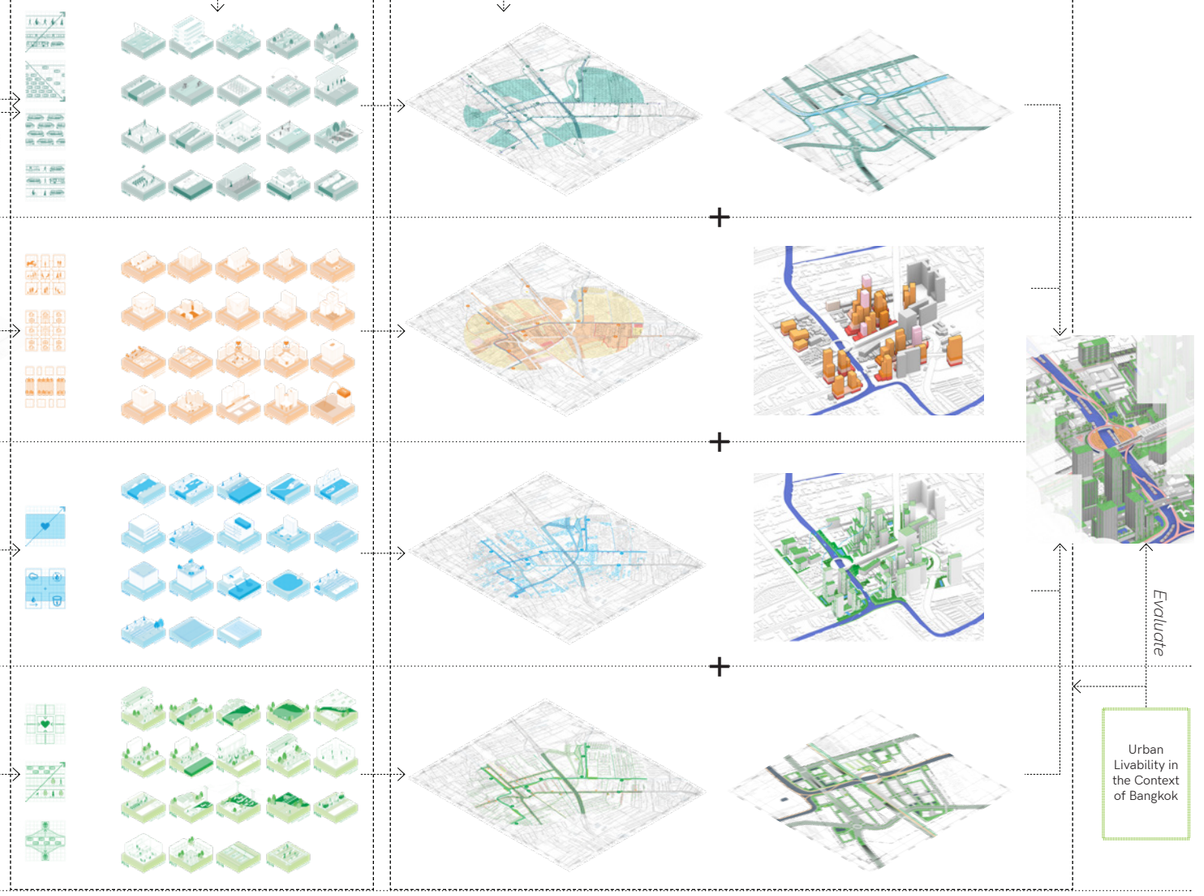


SQ4
How to revitalize the neglected water systems to mitigate flood vulnerability and integrate them with the mobility?

Hybrid infrastructure
Green-Blue Grids
Demand Responsive Transport

SQ6
How can urban fabrics stimulate livable and socially diverse environments in Bangkok? What are the main principles?

Public Life
Social Diversity



Evaluate

Urban Livability in the Context of Bangkok

SQ3: Which waterways have potential to be developed for daily commute transport?

The metropolitan-scale analysis of the land-based and water-based networks has responded to this sub-research question with the potential waterways. The spatial analysis of waterways highlights the potentialities for the development, especially the navigability, anchor functions, and existing water transport routes. Canal's profile determines whether transit boats could travel through or not. While the existing waterways, used for transport, are used as a reference for the appropriate profiles that apply to other potential canals. Thus, waterways' navigability categorizes canals as three types in which the most suitable type is the primary one. Besides, anchor functions such as university and government center create waterborne traffics. Therefore, this question is answered with eight potential waterways, which are used to consider potential TOD locations.

SQ2: Which station area could serve as a pilot project?

After the potential waterways and TOD locations are derived from the metropolitan-scale investigation, they are compared using the concentration of transit routes that cross at particular location. Ramkhamhaeng stands out with seven routes, three potential canals, N1, E1, and E2, and four rail lines. The area is also promising for the future development, situated in between the city center and Suvarnabhumi Airport, making it the Eastern gateway of Bangkok. Thus, it has a great potential to be a pilot project where guidelines are tested.

SQ1: Which aspects of Transit-Oriented Development are specifically applicable to Bangkok?

TOD is a general term for urban planning that places urban mobility as the core of urban development. These two elements intertwine and support each other; for example, high-density mixed-use areas increase the ridership of transit networks while high-quality and affordable transport encourages commuters to use and increases accessibility to the area. However, Bangkok is diverse in terms of the built environments, social groups, and each area has distinct characteristics and problems. Thus, there is no fixed set of principles that works in every place. Moreover, what makes the applicability of TOD in Bangkok different from other cities is the waterways that serve as a means of transport. To derive a set of principles, literature and cases are studied, particularly in the theory essay. Chapter 5 shows that Bangkok's governance and urban planning are problematic, full of hindrances embeded in institutional layers, less efficient public participation, and unimplemented policy that might not suit Bangkok. Therefore, the project proposes a solution that tackles these issues.

The guidelines proposed in the macro-scale strategy are tested at Ramkhamhaeng, situated in between the inner-city and suburban areas. The design intervention at this pilot project demonstrates the application of patterns through multiple scales. The macro-scale covering two 2-km catchment areas around Ramkhamhaeng station and the convergence of canals proposes comprehensive planning that applies patterns that could work in such a scale, such as integrating DRT with informal transport to enhance accessibility to local services further than walking distance. However, not all patterns work in this scale; thus, connector and node are selected to explore the applicability of patterns. In this scale, specific guidelines such as bicycle paths are applied along the canal to activate the waterfront. Also, the densification around the

station that considers the preservation of local communities is proposed. Lastly, four precincts on the embankments are chosen to elaborate on the correlation of strategic layers and engagement of diverse stakeholders. Since the TOD project takes a long-term implementation to accomplish and involves many stakeholders to realize which principles work, the pattern language is the effective method for experimentation and discussion. In conclusion, this project is an unfinished work, and there are still rooms to explore and implement the guidelines in reality.

SQ5: What does the concept of Compact City mean in the context of Bangkok?

The investigation of the current and future land-use plan and policy (chapter 5) has shown how BMA desires Bangkok to be a Compact City. However, the new zoning plan aims to densify extensive areas. The densification of preserved agricultural land to low-density residential area will continue the urban sprawl and encourage people to move to the outskirts as happened. Moreover, the densification of a broad low-density residential to medium-density residential zone will increase inhabitants in the superblocks, resulting in the congested streets unless the inclusive public transport networks exist. These determinations contradict the Compact City which aims to arrange out urban areas vertically to reduce travel time. Therefore, in the macro-scale strategic planning (chapter 6), "From Sprawl to Compact Primary City, Bangkok 2050" vision proposes a new development framework for Bangkok, based on four strategic layers. The density configuration and integrated urban mobility are closely related where mixed-use densification is proposed around stations and along the waterways. In chapter 8, the micro-scale intervention elaborates on the design at the pilot project, where density is explored, concerning the diverse building types and social groups. However, to achieve the Compact City outcomes, a metropolitan-wide long-term vision needs to be implemented in which all strategic locations are developed and support each other.

SQ4: How to revitalize the neglected water systems to mitigate flood vulnerability and integrate them with the mobility?

The layer of revitalizing water systems in the macro-scale strategy proposes the measures to cope with flood vulnerability. Catch, treat, convey, and store are water management elements whose performance is enhanced by integrating green, blue, and grey infrastructure and public engagement. The catchment elements catch stormwater, whether it is vehicular infrastructure, waterway and water body, and architecture. Simultaneously, treatment can be done through natural elements, technologies, and public engagement. Water design guidelines are proposed, for example, infiltration strips and bioretention systems, incorporating into the catchment elements such as roads and green roofs. While communities can participate in the plastic fishing project in the waterways to create a sense of belonging and demonstrate to the city that they are not polluters but the important asset that helps maintain the canal system. Another plausible way to treat water systems is through autonomous debris collecting boats. Besides, waterways act as a conveyance element that needs greening and beautifying. The enhanced aesthetic and cleanliness encourage more people to use the canal to transport for active mobility through bicycles, walking, and fast mobility through boats. Lastly, the storage performance is enhanced by providing waterbody and retention tanks in the buildings that allow the reuse for irrigation. The design intervention at the pilot project applies the mentioned strategy, which ultimately zooms into the POPS and interchange piers to elucidate how the revitalization can enhance mobility along the waterfront.

SQ6: How can urban fabrics stimulate livable and socially diverse environments in Bangkok? What are the main principles?

Urban livability and diverse environments are the primary goals of this project in which the implementation of four strategic layers will contribute. Since public space plays a crucial role in structuring urban fabric and urban life and supporting social and economic dynamics, it can be an agent to promote cohesion, which ensures continuity, permeability, and mobility of citizens (Pinto & Remesar, 2012). These values are parts of the assessing indicators of urban livability in the Bangkok context (Alderton et al., 2019). Besides, public space stimulates outdoor activities, whether necessary, optional, or social (Gehl, 2011). Therefore, public space is placed as the central element in the densification where POPS is used to enhance the perception of public space in market-driven urban development. Moreover, neglected ones such as the canals and roads are restored to provide paths for active mobility and more rooms for the public realm.

Talen and Lee (2018) argue that a socially diverse neighborhood is where residents have different income levels and wealth, racially and ethnically mixed. Moreover, what could indicate why neighborhoods are socially diverse are historical/economic/social, policy-related, and physical/location factors. Therefore, the micro-scale design intervention aims to preserve local communities and embrace the informal settlers. Also, mixed-income housing is proposed to accommodate diverse groups of residents.

Ultimately, the design outcomes are evaluated using the indicators of urban livability in the Bangkok context (Figure 9.2).

Indicator	Evaluation
Indicators for immediate action	
Crime	Mixed-use development stimulates the use throughout the day, making the area active and reducing crime rate. Informal settlements are upgraded and organized resulting in the more safe environments
Tree coverage	Pubic spaces and streets are restored with the canopy trees provided
Air quality	The improved and integrated public transport, together with the mixed-use densification around stations will discourage people from using private vehicles
Water quality	Water quality in the canal will increase through the integration of catchment and treatment elements in the developments which infiltrate stormwater before it is discharged to the canal in the long term. While, plastic fishing sessions and
Flooding	The optimization of green, blue and grey infrastructure through catchment and treatment elements on the buildings and streets will enhance the performance of stormwater management and initially counteract with flash flood.
Access to temples	Religious places are preserved, for example temples, mosques, and churches in the design.
Access to schools	There are already sufficient educational institutes ranging from elementary schools to universities. Also, student housing is provided for convenience of university students.
Waste management	Design does not tackle this issue
Indicators for medium-term action	
Sense of community	The enhancement of public space will encourage people in the community to use and mingle with each other. The establishment of communal association will encourage residents to gather, contribute to society and share the same commonality.
Job security	Local business is preserved. Mixed-use development includes office spaces, and retail spaces which provide job opportunities for people with all-income ranges.
Income	Design does not tackle this issue
Education	Design does not tackle this issue
Health	The provided public space, privately-owned public space, and active mobility path encourage people to do more exercise and relax outdoor, which improve physical and mental health.
Local employment	Local business is preserved. Mixed-use development includes office spaces, and retail spaces which provide job opportunities for people with all-income ranges.
Quality food	Design does not tackle this issue
Traffic congestion	The improved and integrated waterborne transport into the public transport network, together with the mixed-use densification around stations will discourage people from using private vehicles. Also, the policy mechanism such as green tax, ERP will reduce the amount of traffic in the inner-city area.
Sewerage	The optimization of green, blue and grey infrastructure through catchment and treatment elements on the buildings and streets initially purifies stormwater before it is dischraged to the drainage and sewerage systems.
Indicators for long-term action	
Areas for passive recreation and physical activity	The provided public space, privately-owned public space, and active mobility path encourage people to do more exercise and relax outdoor.
Public transport	In the macro-scale, waterbourne transport is integrated into the whole public transport systems. Informal transport especially motorcycle taxi is upgraded and equipped with DRT technology to enhance accessibility in the shadow.
Housing affordability	Mixed-income housing ensures the provision of residential units with an affordable price range in each mixed-use development.
Work/Life balance	Design does not tackle this issue
Access to community centers	Design does not tackle this issue
Neighborhood amenity	Multifunctional area ensures the accessibility to amenities in the neighborhood, for example local fresh market, convenient store, and retail shop.
Drinking water quality	Design does not tackle this issue
Access to liquefied petroleum gas	Design does not tackle this issue

Figure 9.2. Evaluation of livability in the context of Bangkok
Source: Author, adapted from Alderton et al. (2019)

09.3. Reflection

Relation between graduation topic, studio topic, urbanism master track

This project focuses on the urban transformation in Bangkok through densification around intermodal hubs, which perfectly aligns with the Design of Urban Fabrics (UF) studio, especially this year's theme of "Urban transformation and qualities of density" as density plays a crucial role in the urban development in Bangkok. This metropolis has gone through rapid urbanization, and market-driven development resulted from the unplanned phenomena, posing how vital the urban transformation is. The investigation of Bangkok's complexity via quantitative and qualitative approach is needed, and UF studio supports me with helpful inputs that assist me throughout the research and design process. Moreover, adapting the TOD concept is accomplished by the design-oriented approach and the planning process that deals with various stakeholders and policies. Thus, to comprehend the broader planning perspectives, the project requires guidance from the expertise of the Planning Complex Cities studio.

The relation of this thesis with the Urbanism track is the multi-scalar approach of thinking and analysis, ranging from integrating spatial planning and strategies in the metropolitan- to micro-scale urban design. This notion is embedded in this graduation since it frames the approach and contributes to the desired outcomes. Another connection is the importance of storytelling which is the fundamental method that contributes to a more coherent story and brings about the rational structure. Most importantly, philosophies and values of Urbanism have been taken into consideration in the project, for example, the Compact City and TOD that aim for sustainable and inclusive densification where long-haul travel is less needed. As an urbanist, it is crucial to connect physical space and social environment with multidisciplinary knowledge to achieve this.

Societal relevance

Rapid urbanization resulted from sprawling road networks, and market-driven development contributes to many social issues, such as the scatter of gated communities and scarcity of public spaces. These prevent social interactions between diverse groups and lead to social segregation. This project addresses these issues and aims to find the solution to enlarge public spaces in Bangkok via guidelines and policies and make them a place that facilitates livable and socially diverse environments through design intervention.

Notwithstanding, TOD could cause side effects of gentrification and prioritization of certain groups over others. These anticipated sensitive issues have been taken throughout every step of this research. The qualitative research and analyses of the socio-economic element are executed to comprehend the existing condition and promote a bottom-up approach in urban planning and design is public participation. Therefore, Bangkok's current public participatory models are studied to determine the problems behind this ambiguity, which indicates that the issue lies in the local community setting and new high-rise development. Thus, this project proposes the integration of community engagement activities, for example, workshop, throughout the design process.

Scientific relevance

This thesis intensively associates with the adaptation of the theories and filling the knowledge gap as TOD has not been widely applied in the Global South. Due to the mismanaged urban development, diverse social groups, and political logjams, contextualization has to be concerned throughout the research and design process. The methodology therefore includes a literature review of the developed concepts to acquire a set of guidelines for Bangkok. At the metropolitan level, specific potential locations are identified through spatial analyses. Additionally, there has been limited research regarding the integration and revitalization of water systems in Bangkok and the urgency of sustainability is yet to be realized. Thus, the existing projects are examined and added up concerning possible future scenarios by this research.

The aspects of livability and social diversity through TOD implementation have not been studied in the Bangkok context. Also, the quality of density and typology has not yet been investigated to enable livable and socially diverse environments in the built-up areas in Bangkok. Therefore, balanced quantitative and qualitative approaches are needed to analyze the numerical density, socio-economic and physical environment study.

Furthermore, the project's outcome contributes to the Sustainable Development Goals (SDGs), particularly SDG 11, sustainable cities and communities, and SDG 13, climate action, where inclusive TOD and climate-adaptive design are applied (United Nations, 2015). However, to implement them in Bangkok, contextualization is essential. Thus, the project phasing is planned, including public participation in every phase, by referring to the Participatory Incremental Urban Planning Toolbox (PIUP), guided by UN-Habitat (2020).

Advantages of the chosen methodology

In the first phase of the project has relied heavily on the literature review to comprehend the existing theory and determining the elements that should be analyzed; for example, TOD is the integration of the high-density land-use and transportation networks. Therefore, the spatial analysis of land-use, density, and mobility networks are conducted to find potential testbed locations on metropolitan and micro scale. Choosing the pilot project as a testbed allows me to thoroughly research by design than superficially propose the design for multiple locations. By doing so, a more comprehensive investigation of the complexity of urban fabrics can be done. Also, the layer-based approach for the design and strategic planning offers me the opportunities to present the interdisciplinary proposal, which can be an effective way to tackle the complex problems of Bangkok. Moreover, to express rational ideas, analytical mapping is the most effective method in the urbanism field. It assists other methods in demonstrating the findings and investigation. This method allows me to explore the possibilities to visualize the drawings to support the storyline.

Limitations of the chosen methodology

Since Bangkok is home to a diverse social group, unstandardized building typologies, and complex mobility networks, every aspect cannot be addressed due to time constraint. Therefore, the parameter is established to reduce the excessive workload of the inessential analysis. Moreover, limited academic research about urban planning and design in Bangkok is available. There has not been any research conducted in the pilot project area in any fields to support this project. Thus, the data needs to be collected and analyzed based on an assumption and hypotheses. Besides, the Covid-19 pandemic has restricted me from traveling to the site to experience the actual physical environment and interview local people for insights. Therefore, substituted methods have to be taken to acquire the desired information, such as desk research and virtual site observation.

Another remark is the balance between time and workload. The planned roadmap of the research in chapter 3, aiming to propose design intervention at the second location, does not suit the given time. Thus, it can be suggested that the arranged roadmap is more applicable in the practice with other actors in the team, for example, the city administration, and colleagues to execute this plan. This paves the avenue for further research at other locations and shows that urban developments are always an unfinished project.

The problems occurred during data collection

Data accumulation in Bangkok might not be as easy as in the Netherlands. Not all the information is transparent and could be derived from open sources, especially for the local district scale. Therefore, alternative ways are needed to steer the research, for example making assumption and hypotheses. Moreover, the acquired information, for example, the shapefile of the built forms and existing function, is outdated and not accurate enough to conduct the density analysis. Thus, virtual observation via Google Street View is needed at the pilot location, where the built forms were surveyed and used for density calculation.

Ethical considerations

Since the project aims to enable livable and socially diverse environments in Bangkok through TOD project, the ethical issues arise such as social disparity. The informal settlements are the communities that are overlooked and prejudiced by the higher-income citizens. The neighborhood is seen as a dangerous place that do not invite outsiders. Moreover, the settlers are seen as a polluter, encroaching and disposing waste to the waterways. Contrarily, canals are seen as a dumpster. In response to this, this project tries to alter the perception towards the slums and recognizes their rights to participate in the project. Instead of pressuring them to leave and top-down propose the design, the project integrates public participatory models to promote bottom-up approach and let them tailor their desired home. Simultaneously, initiatives for public engaging projects are established to organize the sessions such as cleansing and greening canals to enhance sense of belonging.

Regarding the research, correct citation is necessary to indicate whose original knowledge is and what is added to the current field. Moreover, due to the research site being in Bangkok, some information is in Thai, therefore precise translation is required to avoid distortion and misrepresent the data. Besides, since the research is conducted remotely, and the pandemic is continuing, which prevents me from doing fieldwork. The assistance by peers located within the site is inevitably needed to collect specific data. Also, certain GIS data is given by my colleagues from the bachelor university with kindness which I ensure that all the contributions are acknowledged in this research.

09.3. Reflection

Transferability of the project

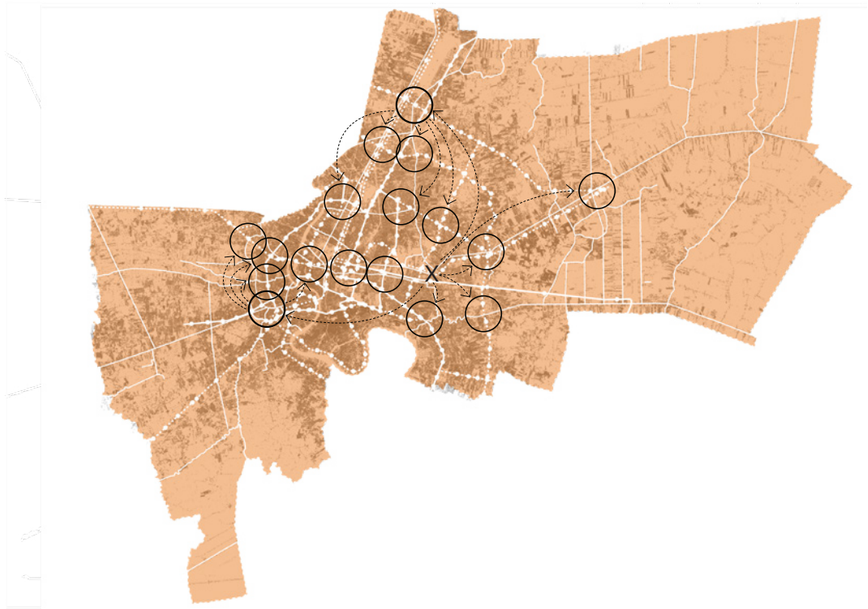
The transferability of the project can be evaluated through multiple scales. On the metropolitan scale, the solutions applied at the pilot project can be transplanted to other locations. Since all locations are a part of BMA and Bangkok TOD proposed in chapter 6, the transferability of policy and principle is high. The promising solution is integrating bicycle paths and pedestrian ways with fast mobility, such as metro systems and waterborne networks. Pattern languages can be used as a tool for urbanists to communicate with other stakeholders and to contextualize the guidelines. Moreover, an element that could be transplanted to other sites is the layer-based approach mentioned earlier in the advantage part. Four components will convey the design process with the objectives and ensure that the crucial aspects will be tackled.

Regarding the impact of micro-scale projects towards metropolitan-scale strategy. All proposed TOD projects have to be implemented so that the whole network synergizes and contributes to a more compact city. Phasing planning and stakeholder scheme are required to organize the implementation of each project with involved actors.

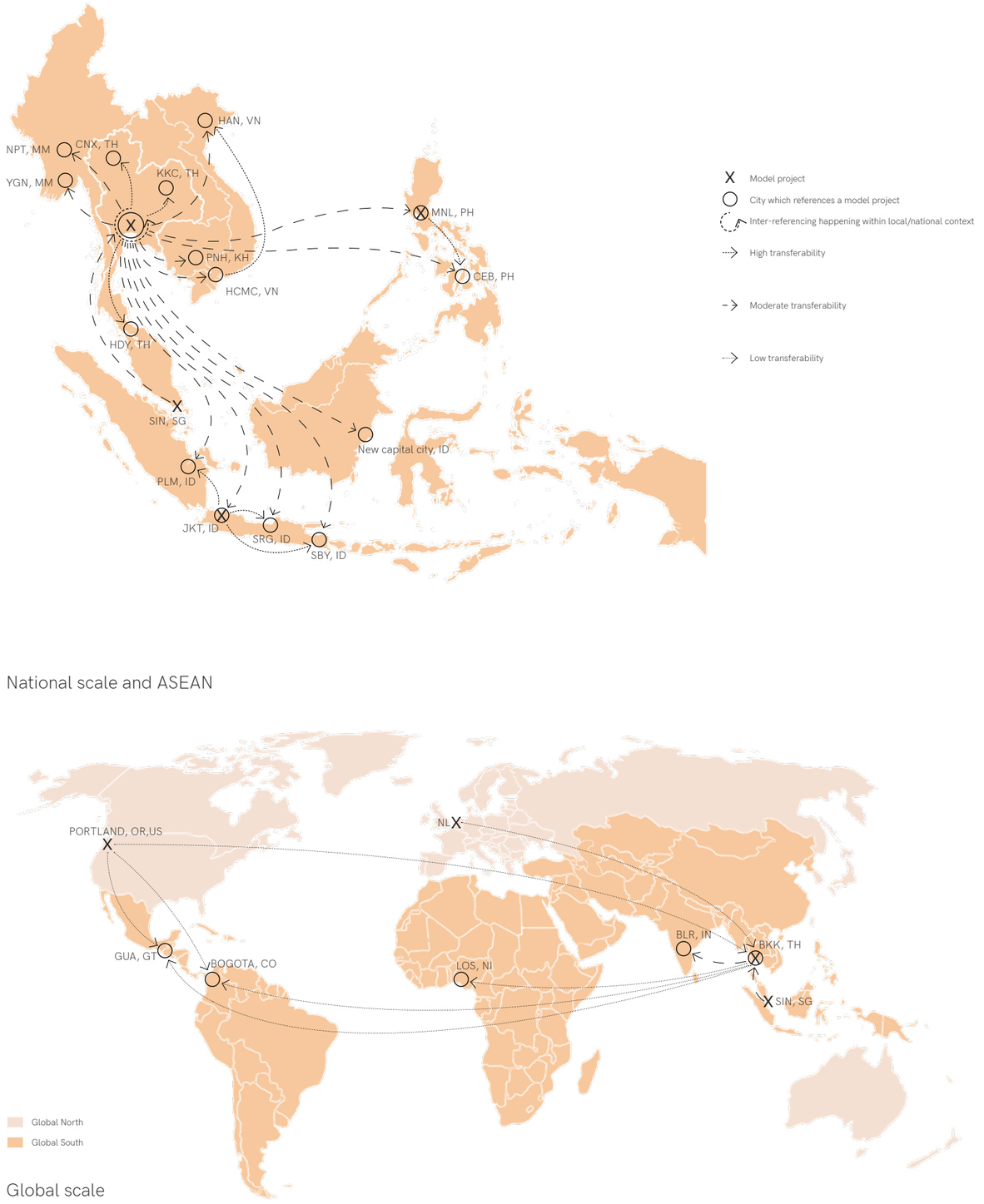
On the national scale, rail infrastructures are being developed and connect Bangkok with other provinces. The major cities have the potential to be developed to offer the opportunity for people from surrounding provinces. The project can be referenced by these cities, for example, Chiang Mai, Khon Kean, and Hadyai. Although they have different authorities, the level of transferability is considered high because of the same culture and language.

In SEA, Singapore, as part of the four Tigers, is referenced for the guidelines to be applied in Bangkok (Pojani, 2020). In this project, Bangkok is a testing ground and transfers the guidelines to other developing cities in the region. Due to some similarities of urban problems, for example, urban sprawl, traffic congestion, and neglected waterways, the solutions to tackle these issues, such as the densification around transit stations and integrating waterborne transport, can be applied. Notwithstanding, the planning systems in other cities are different from Bangkok, they share some commonalities such as culture and way of life; thus the level of transferability is moderate compared to the local condition.

Globally, this project can be referenced by the Global South cities in Asia and other continents. However, since the contexts are different, the level of transferability is low. As mentioned earlier, contextualization is required, in order to adapt principles to fit the specific conditions.



Metropolitan scale



National scale and ASEAN

Global scale

Figure 9.3. Transferability of the project
Source: Author, Author, inspired by Christiaanse, Hanakata, & Gasco (2019)

10. Bibliography

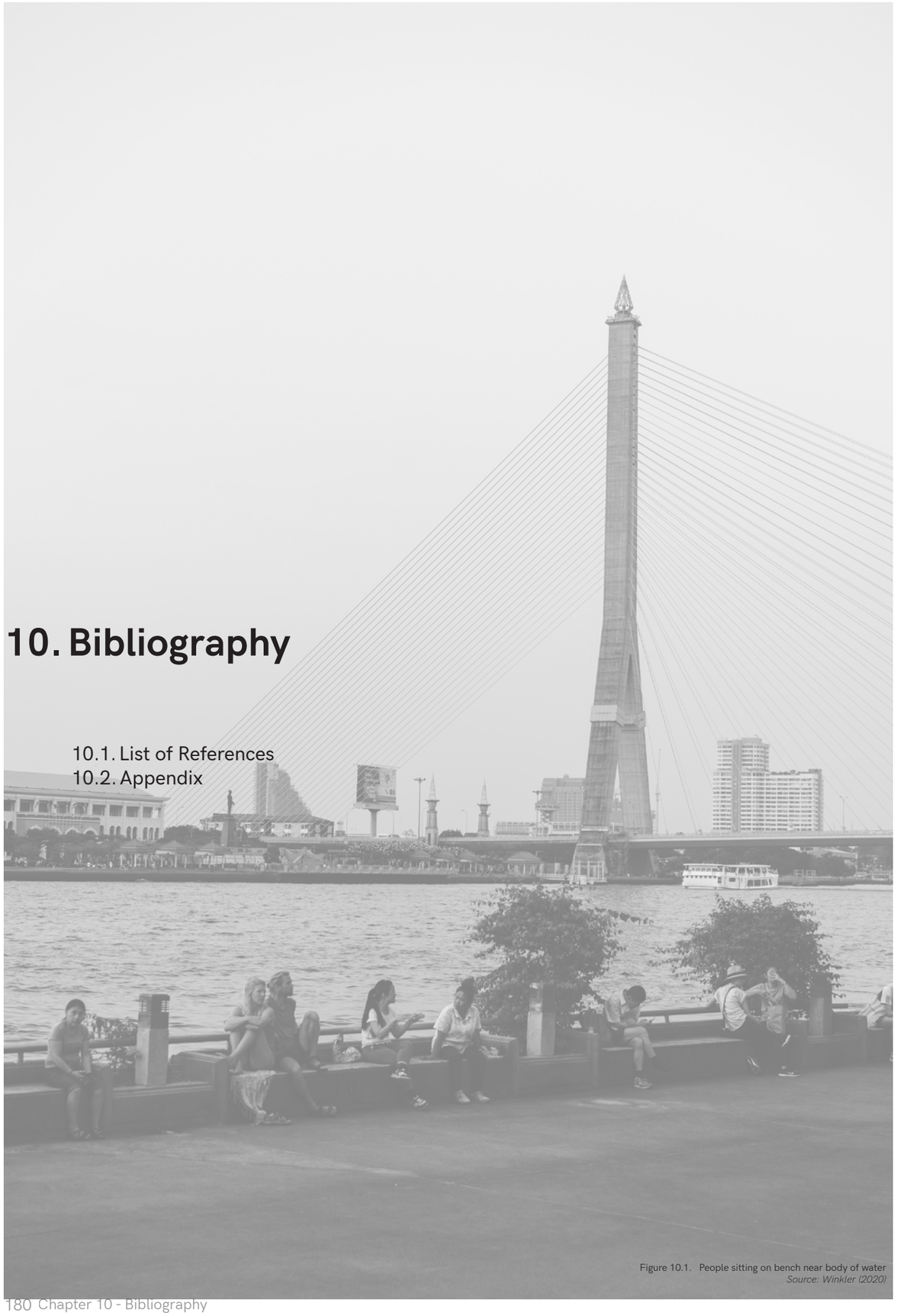


Figure 10.1. People sitting on bench near body of water
Source: Winkler (2020)

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10.2. Appendix

10.2.1. Theory paper

Transferability of the Transit-Oriented Development to developing Southeast Asian city, Bangkok

Learning from the case studies of *Stedenbaan,* the Netherlands and Singapore

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Abstract:
Urban sprawl resulted from the unplanned development of street networks has been the problem in many cities in the Global South, and remarkably, Southeast Asia (SEA) is seen as the home of this haphazard growth. Bangkok is one of SEA cities where the socio-economic activities concentrate, leading to the influx of population and congestion. What could alleviate the immobility is the transit infrastructure, which is expected to influence the urban form and land-use patterns. Transit-Oriented Development (TOD) is a Western concept defined as a compact mixed-use development with pedestrian- and bicycle-friendly public streets and spaces around the mass-transit stations. The concept has been applied in the Global North; while, its application in the emerging cities is in the experimental stage. Due to different contexts, it needs a comprehensive study to adapt appropriately. The paper aims to investigate to what degree the concept of TOD can be transferred to the development of SEA city, Bangkok. The research looks at the developed concept through literature reviews of the concept, the case studies of the successful implemented projects, *Stedenbaan*, the Netherlands, and Singapore, and the comparative analysis of the cases. Moreover, the deterrents to the transfer of concept to developing Bangkok are examined, for example, institutional framework, legal framework, auto symbolism, and thermal discomfort in the tropics. Finally, the research concludes with plausible guidelines for the TOD that can be used in Bangkok as well as the recommendations for further research.

Keywords: Transit-Oriented Development (TOD), policy transfer, Bangkok, *Stedenbaan*, Singapore

1. Introduction

Urban sprawl resulted from the unplanned development of street networks has been the problem in many cities in the Global South, and remarkably, Southeast Asia (SEA) is seen as the home of this haphazard growth (Barrington-Leigh & Millard-Ball, 2020). Thailand is one of the developing countries in SEA, where Bangkok, its primary city, is concentrated with socio-economic activities, leading to the influx of population and congestion. What could alleviate the immobility is public transit infrastructure investment, which is expected to influence the urban form and land-use patterns. Rail public transport has been developed connecting urban and peri-urban areas, providing alternatives to automobiles, aiming to encourage citizens to alter their commuting behavior and mitigate traffic congestion. In parallel with the development, the spatial organization needs to be planned and implemented to synergize with the mobility network and increase ridership. Transit-Oriented Development (TOD) is a Western concept defined in terms of a compact mixed-use development with pedestrian- and bicycle-friendly public streets and spaces around mass transit stations. This concept and policy have gained interest and been widely utilized in the Global North, for example, in North America, Europe, and Australia (Cervero, 2013). However, adopting the concept directly in the developing world might lead to side effects, such as gentrification, where new wealthier residents displace local inhabitants. Thus, there is a necessity to thoroughly investigate the concept and adapt the appropriate guidelines for the context of emerging cities, particularly in Bangkok.

The aim of this paper is to examine to what degree the concept of TOD can be transferred to the development of SEA city, Bangkok, by learning from two case studies, namely *Stedenbaan,* the Netherlands, and Singapore. The former is chosen due to its reputation as regarded as "best case" in transit and land-use development integration, and similar strategies have been adopted in other Dutch regions (Balz & Zonneveld, 2014). In comparison, the latter is selected because of its successful urban planning in a multi-scalar approach. Also, to understand how TOD is implemented in SEA, where the climate is similar to Bangkok.

The approach of this paper in order to seek the plausible guidelines for TOD implementation in Bangkok is through a review of the literature, case studies, and comparative analysis. The paper is divided into 8 main parts, beginning with the introduction of the study context, Bangkok, with its major transport problems that trigger Bangkok's citizens to see more sustainable solutions, also the concern of TOD to cope with the transit issues and drives for the adaptation of the concept from the international case. Second, the literature of the TOD concept is reviewed, whose authors are the protagonists in this field, namely Peter Calthorpe, Robert Cervero, Ren Thomas, and Luca Bertolini. In the third part, the discussion of soft and hard elements that determine TOD's transferability is conducted. Simultaneously, Critical Success Factors in TOD's implementation are introduced as a framework for case studies. Fourth, *Stedenbaan* and Singapore models are studied using a framework from the previous part: plan and policy; actors; and implementation. In the fifth part, the comparative analysis is shown in the table. Sixth, the deterrents to the transfer of TOD policy to Bangkok are examined, evidenced by the comprehensive interviews with local stakeholders by Pojani (2020). Seventh, the plausible instruments and guidelines that Bangkok could implement are discussed after deriving findings from two cases and deducting the hindrances. Lastly, the paper identifies the conclusions and limitations of this research as well as the recommendation for the further graduation project.

2. Study context: Bangkok and drives for TOD

As mentioned in the earlier section, the SEA is where rapid urbanization has occurred. This is due to the whims of market forces of globalization driven by the dispersed road network, leading to how these cities are dependent on automobiles. "Build-now-and-plan-later" is the philosophy that could describe SEA new towns (Phillips & Yeh, 1987, pp38). Bangkok started to be regulated by the first master plan in 1992 (Sintusingha, 2011). However, the city had already dispersed, and policy might arrive too late to reclaim the agricultural landscape, displaced by the sprawl.

Domestic transport problems, such as traffic congestion and pollution, have triggered Bangkok citizens' motivation to see more sustainable solutions. The comparison between their current situation of urban transport and other better models elsewhere has been made. In parallel, the extension of the rail public transport network throughout Bangkok is on-going, giving citizens hope to have better lives with less congestion. However, transport development alone cannot tackle the overwhelming issues; the land-use readjustment is being conducted with TOD's concern. Governors and planners began to be aware of these issues and searching for international case studies to facilitate policy-making and implementation (Pojani, 2020). Thus, the comprehension of the concept and the realization of contextualization need to be there. In the next chapter, the TOD concept is reviewed and further elaborated in the later parts.

3. Definition of Transit-Oriented Development (TOD)

First defined by Peter Calthorpe in his book, The Next American Metropolis, in the 1990s, TOD is the concept of mixed-use development and density around public transport stations. He established seven design guidelines of TOD as followed: organizing growth on a regional scale to be compact and to support transport; placing retails, residences, offices, and public functions within walking distance of stations; creating street networks that are pedestrian-friendly and directly linking local destinations; providing mix types of housing, density, and cost; preserving sensitive habitat, waterfront, and high-quality open space; planning public spaces as a core where buildings are oriented, and activity happens; and encouraging infill and redevelopment within existing neighborhoods along transport corridors (Dittmar & Ohland, 2012). Since then, the concept has been built upon Calthorpe's definition with the ecological, aesthetic, anti-sprawl, regional, and inclusive aspects (Carlton, 2009).

While Cervero (2006) claims that TOD is the integration of transportation and land-use that is feasible in developed and fast developing cities. Asian cities used to be transit-oriented with mixed land-use, ample pedestrian and cycling pathways, and abundant transit services; however, the ascendency of car ownership advent has made Asian cities grow auto-dependently.

In response to the era of car-oriented development, the modern vision of the TOD started as a rail-based concept with development concentrated within station areas with the fundamental premise that reorienting urban development toward denser corridors and aims for controlling urban sprawl, preserving land, decreasing car use, and facilitating regional growth (Thomas & Bertolini, 2020).

4. Understanding the critical success factors in the implementation of TOD

Firstly, there needs to be an understanding that TODs are not fixed guidelines that can be applied in any city, and the outcomes will be successful as the imitated model. Since TOD is like medicine, if the wrong patients take it, they could experience side effects. Compared to a city that TOD is applied, for example, a Global South city where the resources of professional and innovative politicians, policy-makers, and other stakeholders who share the same understanding of the concept are scarce. The comprehension to what extent the policy can be transferred starts from categorizing the instruments of policies. "Hard" instrument refers to elements that could be transferred easily to the destination, particularly TOD principles and technical tools. While the "soft" lesson is more difficult to contextualize in different cities, for example, communication and negotiation strategies, developing shared goals (Thomas et al., 2018).

Critical Success Factors (CSFs) in TOD's implementation comprises 16 factors that fall under three categories: plan and policies; actors; and implementation (Thomas & Bertolini, 2020). The next part will examine two case studies from different continents to understand how TOD is contextualized in the different cities by using the main headings from CSFs as a framework in the examination.

5. From Western city to Southeast Asian city

As mentioned earlier, TOD's concept has been elaborated by Peter Calthorpe in the US; notwithstanding, in European cities, a similar concept has been applied before the establishment of TOD. In Europe, this concept tends to be implemented with a more regional approach, different from America and Australia's approach (Thomas & Bertolini, 2020). Copenhagen's Finger Plan and *Stedenbaan* project in the Netherlands has been discussed broadly by the scholars. On the other hand, Singapore has been seen as the successor in urban planning and policies in Asia. To understand how TOD has been applied and implemented, studying case studies is an effective method to see whether which guidelines could be used in SEA cities. Therefore, this section will review the case studies from the West and East in which Randstad's *Stedenbaan* and Singapore respectively are chosen and investigated in three aspects as proposed.

5.1 How transport network compliments development of the European city – *Stedenbaan*, the Netherlands as a case study

The Netherlands has developed an extensive rail network, making traveling between cities more efficient and convenient. However, the most prominent and successful regional project in the Netherlands is the *Stedenbaan*, which shows the collaboration between many administrative parties in the city-region. Moreover, it indicates that efficient public transit development can be a catalyst for spatial development around the stations, supporting the rail network and increasing its ridership. The following section will discuss this regarded "best case" (Balz & Zonneveld, 2014) to comprehend its implementation.

5.1.1 Plan and policy

The services are improved by increasing train frequency on the three oldest rail lines in the South Wing: Leiden and Dordrecht; The Hague and Gouda; and Rotterdam and Gouda (Balz & Schrijnen, 2009; Balz & Zonneveld, 2014). Nevertheless, it enhances the mobility of the networks, but this development of the rail network also stimulates spatial development. The project scope was enlarged in 2003 to include a spatial dimension since the improved train service offers a strong stimulus for the spatial development around the *Stedenbaan* station areas. This integrated spatial and network development strategy was known as the Dual Utilization Strategy (Balz & Schrijnen, 2009).

Two ways were proposed regarding the network development: a more frequent intercity service, serving the large and medium stations; and a more often 'Sprinter' increasing the service from four times to six times hourly, facilitating the stations in smaller cities. The existing metro service, including 34 existing stations, and 13 new stations, was improved with more modern train equipment (figure 1) (Balz & Schrijnen, 2009). While spatial development consists of studying potential station areas and categorizing them in the inventory, and formulating the strategy for each sphere to make a specific plan and effectively implement it.

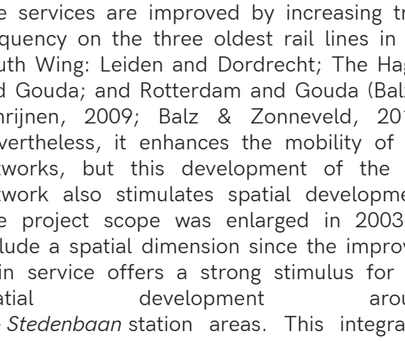

Figure 1. City Line Stations Source: *(Balz & Schrijnen, 2009)*

The Dual Utilization Strategy plays a crucial role in encouraging people to use more public transport than private automobiles. However, spatial development is inevitably creating more amount of car ownership. In the Netherlands, this problem might not be as critical as in other countries that the extensive cyclist- and pedestrian-friendly infrastructure do not exist. However, although this country lies on a flat topography and has the cycling culture embedded in the lifestyle that supports the high level of cycling and facilitate slow mobility, the policy and government funding are also the crucial factors. Between 1990 and 2006, Dutch Central Government subsidized the cycling projects with an average of €60 million annually, including €25 million, particularly for the parking facilities at train stations (Pucher & Buehler, 2008). This contributed to the safe and convenient, well-maintained bicycle networks throughout the country. On the other hand, car traffic is disincentivized in terms of the limits of speed, turns, and direction of travel, provision of car-free zones, and reduced parking (Pucher & Buehler, 2008). For example, there are fewer parking lots than bicycle parking spaces at urban train stations. Also, the more pedestrian-friendly design can facilitate the connection from other public transports more convenient than from private cars.

Other disincentives are "green taxes" which aim to decreased greenhouse gas emissions and fossil fuel dependence. Taxes on unsustainable transport consumption, including fuel tax, and excise on new cars, have been increased (Parker, 2001). Overall, the broad coverage and high quality of bicycle infrastructure and the dissuasion of private automobile use assist the spatial and network development integrated with the TOD project in *Stedenbaan*.

5.1.2 Actors

One of the *Stedenbaan* project's challenges is the complex administrative structure in the South Wing, ranging from the state, provincial, and local governmental layers to the intergovernmental parties with various responsibilities. Particularly in this project, the administrative platform is hybrid, comprising political representatives from five city-regions, South Holland province, and the major cities: Rotterdam; and The Hague. Moreover, it includes the National Rail Company (NS), real estate developers, and the national government.

Another crucial party is South Wing Studio, which was established to concentrate on the spatial effects resulting from the agglomeration of social and economic interactions and establish the meeting between various stakeholders (Balz & Schrijnen, 2009). At the national level, the government has consistently supported the project, included in the National Spatial Strategy in 2004 and the National Policy Strategy for Infrastructure and Spatial Planning (SVIR) in 2012 (Balz & Schrijnen, 2009; Stead & Meijers, 2015).

5.1.3 Implementation

The first feasibility study was conducted by NS, they forecasted travel demand, and the result indicated that more frequent trains on the *Stedenbaan* would be viable if a considerable number of new residences and offices in the ratio of 35% and 60% respectively were constructed in proximity to *Stedenbaan* stations by 2020 (Balz & Zonneveld, 2014). Then the South Wing Studio was in charge and continuing with potential station areas study. The inventory of the station areas with 1200-meter catchment areas expected to transform in the 2010s was conducted. It was based on the plans regulated by local and regional authorities. The local authorities designated the majority of the area to be housing, mixed use, and employment zones. Consequently, the outcomes affirmed the city-regions' aims to set new uses and accommodate 40,000 residences and 1,000,000 square meters of office spaces can be achieved in the station areas (Balz & Schrijnen, 2009). This shows how the initial feasibility study is embedded in the project to ensure that the transformation results will be as proposed.

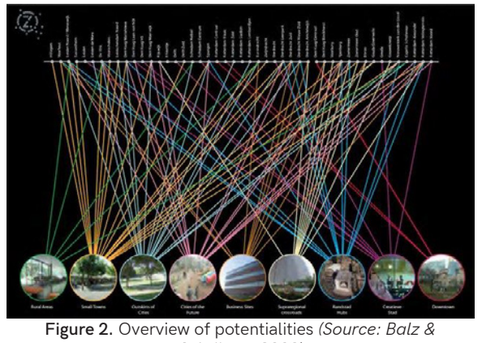

Figure 2. Overview of potentialities *(Source: Balz & Schrijnen, 2009)*

At the time the project began, most of the areas along *Stedenbaan* were already built up. In the second stage, the relationship between these existing spatial conditions and networks was investigated using a set of indicators that include the degree of access by public transport, car, degree of mixed use, and local density of inhabitants and jobs. Consequently, it resulted in nine potential typical configurations. The analysis demonstrates that some station areas correspond to one particular typology, such as Rotterdam Central Station fits in the City Center typology. While the station spheres located in the open land match with the Rural Area one (figure 2) (Balz & Schrijnen, 2009).

To assess each local sphere's potentialities in how they can be exploited to achieve the regional level's objectives, in the last phase, the potential spheres were validated by three scenarios. These scenarios show how micro-scale development supports the macro scale and how the project's aspiration can manipulate decision-making at the local level (Balz & Schrijnen, 2009). These three scenarios are the developments of (1) dense station areas which reflect on an overall densification strategy, (2) diverse and complementary urban environments, and (3) sustainability where open landscapes are excluded from densified areas. In conclusion of the spatial survey, results allow for discussion on the determination of the strategic station development, as each development serves different objectives that lead to the accomplishment of *Stedenbaan* (Balz & Zonneveld, 2014).

5.2 How Transit-Oriented Development landed in Southeast Asia – Singapore as a case study

Moving on to the East, out of all eleven countries in SEA, Singapore is the only country in the Global North and considered developed. It is also one of the original Asian Tigers, being the precedent that other Tiger Cub countries in SEA follow a similar model of economic development (Pojani, 2020). Regarding urban development, Singapore has always been a case study of successful urban planning. How Singapore has implemented TOD and what guidelines can be adapted to the cities in Tiger Cub countries will be examined in this section.

5.2.1 Plan and policy

Singapore had confronted the excessive numbers of private-automobile. In the early 1970s, half of the population commuted by automobiles, which contributed to traffic congestion. In response to

the problem, the Concept Plan 1971 was proposed to decentralize along the transit corridor to mitigate congestion within the city center (Yang & Lew, 2009).

In 1991, Constellation Plan was proposed as the follow-up governmental action from the mentioned 1971 Concept Plan. The ring pattern and radial urban corridors were realized, linking hierarchical urban development nodes of the central business district, regional centers, and sub-regional centers (figure 3). Satellite new towns, where development concentrated, were planned in strategic locations along transit corridors, controlled by the governmental planning model (Yang & Lew, 2009). Moreover, what makes Singapore different from others is how the vision and implementation are successfully delivered through its strict and proactive policies and visionary government. Land-use strategy and supportive policy to implement TOD in the Singapore model will be examined in the next parts.

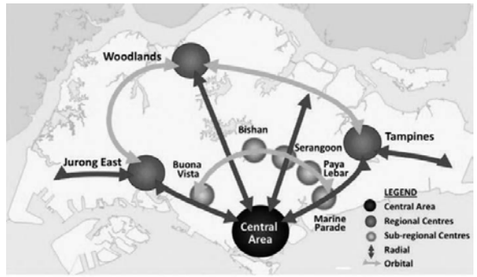

Figure 3. Singapore Constellation Plan *Source: (Good, 2019)*

Singaporean government began to deter road traffic growth in the 1970s strategy, which complements the 1971 Concept Plan. Its goals are preventing and offering. Preventing refers to averting excessive traffic congestion using two essential methods: primary, by slowing private vehicle ownership growth by making vehicles expensive; and secondary, by pricing vehicles use in busy places. While offering means providing benefits in return for sacrifices in the preventing strategy, which includes two methods: a high-quality road investment to serve road users; and alternative public transport improvement (Barter, 2019).

Regarding the preventing strategy, various tools were used to decrease private automobile ownership. For example, Travel Demand Management (TDM) is a policy that aims to make car ownership more expensive. This includes the Additional Registration Fee (ARF), Annual Ownership Tax (road tax), and Area Licensing Scheme (ALS), which was transformed into Electronic Road Pricing (ERP) later. The latter was the world's first congestion charging scheme that was implemented in the central cordon area. Another mechanism is Certificates of Entitlement (COE) that determines the limited number of cars that can be registered monthly through auctions. Whereas offering in return, the network of major roads and expressways were developed broadly in line with the 1971 Concept Plan. Also, the MRT network has enabled high-density rail corridors and connected city centers and other centers. In turn, this transit-oriented urban fabric, combined with low car ownership, has contributed to cheaper and more efficient public transport (Barter, 2019).

5.2.2 Actors

Various statutory boards were established for specific field development in Singapore. Urban Redevelopment Authority (URA) is responsible for the proactive and long-term strategic and master plans, while the Housing and Development Board (HDB) is the world-leading public housing program. They collaborate intimately with the Land Transport Authority (LTA), the lead government agency coordinating urban transport strategy (Chye, 2019). LTA also owns a transport operator, SMRT Corporation, and works with SBS Transit to develop bus and rail service efficiency (Tan, 2018). Moreover, public and stakeholders incorporate throughout the process, for example, public participation of on-specific plans to develop control guidelines (Tng, Tan, & Urban Redevelopment Authority (Singapore), 2012).

Good relationships between actors are significant in the TOD since it requires communication and negotiation between multidisciplinary parties to steer the project forward, and Singapore seems to possess this strength.

5.2.3 Implementation

Due to the limited land resources, the government has to ensure that they have to be efficiently developed. The reason Singapore could succeed in this vision is the large-scale compulsory acquisition of land by the government. State lands are sold through the Government Land Sales (GLS) instrument, which shapes the physical development and contributes to the masterplan's desired outcomes (Good 2019). Within the long-term process, the government estimates population growth and future economy. Having these accepted benchmarks in the planning period, planners can simultaneously determine the approximate allocation needed for each land use and collaborate with other parties to determine public facilities' needs. In the meantime, the government has adequate time to plan the significant MRT lines that incorporate new development and designate the station areas where densification will be implemented (Good, 2019).

The integration of land-use and transportation is more thorough and explicit in the Master Plan. The classification of zoning, road layout, and plan of plots to be sold for development are planners' duties, while the government allows for higher density at sites near MRT stations. GLS auction in unlocking the land comes when the government releases the land parcels to real estate developers in a 99-year leasing condition. Developers are permitted to build more space or units closer to the transit stations, which in turn, higher prices can be determined. By doing this, the government gains revenue to subsidize the necessary rapid transit investment. Another innovative land-use strategy is that the government stocks buildable land in strategic locations, particularly the plots next to transit stations. This allows the government to capture the increase in land value when the lands are sold via the GLS process. Concurrently, these open spaces are utilized as public spaces and stimulate walkability around the station areas (Good, 2019).

The heart of the development systems in Singapore's TOD is Land Value Capture (LVC), allowing governments to capture the increase in the land value, which then will be used to fund the public infrastructure investment, for example, new MRT lines. Also, it is integrated into the systems of government land ownership released by the GLS tool (Good, 2019). The integration of LVC into the GLS process makes the virtuous TOD cycle in Singapore's context different from the typical cycle that other city governments use as a framework (figure 4).

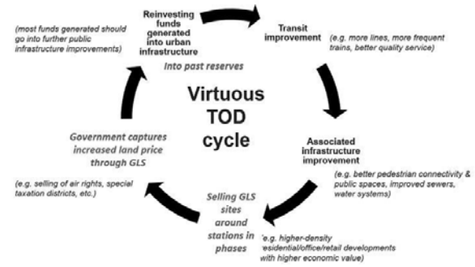

Figure 4. Land Value Capture (LVC) and TOD – Singapore's Unique Approach
Source: (Good, 2019)

6. Comparative analysis of two case studies

In this section, two case studies in section 5 are compared in table 1, incorporated with 16 CSFs derived from part 4. This comparative analysis results in the guidelines that will be elaborated further to seek the plausible principles for TOD implementation in Bangkok in part 8.

7. Deterrents to the policy transfer to Bangkok

7.1 Hierarchical work environment

It is inevitably evidenced that politicians and planning advocates play a crucial role as determinators in urban development, and planners engage as advisors. However, Thailand's work environment is still hierarchical; younger and more passionate planners tend not to have their voices be heard, while senior executives who are no longer passionate have the responsibility to make a decision (Pojani, 2020). This situation could deter and slow down innovative development projects in Bangkok and the country.

7.2 Lack of knowledgeable planners

Planners with the vital knowledge of the concept are a significant TOD component, scarce in Thailand. Most local planners do not thoroughly understand TOD's core theories, and their superficial interpretation of TOD leads to various issues and conflicts. In particular, when developers are allowed by building code to

	Stedenbaan , the Netherlands	Singapore	Critical success factors
Plan and policy	(1) Specific station areas along *Stedenbaan* have been developed and some are underway (2) Dual Utilization Strategy, stable vision developed from *Stedenbaan* to *StedenbaanPlus* (3) Governmental funding to cycling projects, car-free zones, reduced parking, green taxes (increased fuel tax, new cars' excise (5) Stable regional (*Stedenbaan*) and municipality (*gemeente*) political agenda supporting TOD	(1) Specific station areas have been designated for development along transit corriders with a clear land-use plan (2) Stable vision developed regularly since the first Concept Plan and Master Plan to the latest ones (3) Travel Demand Management (TDM), Additional Registration Fee (ARF), Annual Ownership Tax (road tax), Area Licensing Scheme (ALS), Electronic Road Pricing (ERP), and Certificates of Entitlement (COE) (4) Stable national political agenda supporting TOD	(1) Policy consistency, (2) Vision stability, (3) Government support, (4) Political stability (national), (5) Political stability (local)
Actors	(6) Good relationships between actors (9) National government, political representatives from five city-regions, the province of South Holland, South Wing Studio, the National Rail Company (NS), real estate developers (7) South Wing Studio was established for planning in this area	(6) Good relationships between actors (9) Urban Redevelopment Authority (URA), Housing and Development Board (HDB), Land Transport Authority (LTA), SMRT, SBS Transit, real estate developers (7) URA and LTA works intimately for Master Plans (8) No intermunicipal competition as Singapore is a city-state (10) public participation of on-specific plans to develop control guidelines which leads to (11) high public acceptance	(6) Actor relationships, (7) Regional land-use transportation body, (8) Intermunicipal competition, (9) Multidisciplinary implementation teams, (10) Public participation, (11) Public acceptance, (12) Key visionaries
Implementation	(13) Initially 40,000 houses and a million square meters were targeted in *Stedenbaan* (14) Strategic plan that determines each station areas with different scenarios	(13) Government Land Sales (GLS), Land Value Capture (LVC), Stocks of buildable lands in strategic locations (14) Concept Plan to Master Plan determine the land-use of the whole country (15) Developers are permitted to build more space	(13) Site-specific planning tools, (14) Regional-level TOD planning, (15) Certainty for developers, (16) Willingness to experiment

Table 1. Comparative analysis of *Stedenbaan,* the Netherlands, and Singapore *Source: Author*

decrease parking lots in the condominium project close to stations, aiming that residents would use public transport, however, low-income and carless people could not afford residences in TODs. Ultimately, the benefits go to real estate developers to invest in more commercial spaces for more profits (Pojani, 2020).

7.3 Rigid legal framework

Coordination of transport and land-use is the keystone of successful TOD, albeit, in Bangkok, there could be some hindrances in the integration. In contrast to Singapore, most plots in Bangkok are privately owned. Moreover, land expropriation is only allowed for the station's construction, not for the surrounding areas. This leads to the owners of lands in station areas being benefited from the mass transit development (Pojani, 2020).

7.4 Financial limitation

Budget limitation, both governmental finance and citizen's wealth, is another obstacle in transferring TOD policy. In Bangkok, sky train and metro are considered for commuters with middle to high income due to their expensive fare compared to an average wage per capita. Bus and boat have not been developed and old-fashioned, making the fare cheaper and being widely used by those with limited financial means (Pojani, 2020). This proves that financial limits are an apparent concern in transport development. Public transport is only accessible for the middle-income group, which is the minority of the citizens. To what extent TOD can help increase the ridership and contribute to the integrative system. The government needs to manipulate transport fares and make them accessible to everyone.

7.5 Institutional gaps

Various agencies participate in Bangkok's urban development, particularly in transport projects; three different ministries, the prime minister's office, Bangkok Metropolitan Administration (BMA), and many others are involved (Pojani, 2020). Communication between divisions is the key in collaboration; however, the more personnel interlace, the higher the coordination level. Moreover, if the relationship between institutions is undesirable, it could lead to a delay in the projects. Therefore, having many stakeholders involved in the project are not always efficient.

7.6 Automobile dependency and symbolism

Cars are always prioritized in Bangkok, as seen in how roads are extensively built with generous and spacious driveways while footpaths are narrow. According to Pojani (2020), the government still plans to reclaim the land to construct roads, which indicates that cars will always come first in urban development. Moreover, status-conscious cultures play a crucial role in the increase in private car ownership. Car owners tend to be seen as wealthier than the carless ones. It is the symbol that indicates an individual's purchasing power and class and, therefore, is treated with more privileges (Ashmore et al., 2019). For example, in recruitment, the opportunity goes to the applicants who own cars, since a particular field requires traveling to working sites, and driving is more convenient.

7.7 Equatorial climate

Active transport in Bangkok has been discouraged by not only the unorganized, unsafe, and narrow footpaths but also the harsh sunray and humid weather. Therefore, people tend to catch motorcycle taxis rather than walking if their last-mile connection is farther than 500 meters (Pongprasert & Kubota, 2019).

8. What can be transferred to Bangkok

Since two case studies are examined previously in parts 5 and 6, also the hindrances that could obstruct the transferability of TOD policy are mentioned in part 7. This section will discuss the plausible instruments and guidelines that could be implemented in Bangkok.

Concerning the "soft" instruments that include every point in "actors" of CSFs, it is inevitably difficult to transfer such aspects to Bangkok, where the institutional gaps and high hierarchy-oriented authority exist as mentioned in parts 7.5, and 7.1 respectively. It is beyond the roles of an urban planner to reform these political aspects. However, "hard" tools are possible to be transferred. As learned from Singapore, where land ownership is predominantly private, dissimilar to Bangkok as mentioned in part 7.3, planners have to realize that GLS is not feasible to be transferred, and the plausible tool is LVC (figure 5) (Good, 2019).

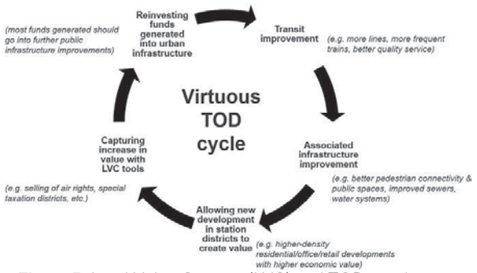

Figure 5. Land Value Capture (LVC) and TOD – a virtuous cycle
Source: (Good, 2019)

As claimed previously, auto symbolism is still occurring in Bangkok, and this culture will not vanish unless the rail public transport project is completed. Once the alternative modes to private cars are entirely ready for citizens, it is possible to apply the strategies derived from Singapore and *Stedenbaan* cases, such as car-

free zones, green taxes, and ARF, to deter the increase of car ownership.

Notwithstanding, since in Bangkok, parcels are privately owned, one possible way to reclaim more public spaces is taking advantage of these privately-owned parcels near stations. To achieve this, the incentives for real estate developers to give more open spaces to public use are viable ways; meanwhile, these given spaces could be designed to enhance walkability. Moreover, the design to encourage walkability in Singapore's tropics could be learned and implemented in Bangkok. However, to accomplish the desirable physical environments, there needs to be a collaboration between real estate developers, landscape architects, architects, and urban designers.

9. Conclusion

This paper aims to seek to what extent TOD can be transferred and applied in the Bangkok context. TOD is the concept that integrates high-density, mixed-use, pedestrian- and cyclist-friendly developments located within station areas. However, it has been applied in the cities mostly in the Global North. While in Bangkok, where the transport infrastructure is being developed, TOD is the suitable concept to be applied to manipulate this anticipated rapid urban growth. To comprehend how it has been applied in different contexts, *Stedenbaan* and Singapore are selected as case studies, and CSFs in the implementation of TOD is used as the framework to study them.

The first case, *Stedenbaan,* is the project that integrates transport network and land-use in the Randstad's South Wing. Its first phase started with the feasibility study. The housing and office areas' initial ratio was acquired based on the projected travel demand on NS trains. The South Wing Studio's spatial survey was then conducted to affirm the aimed numbers. In the second stage, all station areas' potentialities were categorized into nine typologies. Following the last stage was assessing the potential spheres using three scenarios to investigate how the micro-scale intervention supports the project's macro scale. Within the project, a wide range of actors collaborated, and many policies were applied to reduce car ownership and supported project implementation.

The second case, Singapore, has started its urban planning that integrates land-use and transportation with the long-term Concept Plan. In this plan, proposed hierarchical urban development nodes were linked by the ring pattern. At the same time, the Master Plan is more thorough with zoning, road layout, and plots to be released. Singapore has applied unique tools to control spatial developments and fund infrastructure projects, such as GLS and LVC. Various statutory boards work intimately in the development, ranging from the national government to locals. Furthermore, the world's first car-use deterrent policy, ERP, has been applied here. Overall, such incorporation and implementation have contributed to the successful TOD at regional and local levels.

However, Adapting TOD in Bangkok is not that easy where the planner mimics what has been implemented elsewhere. Bangkok has many conditions that deter TOD transferability, from organizational levels, cultures to climatic context. After deducting the limitation, the plausible guidelines from two cases that can be adapted in Bangkok are mainly "hard" tools. In terms of plan and policy, LVC, and the strategies to hinder car ownership increase can be applied. Besides, incentives should be offered to real estate developers to provide open spaces in their projects near station areas for privately-owned public spaces. To achieve this, there needs to be incorporation where every actor understands and pursues the same goals.

Regarding the limitations of this paper, due to the time constraint, not all information of case studies was acquired from the chosen literature to cover all aspects of CSFs for a more in-depth comparative analysis. The obtained guidelines will be tested in further research, particularly in the macro-scale strategy and micro-scale design interventions. Moreover, another finding that will be useful and can be adapted in the analysis and strategy part of the graduation project is the methodology, for example, the spatial survey of station areas and creating scenarios for regional assessment. Since this paper includes more about the policy and planning aspects, the future developing thesis will cover the design principles, assisted by the more comprehensive literature review and case study on a smaller scale.

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10.2. Appendix
10.2.2. Macro-scale water quality

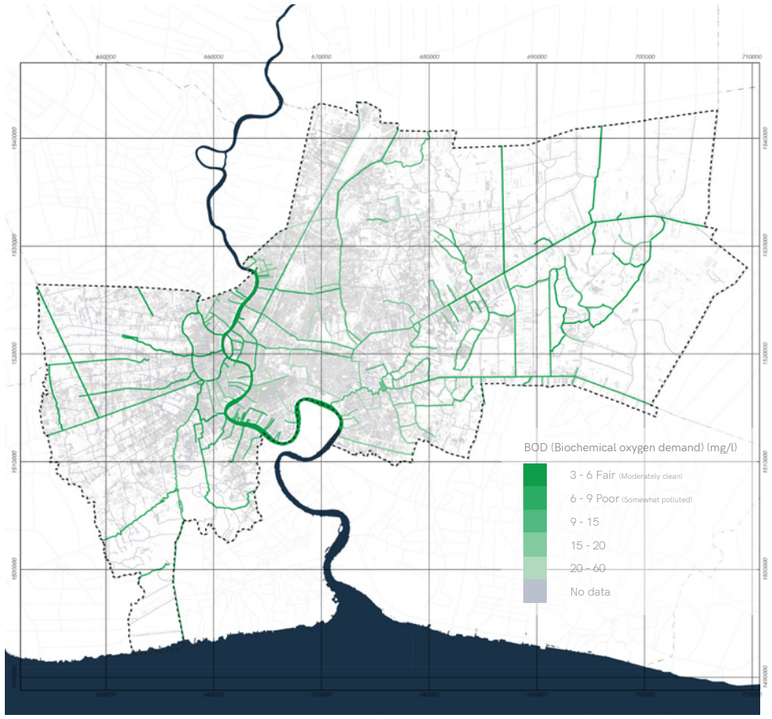


Figure 10.2. Average BOD of waterways in Bangkok
Source: Author, derived information from Department of Drainage and Sewerage (2019)

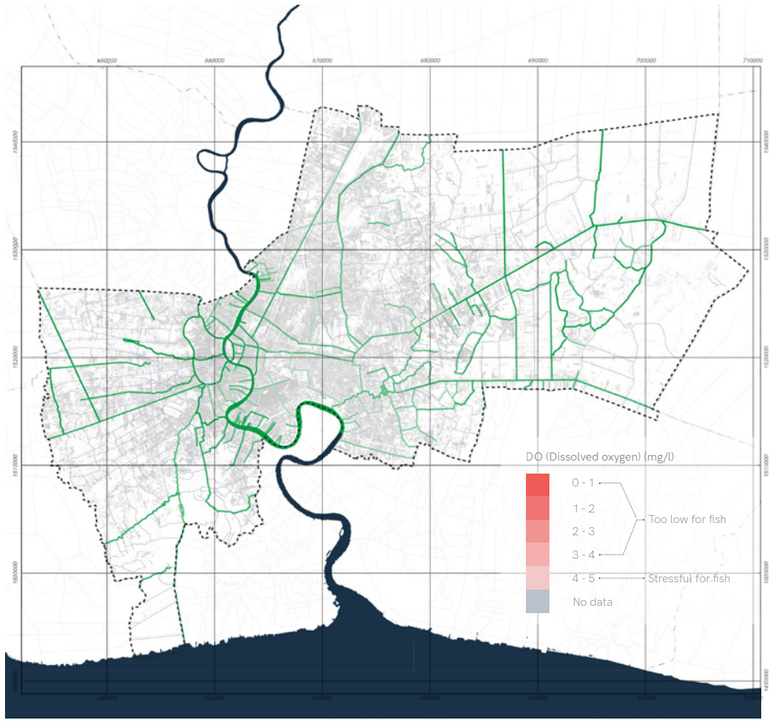


Figure 10.3. Average DO of waterways in Bangkok
Source: Author, derived information from Department of Drainage and Sewerage (2019)

If BOD is high, it means that microorganisms are using most of the oxygen, resulting in difficulties for larger aquatic animals to survive (Ipsaro, n.d.). Whereas DO is the amount of oxygen in the water, it is a significant measure of water quality since it is a direct index of an aquatic resource's ability to support life (US EPA, 2013). Therefore, the lower DO is, the more inferior the quality of water is.

Figure 10.2. shows the BOD of canals in Bangkok, and the majority of them are poorly contaminated with the number of BOD greater than 6 mg/l. Likewise, in Figure 10.3. DO indicates that most canals might not be able to accommodate aquatic animals.

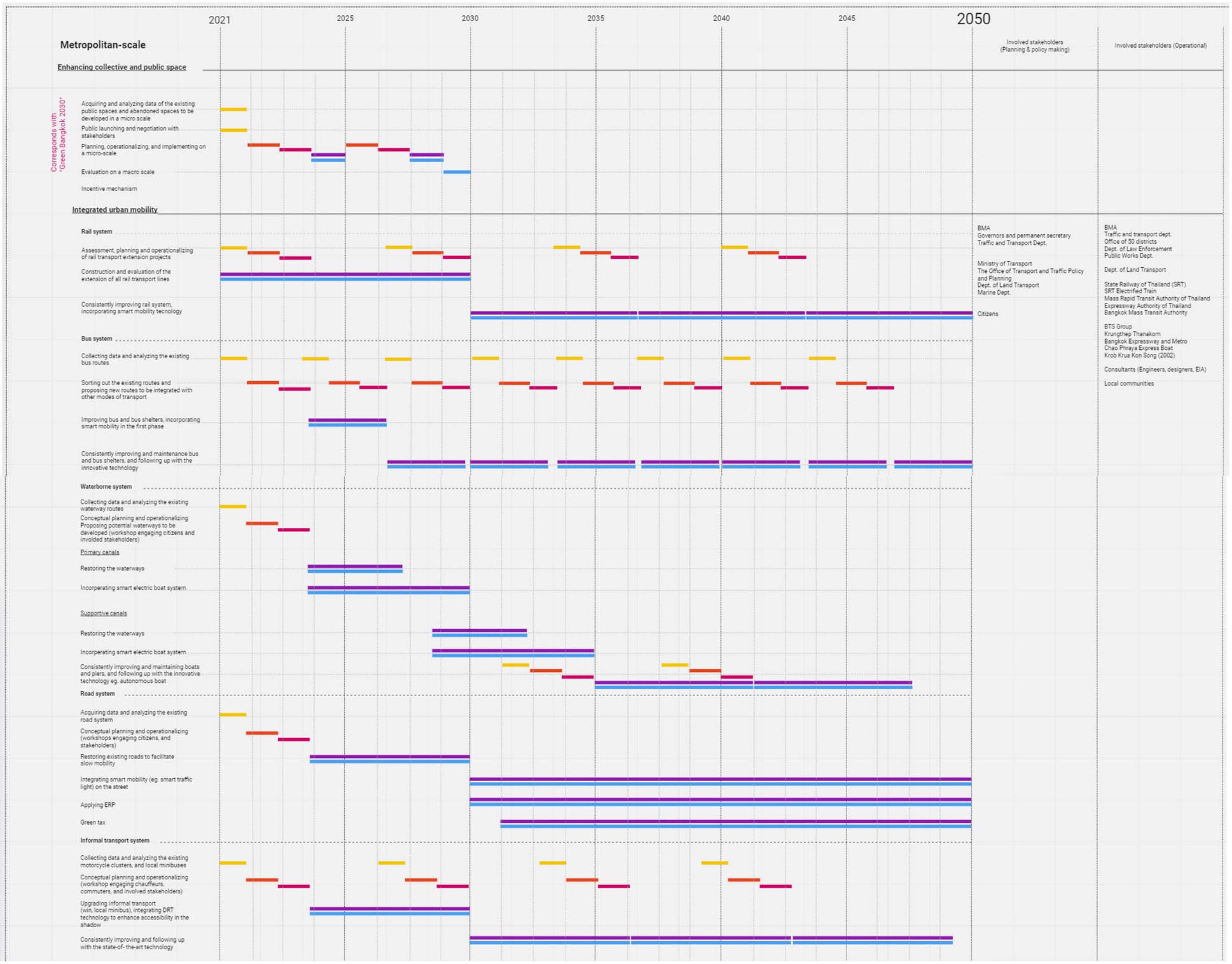


Figure 10.4. Macro-scale implementation phase
Source: Author

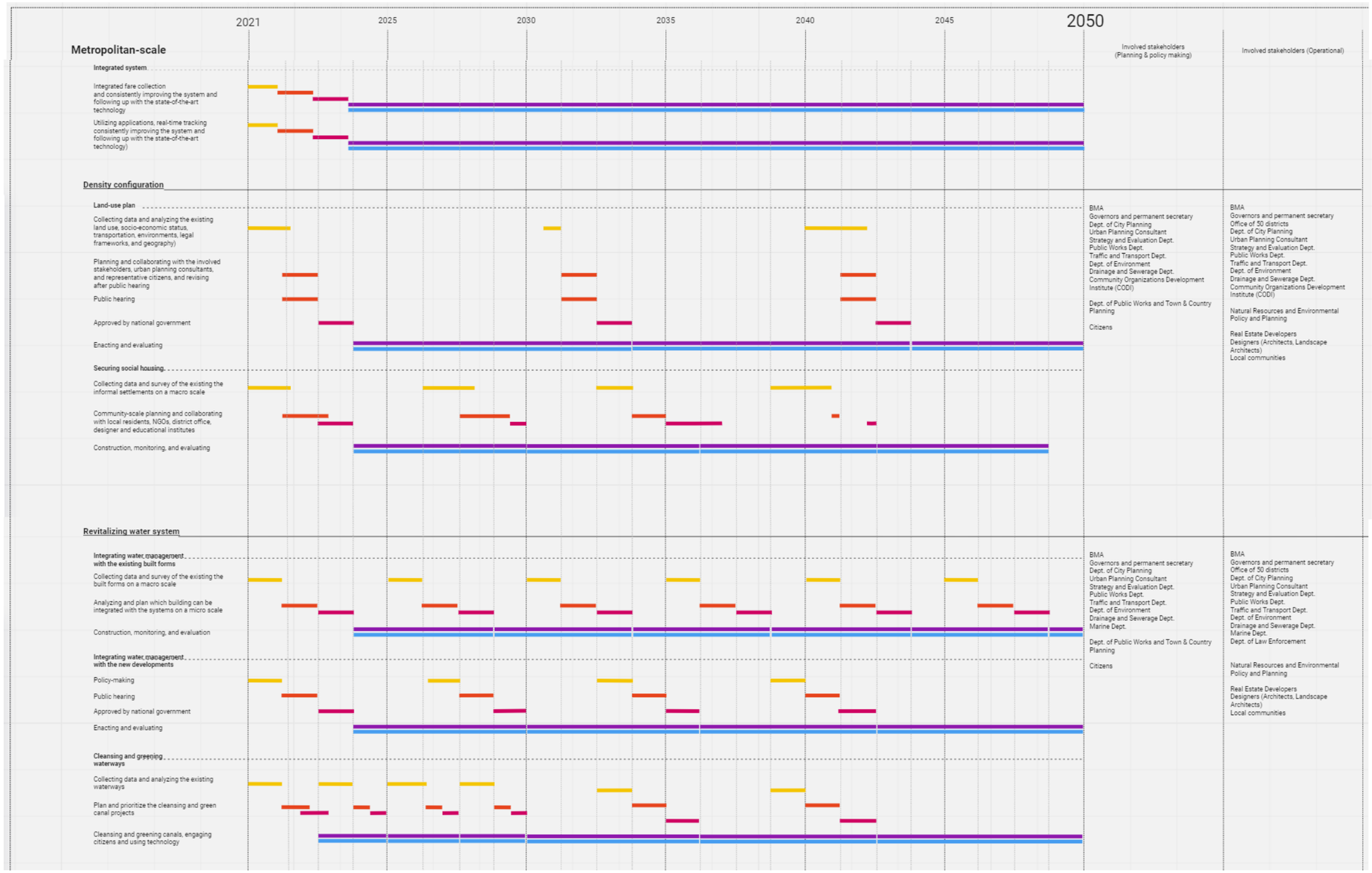


Figure 10.5. Macro-scale implementation phase
Source: Author

10.2. Appendix

10.2.4. Water quality at pilot project

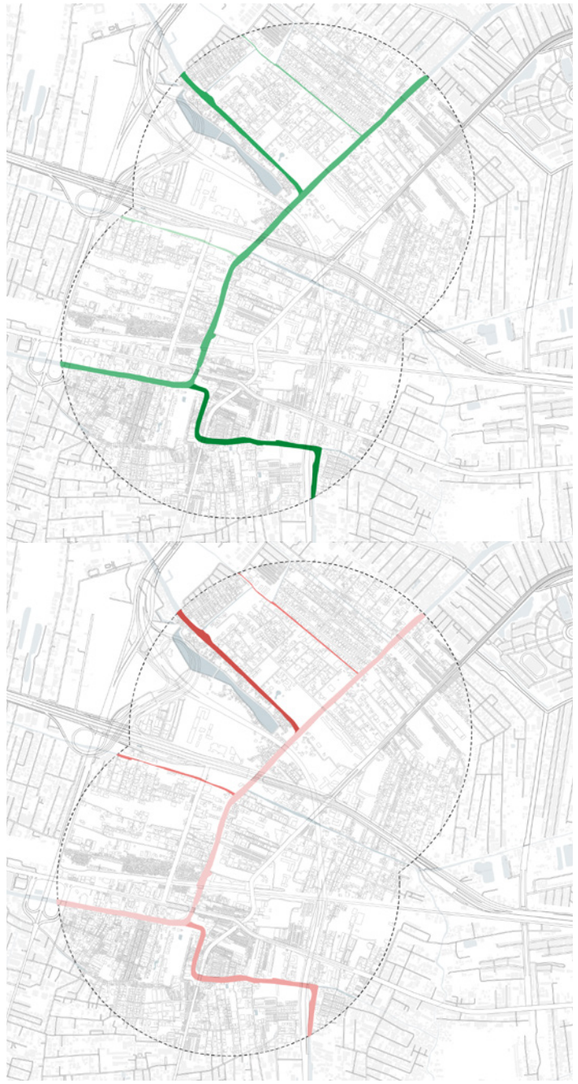


Figure 10.6. BOD of canals in Ramkhamhaeng
Source: Author, derived information from Department of Drainage and Sewerage (2019)

Figure 10.7. DO of canals in Ramkhamhaeng
Source: Author, derived information from Department of Drainage and Sewerage (2019)

10.2.5. Micro-scale socio-economic study

Residential

The first category is residential, which is the principal function of this location Figure 7.42. To be more precise, all residential buildings are also categorized into six types: informal settlement; low-income residence; detached house; townhouse; mid-rise apartment; and high-rise condominium, by sorting building heights and site observation.

Figure 10.8. Informal settlement
Source: Author, adapted from Google (n.d.)

Figure 10.9. Detached house
Source: Author, adapted from Google (n.d.)

Informal settlement

Informal settlements are the communities that encroach public plots. The overall condition is still unorganized compared to other categories. The building types are unstandardized, mixing between 1-storey and 2-storey housings, accommodating low-income residents.

Low-income family

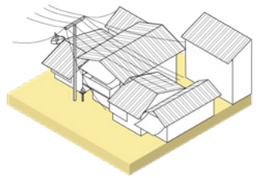


Figure 10.10. Informalsettlement
Source: Author

Low-income residence (Organized slums)

How low-income residence different from the informal settlement is that it has been organized and formalized compared to the typical slum. However, there is no pattern of building types, but some of the residences are fenced, and people who live there are Muslim and low-income families, as per site observation.

Muslim family

Low-income family

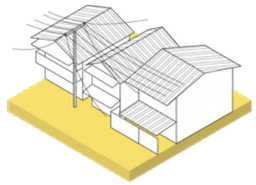


Figure 10.11. Low-incomeresidence
Source: Author

Detached house

The detached house accommodates more affluent people than the earlier two types. The building types vary based on how wealthy the owner is, but the common characteristic is that it is gated and fenced, separated from the *soi*, for safety reasons, and their height ranges between 1-storey to 4-storey.

Muslim family

Medium- to high-income family

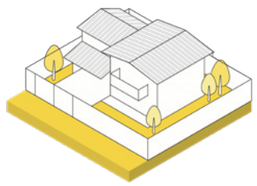


Figure 10.12. Detached house
Source: Author

Townhouse

The townhouse also accommodates wealthier residents compared to the first and second types. It is also fenced in the front and back sides but attached to other houses on the other two sides.

Medium- to high-income family

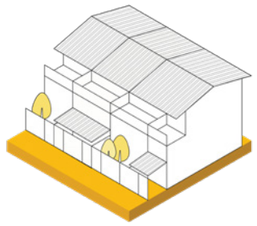
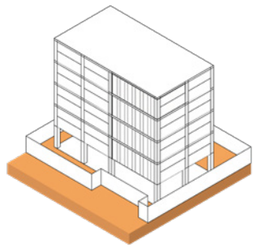


Figure 10.13. Townhouse
Source: Author

Medium-rise apartment / condominum

Mid-rise apartment is more for single people because of the limited space per unit. Therefore, it accommodates university students and office workers. Also, as Ramkhamhaeng is proximate to the airport, aviation-related worker could rent these housings and commute by metro to work. Moreover, based on site observation, some buildings target Muslim tenants. Generally, the height of mid-rise apartments varies between three to eight floors.

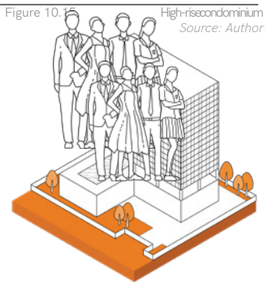
Figure 10.14. Medium-riseapartment
Source: Author



High-rise condominium

The last type of residential building is the high-rise condominium, mostly located next to the major roads. Similar to the mid-rise apartment, it accommodates single people, university students, and office workers due to the small units. The common characteristic of this type is that it is fenced with a guardhouse at the gate. The height ranges from around 10 floors to more than 30 floors, depends on the road width that the building is located.

Figure 10.15. High-risecondominium
Source: Author



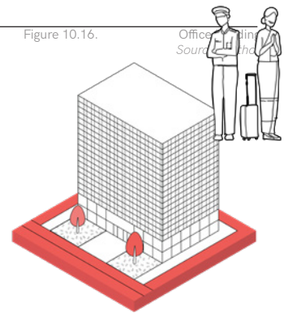
Commercial and mixed-use

The second type of functions is commercial and mixed-use. As illustrated in Figure 7.42 on page 102, most of these buildings are located along the primary roads where most people circulate. Moreover, commercial functions provide job opportunities not only to the local residents but also to outsiders. Based on the observation, it can be divided into seven categories: office building, shopping mall, market, massage parlor, hotel, and shophouse.

Office building

High-rise office buildings are rare in this area, mostly located at the junction, for example, near Ramkhamhaeng Station and the main intersection.

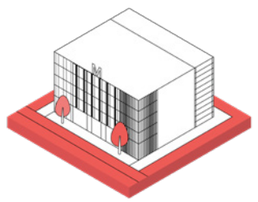
Figure 10.16. Office building
Source: Author



Shopping mall

The shopping mall is probably the most popular place to spend leisure time, purchase products and services, and meet, due to the hot and humid weather outside. Therefore, it is visited by the local residents, and the people from outside the area may stop and grab lunch or have dinner here. The building type also varied, but commonly the building consists of seven to eight floors.

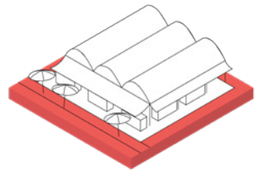
Figure 10.17. Shopping mall
Source: Author



Market

The market is a more informal type of commercial function than others. It is a place where cheap food and products can be found. Therefore, various kinds of people gather here for selling and purchasing purposes.

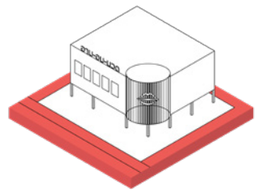
Figure 10.18. Market
Source: Author



Massage parlor

There are substantial numbers of massage parlors located in this area. Generally, the characteristic of a building is closed off due to the private functions happening inside. The people who work here could be from low-income families, and the customers are males with diverse groups of income and age.

Figure 10.19. Massage parlor
Source: Author



Car dealer

Many large car dealers are situated in this area, probably due to the location where highways intersect, making it easier to access by cars. Because the product and service are expensive, customers are people who have medium to high income.

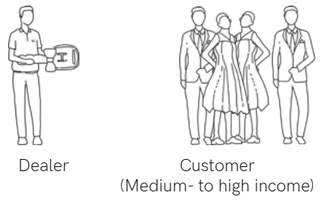
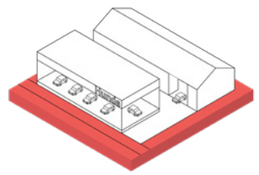


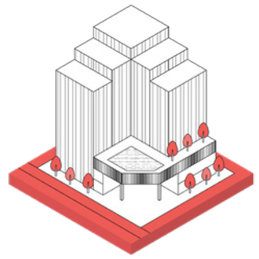
Figure 10.20. Car dealer
Source: Author



Hotel

Since ARL Airport Rail Link passes through Ramkhamhaeng, some hotels are located in this area to attract travelers. In addition to this, due to the proximity to the airport, some hotels could collab[illegible] the f[illegible] eign airlines and accomm[illegible] eir pil[illegible] and flight attendants dur[illegible] r fligh[illegible]

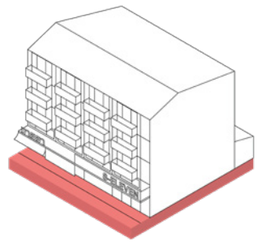
Figure 10.21. Hotel
Source: Author



Shophouse

Shophouse accommodates mixed-use function since the commercial function occurs on the ground floor and residences take place on the higher two to three floors. It is easy to access from the road, and various kinds of business can happen, ranging from the food store, convenient store, pharmacy, and office.

Figure 10.22. Shophouse
Source: Author



Educational and healthcare institute

The third category is education and healthcare, and it can be divided into three functions: kindergarten, elementary, and secondary school, university, and hospital. The most significant of all three types is the university since Ramkhamhaeng University, the largest public university in Thailand is located near this location (Figure 7.42 on page 102).

Figure 10.23. Ramkhamhaeng University
Source: Author, adapted from DD Property (2018)

Kindergarten, elementary, secondary school

Schools in this area are more for the local residents or the adjacent districts, as distinct from the prestigious schools that attract students from other areas. Moreover, some of them are Muslim schools situated next to the mosque. This shows the existence of Muslim people and communities in this area, and they are the significant elements that need to be taken into consideration.

Figure 7.47. School
Source: Author

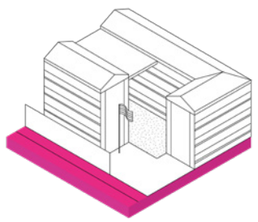


Figure 10.24. University
Source: Author

University

As mentioned earlier, the important educational institute near the site is Ramkhamhaeng University, which attracts students from not only in Bangkok but also in other provinces. Therefore, it is possible that there is a high demand for student housing around this university.

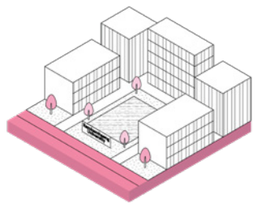


Figure 10.25. Hospital
Source: Author

Hospital

Similar to schools, hospitals in this location are for the local people and residents in the districts nearby as they are not the popular ones that attract people from further away.

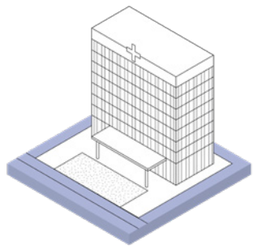


Figure 10.26. Christian Prison Ministry Foundation
Source: Author, adapted from Goodle (n.d.)

Religious site

The fourth category of functions is a religious site, in which there are three religions in this area: Islam, Buddhism, and Christian. However, the most important religion in the Ramkhamhaeng area and along Saen Saeb Canal is Islam.

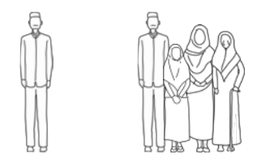
Back in 1785 or around 235 years ago, Pattani, the Malay city, lost a war and was conquered by Siam in the reign of King Rama the 1st, which resulted in the Muslims being herded to Bangkok. The first groups of Muslims started to settle in Rattanakosin Island (the current old town). After that, in the reign of King Rama the 3rd, there was a project of digging the extension of the Northern Saen Saeb canal from Klong Tan to connect with Bangpakong River in the East. The primary laborers of this project were Chinese people. However, the determined construction cost has only allowed them to finish 85% of the project. In order to complete the canal with this cost, these Muslims were hired as laborers. Therefore, they were forcibly moved to the side of Northern Saen Saeb Canal from where the site is. Since then, they started to settle and build mosques, cemeteries, Islam seminaries along canal banks as they were allowed to own the plots (Ali Suasaming, 2011).

Figure 10.28. Wat Pra Kraisi
Source: Author, adapted from Reedthai (n.d.)

Figure 10.27. The Mosque of the Foundation of Islamic Center of Thailand
Source: Author, adapted from Beautiful Mosques Gallery (n.d.)

Islam

As mentioned about the Muslim communities earlier, mosques are the center of soul and spirit of Muslim people in Ramkhamhaeng. Several mosques are located within the sphere, including the Mosque of the Foundation of Islamic Center of Thailand, which affirms that Muslim residents predominantly inhabit this area.



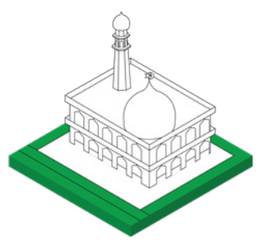


Figure 10.29. Mosque
Source: Author

Buddhism

Despite the concentration of Muslim people along the Saen Saeb Canal, the temple could be seen on the canal bank as well. Since Buddhism is the national religion of Thailand, temples have always been the center of Buddhists' soul and spirit. It is the place where people make merit, meditate, and organize funerals.

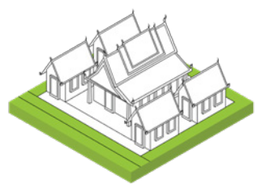


Figure 10.30. Temple
Source: Author

Christian

Notwithstanding, Christian people are the minority among all Thai population, two Protestant churches are located within the area where every Sunday, Christians will gather to attend a service.

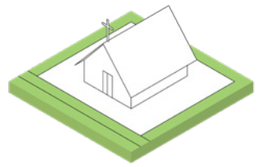


Figure 10.31. Church
Source: Author

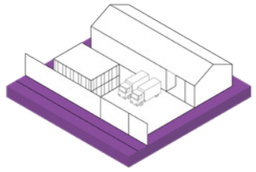
Industrial site

Industry and warehouse

The fifth category of function is the industrial site. As shown in Figure 7.42 on page 102 industrial sites are dispersed all over the area. However, based on the site observation, most of the sites are warehouses that still active, which means that there is freight transport happening within site. While the manufacturing site can be seen active in the pharmaceutical industry in the South.

Industrial workers

Figure 10.32. Industrial site
Source: Author



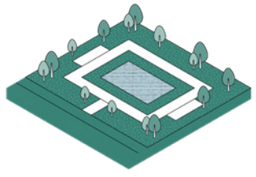
Public park and recreation

Public park

The last type of function is the public park and recreation. Currently, there is a scarcity of public parks within the area. The only park available is on the West, which is not easily accessible for all people.

All residents

Figure 10.33. Public park
Source: Author

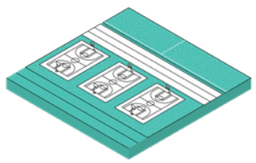


Sport facilities

Most sports facilities within the area are private and only accessible for the subscribers. However, the public sports fields are also available at Ramkhamhaeng University.

All residents

Figure 10.34. Sport facilities
Source: Author



10.2.6. Personal takesways from the project

What I have learned from the methodology part is the importance of research by design method. In this project, the patterns are tested at multiple scales which shows that the specific solutions that work at one location may not work at another place. Besides, there should be an appropriate parameter for the investigation. By doing so, the results are more accurate than the investigation conducted in the broader parameter. For example, it is more sensible to do the simulation of the environmental impact in the areas where people primarily use it at different times of the day rather than studying the whole area.

In the architecture and urbanism fields, presentation skill is essential since effective storytelling could convince and hook the audience, and the project can be rejected if the story does not sound and impressive enough. The most crucial point for the keynote presenter is to know who the message receivers are, so that the presentation is curated with the appropriate amount of information that the audiences can comprehend within a short time. Moreover, how to deliver a concise report is essential. Along the process, a series of drawings has been produced, however ultimately it has to be chosen to correspond with the storyline.

Not to be mentioned, the Covid-19 pandemic forces us to be more isolated, which I found both beneficial and detrimental. On the good side, it makes me concentrate more on the project and encourages me to schedule balancing work, and relax. On the other hand, it is difficult to keep track of other colleagues' progress, which sometimes poses stress. However, the studio sessions on every Thursday help arrange all the students in the studio to meet through Zoom, inspiring and giving each other feedback. Also, as mentioned, it limits us to travel, which makes fieldwork impossible which taught me to be flexible in doing the research and not relying on one method to gain the desired information.

In conclusion, this thesis project has made me improved and added new skills to my skillset, which will be beneficial for my future professional path. Lastly, this project has visualized my perspectives for the coming three decades of Bangkok, which I hope that will shed light on the future development of my beloved hometown and more or less be inspiring especially for the Bangkokians who desire to live in the more livable and socially diverse environments.