



Guangzhou Metropolitan Park

Design of the landscape-nature network
in Guangzhou to increase the adaptive
resilience in the urban environment

Chuhan Zhang
Graduation project

Guangzhou Metropolitan Park

--Design of the landscape-nature network in Guangzhou to increase the adaptive resilience in the urban environment

Delft University of Technology
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Flowscape studio--Graduation project

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Acknowledgement

My graduation project shows my understanding of landscape architecture and the knowledge I gained during my study at TU Delft. In the process, I reconsidered the function of landscape and the role of landscape architecture design. It was a challenging but inspiring experience.

I first would like to thank my mentor Steffen Nijhuis for his support and tutoring on every stage of my graduation project and his helpful advice for both my study and life. His positive energy and attitude toward study influenced me and everyone in our lab a lot. I would also thank my mentor Lei Qu. Her patience and resourceful advice inspire me a lot in my project. She also provides me with lots of new perspectives to better interpret my design. Therefore, I am very grateful for my mentors' efforts and help. I would like to address my appreciation again here.

I would also thank my parents. Their love and unconditional support give me the courage to challenge myself and overcome difficulties. Many thanks for their understanding and their support during my study abroad as they always do.

I would say thanks to my friends for staying in my accompany and for their encouragement and concern. Thanks for all the help and support I received. I would miss my time studying in the Netherlands and always keep learning in the future.

Abstract

Guangzhou is one of the most typical metropolitan cities in the Great Bay Area (GBA). The fast development contributes to massive urban construction in a relatively short time. However, the development prosperity comes at the expense of green space. The problems of green space lead to lower resilient capacity, which means higher flooding risks and more environmental problems. Under this condition, making the city more resilient, livable, eco-friendly, and sustainable becomes a public concern and a big challenge in Guangzhou.


This project proposes to design a landscape-nature network in Guangzhou, which takes into account green, blue, recreation, historical remains, and slow traffic systems. The design will use landscape approaches to strengthen urban resilience against climate change. First, the research will interpret the site from the perspective of time and space, with an understanding of historical development and the current landscape system. Then, learning from the case study of Boston Metropolitan Park and the historical wisdom of managing water and green could help to conclude principles and strategies for designing a Guangzhou Metropolitan Park. The design exploration will apply different strategies and principles on regional, meso, and local scales. The green patches inside the city will be preserved and more connections will be created. Moreover, nature and landscape areas, including green space and blue system, historical areas, recreation spots, and urban networks will be managed to co-exist with each other coherently.

The creation of a landscape-nature network will provide more benefits for the city through landscape design. It aims to create a social-ecological inclusive and futureproof Guangzhou and also has the potential to become an inspiration for other metropolitan cities.



Chapter 1

Introduction



- Fascination
- Guangzhou as a case study
- Problem statement
- Research objective
- Scope and relevance
- Reading itinerary

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Chapter 1 consists of the introduction of the project and a brief explanation of the site. It will first give an impression of Guangzhou. Then, this chapter will explain problems related to the project. Pictures, drawings, and texts will be means to clarify the most critical problem in this research, problems of green space. Research objective, Design the metropolitan landscape-nature network in Guangzhou to create a social-ecological inclusive and future-proof Guangzhou, and four sub-questions related to the objective will also be proposed in this chapter.

Fascination

The Great Bay Area (GBA) has been one of China's most important urban agglomerations. The rapid development in the Great Bay Area has caused many social and ecological problems. As the capital city of Guangdong province and regional economic and transportation center, Guangzhou experienced large-scale urban constructions in the past decades, while, at the same time, inevitably suffering from the negative effects of urban expansion. On one hand, Guangzhou has rich cultures and abundant natural resources. On the other hand, it has to deal with problems brought about by the urbanization trend in the GBA.

Guangzhou is a city of old and new, as shown in picture 1.1. It has been the regional political and cultural center since it was first established as a city. If the long history would be the base of Guangzhou, the fast urban development in recent years has entitled the city to more different meanings and textures. These new colors have given Guangzhou more special characters. However, floods of migrants have given urban planning a very heavy burden. Plenty of extremely dense urban blocks were built. A large area of green space was occupied. More water space was sacrificed.

The city has tried its best to satisfy the basic need of the large population. But at the same time destroyed many precious historical relics in the city. Guangzhou has the tradition of manipulating water. The famous six-vein canals used to be the most essential system inside the city. For different reasons, they could barely be seen nowadays, eg. population growth, water pollution, massive road construction, etc. Besides, Guangzhou was also a city famous for its natural views. In every dynasty, People in Guangzhou would select eight of the most representative views in Guangzhou. This phenomenon shows the importance of landscape and nature in people's life.

Although there have been many reconsiderations and discussions of green space and resilient design in Guangzhou. To relieve the pressure of Guangzhou, there's still a long way to go.



Picture 1.1 A picture of Guangzhou
Source: Google picture, unknown

Guangzhou is a city of old and new

Fast urban constructions has added more characters to Guangzhou. The old river canal, dense living blocks from last centry and the new landmark of Guangzhou, Guangzhou tower, could be seen in the same picture.

Guangzhou

Guangzhou is located in the Southern part of China, Guangdong Province, the Great Bay Area (picture1.2), 113.27°E, 23.13°N (Google map). It is the capital city of Guangdong Province. It was also called Fanyu or Fanyu City in the past. In the long history of development, Guangzhou is one of the most important cities in this region. Since it was established, Guangzhou has become a cultural, political, and transportation center.

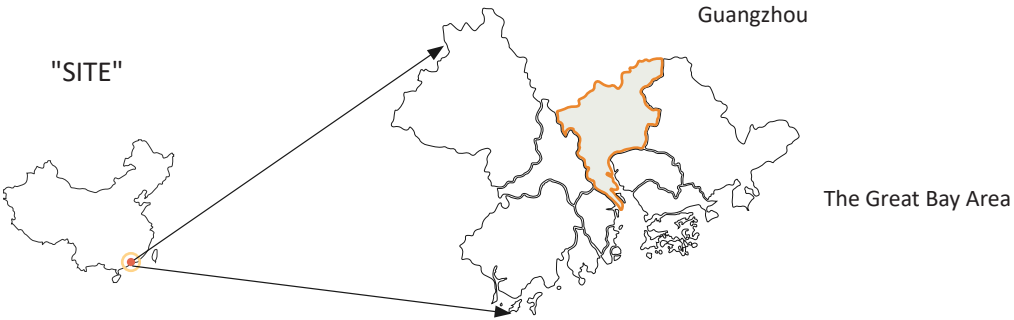
Guangzhou is in the subtropical monsoon climate zone. It has a relatively warm, humid, and rainy climate all year round. The average relative humidity is above 60% in each month. But in the spring and summer seasons, it will reach 75%-80%. The rain season in Guangzhou is spring and summer. Torrential rains are commonly seen. The average annual precipitation is more than 1800mm. The annual average temperature is 20-22 °C. In summer, the weather is quite hot, with an average temperature of more than 30 °C, and sometimes close to 40 °C. Winters in Guangzhou have relatively less rainfall and milder temperatures. The average temperature in winter is above ten °C. Influenced by the monsoon climate, the prevailing wind direction in Guangzhou has clear seasonal changes. The southeast wind prevails in summer and will turn to the north wind in winter (Guangzhou Meteorological Bureau, n.d.).

The terrain of Guangzhou is higher in the north and lower in the south. The average altitude is 6.6 meters, which makes Guangzhou one of the lowest cities in China. Affected by climate and topography, Guangzhou has dense river networks and abundant water resources. The rivers in Guangzhou all belong to the Pearl River watershed and, generally speaking, flow from north to south into the sea.

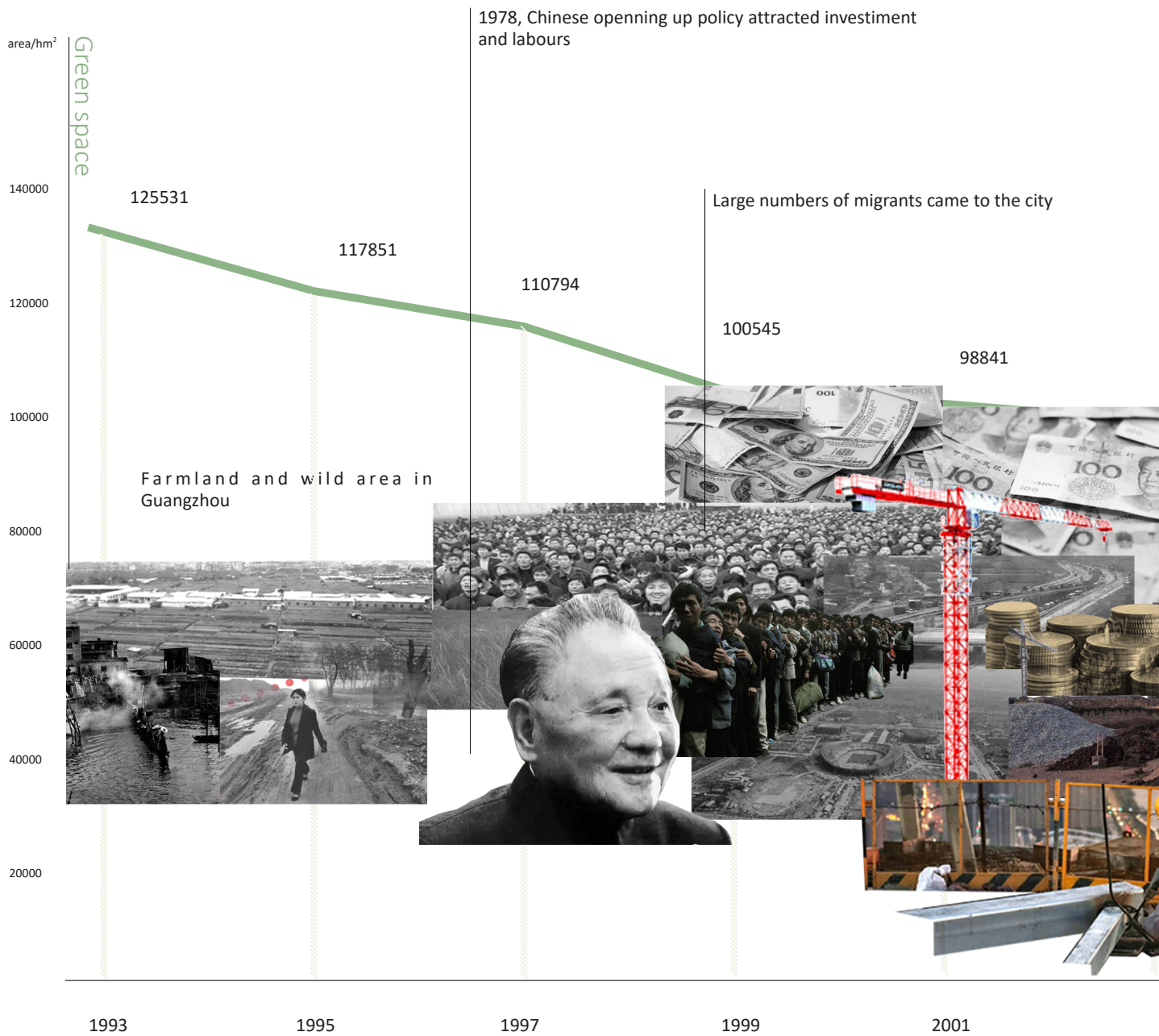
In social aspects, Guangzhou has a population of 18676605 people, ranking first in Guangdong province (National Bureau of Statistics of China, n.d.). Among them, people from 15-59 account for 74.72%, which means that Guangzhou is a city with a large amount of working labor. More than 85% of the population lives inside the city. Guangzhou covers an area of 7434.4 square kilometers, with 11 districts. It has been the commercial center of China for thousands of years in history. Until now, Guangzhou is still an important commercial city. The total amount of GDP ranks 4th in China. Besides, Guangzhou is also the cultural center of Guangfu culture, with rich historical relics and urban development history.

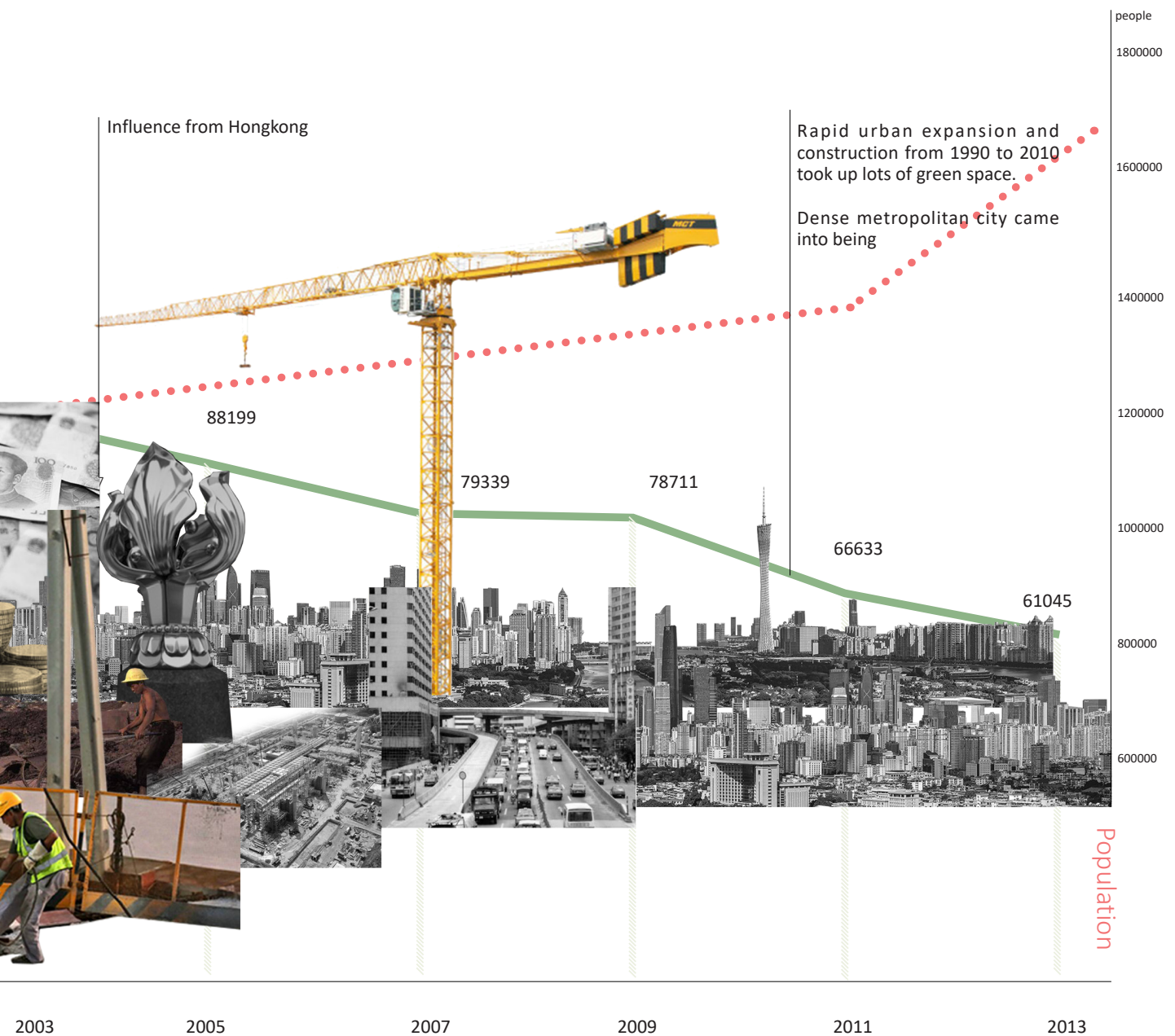


Picture 1.2 Location of Guangzhou
Source: google map



Fast urban development in Guangzhou





Picture 1.3 Urban expansion reasons of Guangzhou
 Drawing by author
 Data source: Xie, 2019
 Master thesis

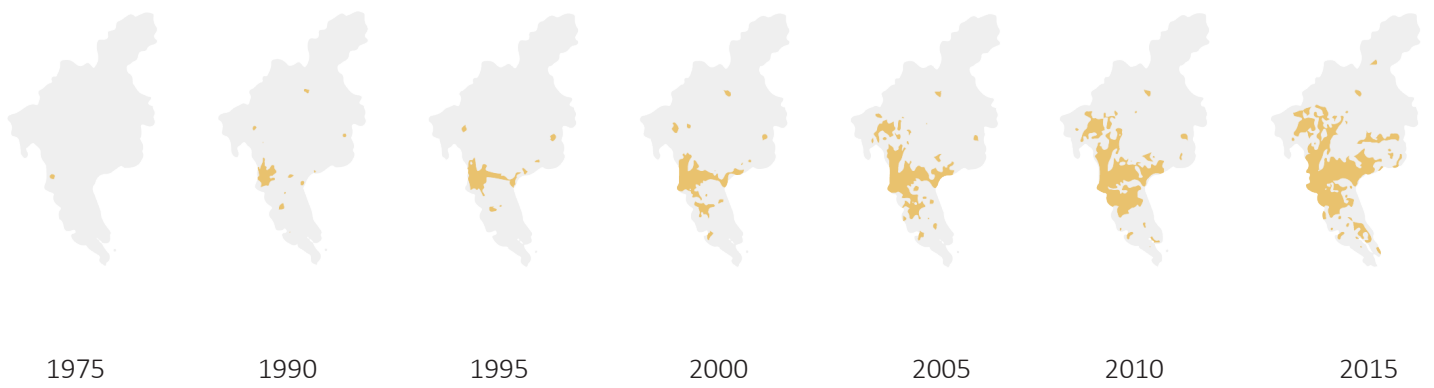
Problem statement

After the 1970s, China's opening-up policy attracted large numbers of investments and labor from home and abroad to the Guangdong province. In the developing process, metropolitan city agglomeration was formed, which leads to the developing concept of the Great Bay Area (GBA). Guangzhou, as the capital city of Guangdong province and regional economic and transportation center, also went through the process of unexpectedly fast urban expansion (picture 1.4). The population has been growing rapidly. Average income and GDP are reaching a higher level. Massive urban infrastructure construction has been conducted in the past fifty years. The size of the city center has expanded more than three times (picture 1.5) and is still becoming more spread and denser. However, every coin has two sides. The fast development in the GBA has caused many social and ecological problems.

Along the process of urbanization, more natural area was occupied or pushed outside the city. However, natural spaces in cities have an unignorable influence on the environment and society. They could provide multiple ecosystem services, which are beneficial to the public and the ecosystem. The three main problems of green space in Guangzhou are shrinking area, imbalanced distribution and lack of ecological concern. These problems of green space decrease the resilience capacity of the city. Thus, the city becomes more vulnerable to external changes. Problems, such as loss of biodiversity, extremely high temperatures, stormwater problems, and adverse effects on human health, are becoming increasingly serious under the influence of climate change. The shrinking of green space and occupation of water body result in poor living quality in the dense urban center. More hard surfaces replaced the permeable surfaces and original water space, leading to water systems problems. Green spaces become islands of green patches faced with increasing environmental pressure. All mentioned above leads harm to urban space and breaks the coherent natural-human relationship.

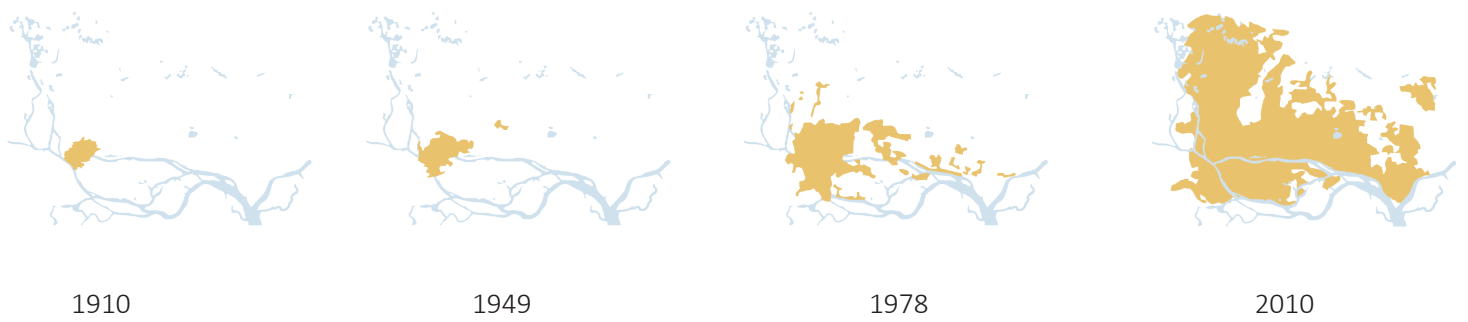
Under this condition, making the city more resilient, livable, and sustainable becomes a public concern in Guangzhou. It means that the city should give solutions to better adapt to changes and recover from unexpected problems. In the design, a landscape-nature network will be applied in the Guangzhou city center. It will connect the green-blue network and involve recreation, history and ecology concerns. A landscape planning and design approach will be applied in the research to talk about the planning of future Guangzhou.

City scale



Picture 1.4 Urban expansion of Guangzhou (city scale)
Source: (Meng et al., 2020) Redrawn by author

City center scale



Picture 1.5 Urban expansion of Guangzhou (city center scale)
Source: Land use in Guangzhou



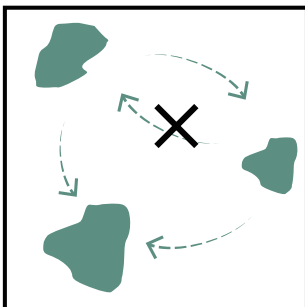
Shrinking area

More green space has been occupied and replaced because of urban expansion, especially in the center center



Imbalanced distribution

In the city center, the imbalanced distribution of green space has been more obvious. Some places in denser city center has scarce green space and relative less public space.

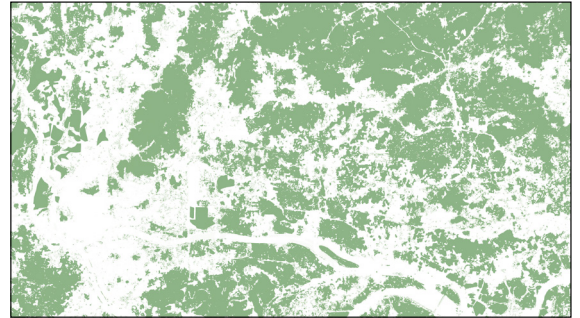


Lack of ecological concern

Green space in the city are planned and constructed mainly to reach the regulated amount of green. However, they are becoming green islands in the city with not enough ecological concern.

Picture 1.6 Problems of green in Guangzhou
(Author,2023)

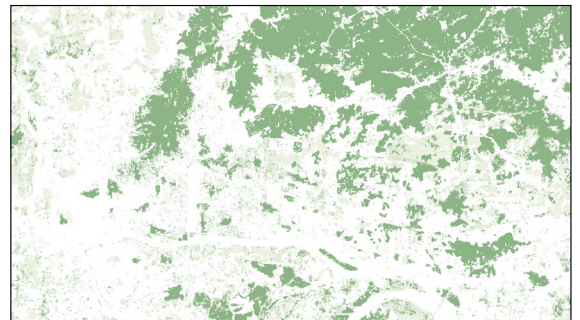
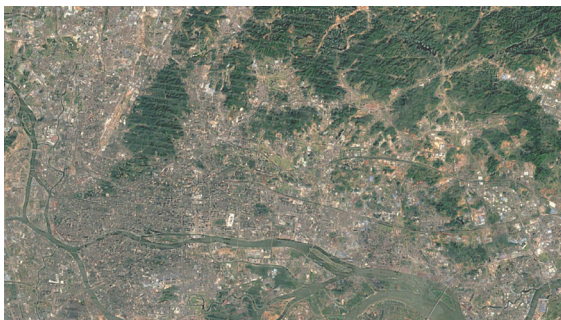
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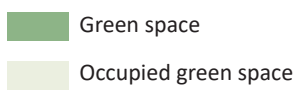
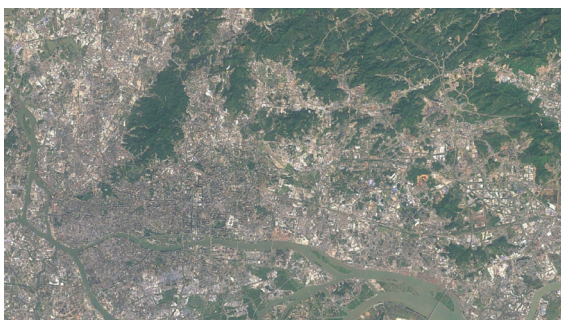
2000



2010



2022



Picture 1.7 Shrinking green of Guangzhou
Source: google map, 2022



Picture 1.8 Dense urban village with scarce green
Image source: http://slide.news.sina.com.cn/c/slide_1_2841_415050.html/d/8#p=1



Picture 1.9 Grey concrete urban area--Highway
Image source: https://www.sohu.com/a/289635116_701855

Urban floods annually

May 2017

Four districts in Guangzhou suffered from heavy rainfall and urban flooding. 172 houses were destroyed in the storm flooding(Liu & Zhao, 2017)



Picture 1.10 Flooding in 2017
(Liu & Zhao, 2017)

Aug. 2020

As a result of the heavy rainfall, several streets were flooded in the city. The storm water flood caused lots of inconvenience and unsafety in citizens daily life (D. Liu, 2020)



Picture 1.11 Flooding in 2020
(D. Liu, 2020)

Sep 2022

In the summer of 2022, extreme hot weather struke Guangzhou. After several days of boiling hot, Guangzhou suffered from the heavy rainfall and again ended up in urban flooding.



Picture 1.12 Flooding in 2022
(xiaohongshu, 2022)

Research objective

Design the metropolitan landscape-nature network in Guangzhou in order to create a social-ecological inclusive and futureproof Guangzhou.

This research aims at working with the landscape system of Guangzhou. It will start from understanding the problems and the background reasons from a system perspective. The history of the site will be explained to elaborate on the changes and landscape system. The current situation will also be analyzed to identify the problems and potentials. Learning from both the site history and other cases, the study will design a landscape-nature network to improve the resilience capacity of the city. Within the landscape-nature network, the green space will be re-regulated as a system. Blue network, recreational and historical layers will also be considered. This network is designed to make the city better deal with external challenges, like flooding caused by heavy storms. Meanwhile, it will relieve other side effects caused by rapid and massive urban expansion, like biodiversity loss and extreme temperatures in summer, through design.

Sub-questions

Related sub-questions to be answered in the research are proposed.

1. How does the landscape-nature network function in Guangzhou?
2. What are the principles and strategies to develop a metropolitan landscape-nature network?
3. How can applying the landscape-nature network improve the urban environment and living conditions in Guangzhou through design?
4. What can be learned from Guangzhou for the creation of a landscape-nature network and what needs to be developed further?

Scope and relevance

The research focuses on the city area of Guangzhou. The calling for a more resilient Guangzhou has been proposed long. However, after several times re-regulating the drainage system and green space, Guangzhou still suffers from extreme weather. Thus, problems of green space are identified as the main problem in Guangzhou. Side effects, like flooding and extreme temperature, of the main problems are also serious.

The objective is proposed based on the analysis of the site and the problems. The research objective is to create a landscape-nature network in order to help with the urban environment of Guangzhou. It is based on original theories and practices. Landscape as a system, ecosystem service and resilient design are the theories applied in the research. In both the design and analysis process, understanding elements within a bigger system and principles fitting in a larger system will be essential (Alpak et al., 2018). Urban green and blue infrastructure can provide multiple ecosystem services in mitigating the heat, protecting human health and stormwater management (Russo & Cirella, 2021). The resilient design provides design methods and ideas for resilient coastal cities. The research on designing the Landscape-nature network will utilize the existing theories and explain how the combined ideas could be applied in coastal metropolitan cities. The case study will also be used as an inspiration for design.

The traditional wisdom of nature and city arrangement had been in use for thousands of years. It has unique ecological, cultural and social functions. However, nowadays, urban expansion takes place so fast that the previous landscape-nature pattern has been deserted. The wisdom of traditional city planning has been ignored. The relationship between the natural system and urban patterns is not as balance as before. By learning from traditional wisdom and new approaches from cases worldwide, new strategies for mitigating the influence of extreme weather could provide citizens with a more livable city and a healthier ecosystem.

The idea of working through scale plays an important role in the design. The analysis will start from a larger scale to have a better understanding of the system. Zooming in for details and zooming out for a general plan will run through the whole process. The concept of designing the landscape-nature network in a metropolitan city, along with the method of system approach and scale continuum, could be applied in more general situations. It will not only be a good inspiration for Guangzhou but also other metropolitan cities in China and the world.

The design will inevitably have strong and weak points in terms of method. Compared with real-life project, the graduation project focuses more on landscape perspective thinking. The connection with other walks of life, eg: economy, politics, etc., is insufficient as a consequence. Besides, in terms of data collection, sometimes data are unavailable or missing. For instance, in the history analysis, the more accurate analysis of green space development history is absent. To still explain what has changed and the developing trend of green space in Guangzhou, I tried to read and collect information from different types of records. I used collages and visualized the records with pictures to show the full changing process to make up for the lack of data.

Moral issues are more related to design exploration. To design the landscape-nature network in Guangzhou city, more space needed to be given back to nature. In this situation, different stakeholders will be involved. Certain degrees of sacrifice and negotiation will be needed. For example, the government should believe that green infrastructure also has deeper and long-term economic value compared with urban gray infrastructure. Local people and communities near rivers or in the old dense urban area need to make changes and contribute to the local design. Different stakeholders need to realize the long-term benefits and the necessity for the changes and work together for a resilient, healthy, and future-proof Guangzhou.

Reading itinerary

In order to help readers better understand the structure of the report, here are the main contents of each chapter and how their relationship.

Chapter 1 consists of the introduction of the project and a brief explanation of the site. It will first give an impression of Guangzhou. Then, this chapter will explain problems related to the project. Pictures, drawings, and texts will be means to clarify the most critical problem in this research, problems of green space. Research objective, Design the metropolitan landscape-nature network in Guangzhou to create a social-ecological inclusive and future-proof Guangzhou and four sub-questions related to the objective will be also proposed in this chapter.

Chapter 2 will explain the methodology of the research. In this Chapter, firstly, the meaning of the Landscape-nature network will be explained, with the support of the background theories. Then, this chapter will also introduce the methods applied in the research.

Chapter 3 will show the full analysis of the site. Site history, site condition, site problems, and reasons for the problems will be explained in detail. This chapter will analyze through scale and time to understand the current situation. At the end of this chapter, there will be a potential map, a challenge map, and a structure map of the study area, which would be the conclusion of the analysis part. Chapter 3 will answer sub-question 1, How does the landscape-nature network function in Guangzhou?

Chapter 4 talks about the relative case-Boston Metropolitan Park. Inspired by the case and history wisdom of Guangzhou, possible strategies and principles will be proposed. This chapter will respond to sub-question 2, What are the principles and strategies to develop a metropolitan landscape-nature network?


Chapter 5 will be the main design exploration part. From a regional scale to more local scales, the design exploration will show how the principles would work in different scales. It will explain how the design concept fits into the context of Guangzhou. This chapter aims at answering the sub-question 3, How can applying the landscape-nature network improve the urban environment and living conditions in Guangzhou through design?

Last but not least, chapter 6 will conclude the report and reflect on the project. It is related to sub-question 4, What can be learned from Guangzhou for the creation of a landscape-nature network and what needs to be developed further? As the ending part of the whole report, it will summarize the main findings and expect future possibilities.



Chapter 2

Methodology



Landscape-nature network
Method & Approach
Conclusion

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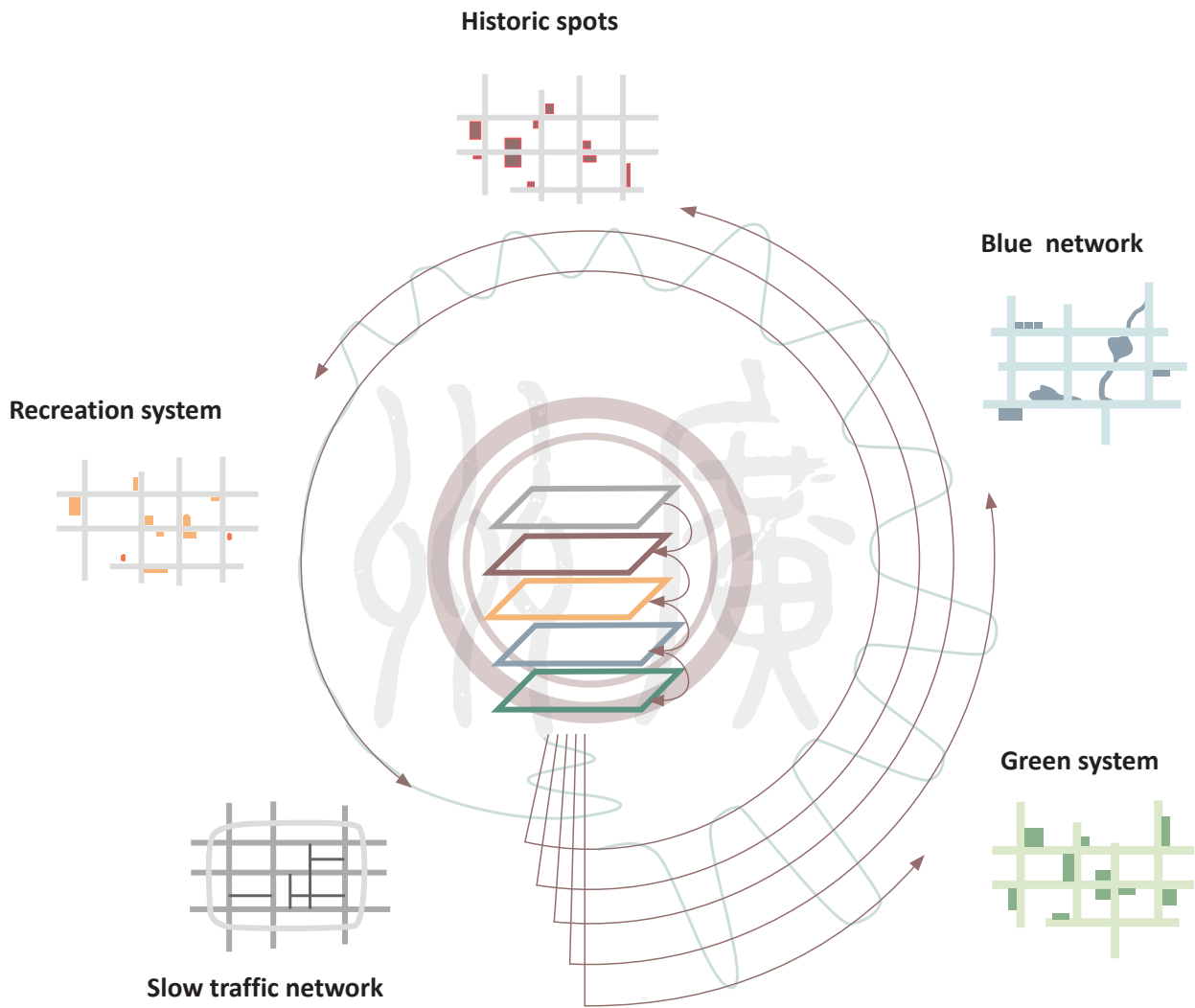
Chapter 2 will explain the methodology of the research. In this Chapter, firstly, the meaning of the Landscape-nature network will be explained, with the support of the background theories. Then, this chapter will also introduce the methods applied in the research.

Landscape-nature network

This project aims at reforming the landscape systems in metropolitan cities. Demand for urban construction and the need for green space often bring metropolitan cities into dilemma. Moreover, coastal cities still need to face challenges from both internal systems and external threats of climate change. The loss of resilient capacity inevitably makes the city more and more vulnerable to climate change. Therefore, reforming a more resilient system would be important. This project proposes a “landscape-nature network” for the development of metropolitan cities. Guangzhou, an essential coastal metropolitan city in southern China, will be used as a case to explain the landscape-nature network more in context. “Landscape as a system” , “Ecosystem service” , “Resilient design” are regarded as the background theories for the project.

The landscape-nature network includes both landscape and nature in the system. It contains city parks, nature reserves, and wetland parks. It is built based on the green-blue network, which links people and nature throughout the city by managing waterways (blue), planting, and parks (green) through a combination of infrastructure, ecological restoration, and urban design (Blue/Green Network Strategy, n.d.). Based on the green-blue network, the landscape-nature network also consider other social aspects. It consists of five layers, the green system, the blue network, the historical spots layer, the recreational system and the slow traffic network. The idea is to preserve the green patches inside the city and create more connections. Besides, nature and landscape areas, including green space and blue system, historical areas, recreation spots and slow traffic networks will be regulated to co-exist with each other. It will provide benefits for the city through landscape design. This landscape-nature network will bind people with the landscape system for a more future-proof Metropolitan city.

Design research and research through design will be applied to the project. Related methods will be used for the construction of a landscape-nature network and the creation of a better environment in Guangzhou.

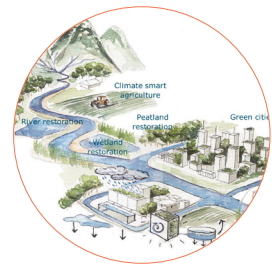


Picture 2.1 Landscape-nature network
Drawing by author

To be more clear about what a landscape-nature network is, the background theories will be explained here. Loss of natural space, especially green space and water area, is stressed as one of the key problems in the study area. In order to create a more resilient urban environment, three related theories will be used as background theories. To be more specific, Landscape as a system and Ecosystem service, resilient design.

Landscape as a system. "systems theory can be considered as an approach to landscape design in terms of both the product and the design process. ...not only involve the identification and consideration of the essential parts of the system but also improve the system as a whole. " (Just a Moment. . ., n.d.). Landscape as a system theory will be applied in both the analysis and design stages, which means that the study will read the landscape as a system. This project will start with understanding the system. With the knowledge of how the system work, the design will try to reinforce the resilience capacity by maintaining a sustainable landscape system. This requires an understanding of the system from both time and space perspective. From a spatial perspective, a Multi-scale approach will be used. The analysis through scale could build up a solid knowledge base for understanding the system and identifying problems. The design will also follow the Multi-scale approaches and propose interventions at different scale levels. For the time concern, the Transformation perspective will be applied. The study of historical development not only provides information about culture and history but also helps with defining problem reasons. This will help designers to understand changing in time process.

Besides, Ecosystem service has been discussed in many types of research. It is defined as ecosystems' direct and indirect contributions to human well-being. (What Are Ecosystem Services?, n.d.). Many studies have explained that urban blue and green infrastructure could offer plenty of ecosystem service (Veerkamp et al., 2021). These services can be divided into four categories: provisioning services (food, fresh water, and fuel wood), regulating services (climate regulation, water regulation, and carbon sequestration), cultural services (recreational, spiritual, and aesthetic), and



LANDSCAPE AS A SYSTEM

Picture 2.2 landscape as a system
Image source: <https://www.wur.nl/en/show-longread/Nature-as-the-inspiration-for-climate-solutions.htm>



ECOSYSTEM SERVICE

Picture 2.3 ecosystem service
Image source: <https://www.earthwiseaware.org/what-are-ecosystem-services/>



RESILIENT DESIGN

Picture 2.4 resilient design
Image source: : <https://www.asla.org/resilientdesign.aspx>

supporting services (soil formation and nutrient cycling)(Kaur & Gupta, 2022). The European Commission (EC) defines "green infrastructure" (GI) as a strategically planned network of natural and semi-natural areas with other environmental features that are designed and managed to deliver a wide range of ecosystem services (ESS) in their communication "Green Infrastructure (GI) — Enhancing Europe's Natural Capital."(Green Infrastructure, n.d.). Applying green infrastructure in design properly would provide ecosystem service for the citizens, help with decreasing the negative effect of climate change (Ramyar, 2017) and emphasize cultural identity.

Resilient design is a method widely used in plenty of projects for creating a system have a higher capability to change. The Resilient Design Institution,(2023) defines Resilient design as “the intentional design of buildings, landscapes, communities, and regions in order to respond to natural and man-made disasters and disturbances—as well as long-term changes resulting from climate change—including sea level rise, increased frequency of heat waves, and regional drought.” The Resilient design will be the guiding method for increasing the resilience of metropolitan cities. Nature-based solutions are important in resilient design. The PBL Netherlands Environmental Agency define Nature-based solution as “actions that enable the protection, sustainable management and restoration of natural and managed ecosystems, that can simultaneously provide human well-being and biodiversity benefits” Booreiland (n.d.). Nature-based solutions (NbS) include restoration, management, and rehabilitation measures as well as ecosystem conservation (Booreiland, n.d.).

The theories together will become the background theories for the Landscape-nature network. They provide theoretical support for the project. The Landscape-nature network originated from different theories and will help with explaining the practice of theories.

Method & Approach

Considering the context and problems in Guangzhou, Designs and research will provide possible ways to help with Guangzhou from a landscape perspective. A landscape-nature network is proposed in this case as the main concept. Theories are used as background reference for the landscape-nature network. The design process will follow the sequence of the sub-questions proposed.

Based on the theories and contexts of the site, approaches are as follows. A multi-scale approach will be used to formulate analysis through scales. The transformative perspective will be an approach to understanding the historical development and the mechanism of the system. These two approaches are selected based on the theory landscape as a system. Another approach is landscape as infrastructure, especially in the creation of urban green infrastructure, which is a means of ecosystem service theory. The nature-based solution is the approach to resilient design theory. Combining all elements mentioned above, the landscape-nature network would be a concluded theory and main theme of this project.

For sub-question 1, the inner mechanism of the landscape-nature network now and in the past will be figured out. The main challenges and potentials in Guangzhou city will be analyzed. In this part, descriptions will be the research strategy. The history research will figure out how the network works in the past. This part will get a basic understanding of the site and the system by comparing the network in the past and now. To have a deeper understanding of the problems and opportunities, literature review, mapping, and history analysis will be the analysis tool.

For sub-question 2, the general principles and strategies will be studied. Classification and evaluation will be research strategies. Case study will be the method for exploring suitable principles and strategies. The main tasks in this part are to classify the patches and connections and evaluate suitable strategies.

For sub-question 3, Applying the principles and strategies to the site will be the focus. Modeling and interpretation will be the research strategies. This part will model the landscape and apply design to the context. All previous steps will lead to the design strategies – the creation of a regional landscape-nature network in the dense urban area of Guangzhou city center. Visions and detailed plans will also be used as solutions to the problems. As urban green infrastructure, the landscape-nature network could help with improving ecosystem service in the study area, and at the same time, create a more resilient urban environment.

For sub-question 4, what needs to be explored further will be summarized. In this part, reflection and summary will be discussed. It will contain the conclusion and reflection of the whole project.

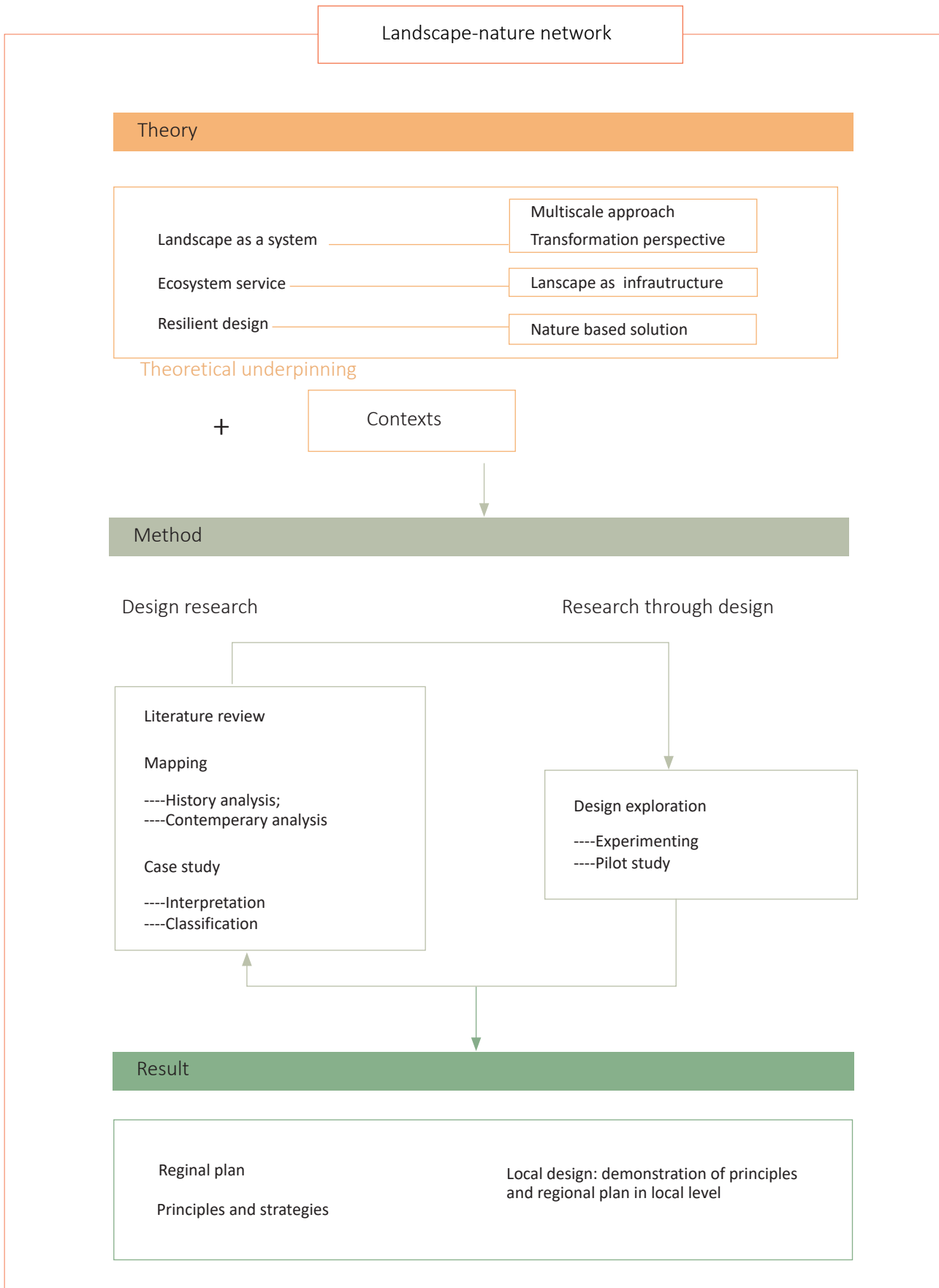


Diagram 2.1 Landscape-nature network
Drawing by author

Conclusion


This chapter elaborates on the methodology of the research. This chapter has two parts. The first part is to identify the “Landscape-Nature Network”. The Landscape-nature network is a combination of the green system, blue network, historical spots, recreation area and the slow traffic network. With all the social and natural systems mentioned above intertwining with each other, the landscape-nature network could help with creating a resilient landscape system for internal and external challenges. It is based on the theory of “Landscape as a system”, “Ecosystem service” and “Resilient design”. Design research and research through design will be used as methods for the research. The result of the research project would be the regional and local scale design exploration.

The research will be conducted with four sub-questions. In response to the questions, the research will first start with analyzing the system. Then, The research will find out suitable principles and strategies for creating the landscape nature network. Thirdly, the research will use design to apply the principles and strategies into context. Last, the reflection part will be used to finish the research loop.



Chapter 3

How does the landscape network function



- Landscape pattern
- Understand the system
- History--city was always part of landscape and nature
- Now--the city to embrace landscape and nature
- Potential map
- Challenge map
- Structure map
- Conclusion



Chapter 3 will show the full analysis of the site. Site history, site condition, site problems, and reasons for the problems will be explained in detail. This chapter will analyze through scale and time to understand the current situation. At the end of this chapter, there will be a potential map, a challenge map, and a structure map of the study area, which would be the conclusion of the analysis part. Chapter 3 will answer sub-question 1, How does the landscape-nature network function in Guangzhou?

Landscape pattern

Guangzhou is a city of “mountain-city-agriculture-water”. This special landscape pattern is formed based on the topography. In the north and northwest of the city, the large number of mountains provide rich natural resources. For a long time in history, the mountains act as barriers between Guangzhou and the other parts of China, which makes Guangzhou sometimes away from the hinterland wars and got strong independence at the end of some dynasties. South of the mountain is a large amount of constructed area. The urban area of Guangzhou has expanded on a large scale since the late 1970s. The relatively flat area south of the main mountain series became an ideal place for urban expansion. Far to the south, the main agricultural area of Guangzhou concentrates near the Pearl River mouth. Agriculture in this region is based on its multiple water resources. Rice growing and fish ponds are the main agriculture types. Guangzhou is situated at the estuary of the Pearl River. It is next to the Shiziyang. Rivers flow from the northwest mountainous area to the sea in the south. Because of its special and important location, it became the regional cultural, transportation and economic engine. The pattern of the city forms the height gradient from north to south, high in the north and low in the south. Also, it creates the wetness gradient, dry to wet from north to south.

When we zoom in on the city center scale, the landscape pattern is also very clear. In the north, a large number of mountains form natural reserves and forest parks. The mountains in Guangzhou are part of the Jiulian Mountain series, which ranges from 200 meters to 1,500 meters. The highest point of the mountains in the city center is about 200-300 meters. Baiyun Mountain is the main mountain in this area. These mountains create a barrier between Guangzhou and the hinterland, which provide Guangzhou with more local characteristics. Nowadays, large numbers of reservoirs are located in between mountains. They provide freshwater resources for Guangzhou city. In the city, lots of city parks, sports parks and memorial parks could be found. Because of the topography, River in the city flows from the northern mountainous area to the Pearl River in the south. Since the 20th century, Guangzhou has started to build public parks. Renmin Park is one of the oldest public parks in Guangzhou. Some parks are constructed based on the original lakes or squares. Before the middle 20th century, China went through a tough time of fighting against invasion and civil war, with a huge loss of lives. To remember the sacrifices in those battles, some memorial parks were established. On the south side of Pearl River, large wetland parks were constructed. The southern area has a relative younger developing history. A large wetland series is located in the southern part. This area now is converted into large wetland parks, which could provide ecological value for the highly dense urban area.



Picture 3.1 LandscapePattern of Guangzhou in city scale
Image source: Google map, 2023

Understand the system

Flooding

Guangzhou's topography characteristics determine that rivers flow from the northern high part to the southern sea. Generally, some rainwater infiltrates into the ground from the mountain area. Except from evaporation, most of the rest will become runoff and flow to the sea with the rivers.

Flooding mostly happens in summer. Guangzhou is influenced by the subtropical monsoon. In summer, under the influence of the Subtropical high, the offshore area sometimes has high tide, which will influence the water flow and inner city drainage. Nevertheless, nearly all the cities in China have their rain seasons in summer. Guangzhou is not an exception as well. When heavy rainfall and high tidal happen at the same time Guangzhou is easy to be flooded. Many methods have been discussed and applied from the past till now. However, inner-city flooding still happens frequently. That is partly because fast urban construction did not consider the resilient capacity of the city. More green space was removed from the city. But, green space can hold and store water. When too much impermeable surface replaced the green, the ability to hold and store storm water is also weakened. And finally urban floods will occur.

Urban heat

As introduced in the landscape pattern part, Guangzhou city has mountains in the north, which blocks the cold air from the hinterland. Besides, although Guangzhou is a coastal city, the city center is far from the sea. In between the city and the estuary, there is a large amount of agricultural area. Consequently, the sea wind decreases with distance. Even if there is a strong wind from the sea, the wind that could reach the city will become softer.

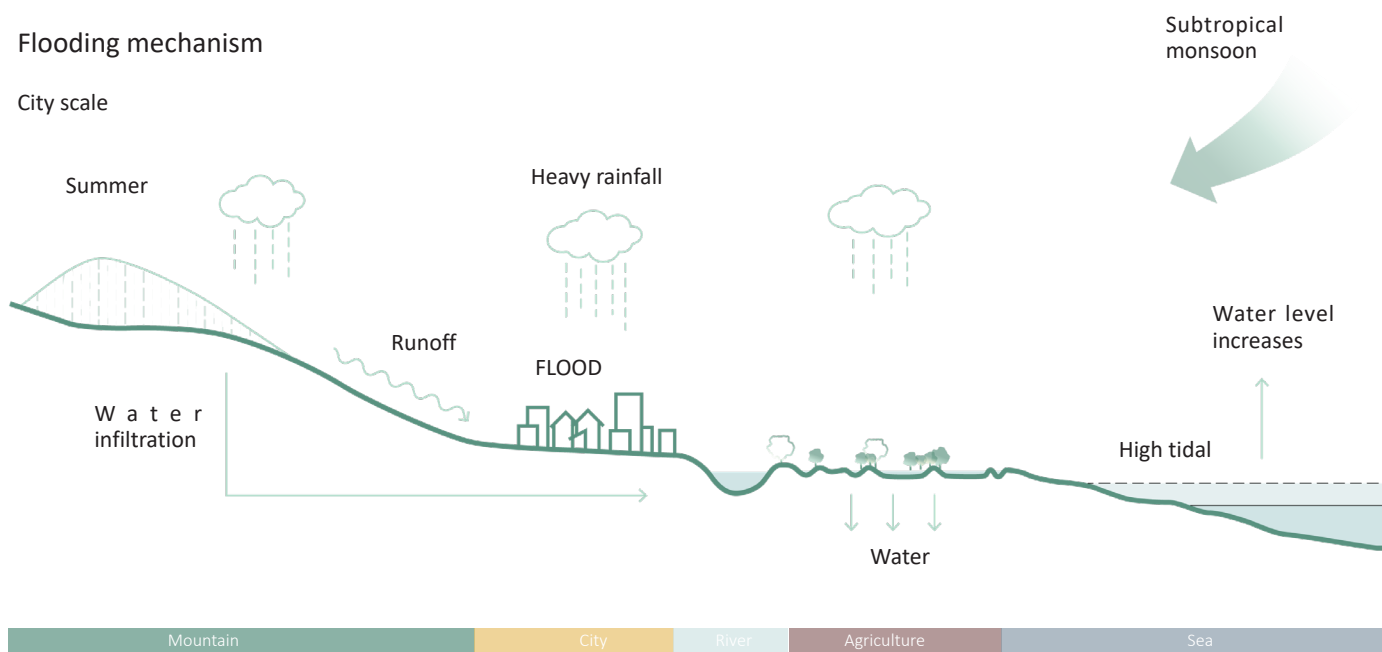
Influenced by the Subtropical monsoon, it is usually hot and humid in summer.

Besides, Guangzhou, sometimes, will also be influenced by the subtropical high and West circulation. They will decrease the rainfall and create hot days with little rainfall.

Altogether, these three reasons contribute to more extreme summer temperatures in Guangzhou. Green in the city could provide shade and absorb sunlight. Greening the city is a useful tool for Guangzhou to decrease the urban heat effect. However, in the process of urban expansion, more green space was occupied and replaced by urban tissue. Compared with green space, the constructed urban area easier to rise the temperature under sunlight and will reflect more sunlight to rise the environmental temperature. This makes the city easier to have extremely high temperatures and suffers more from the urban heat.

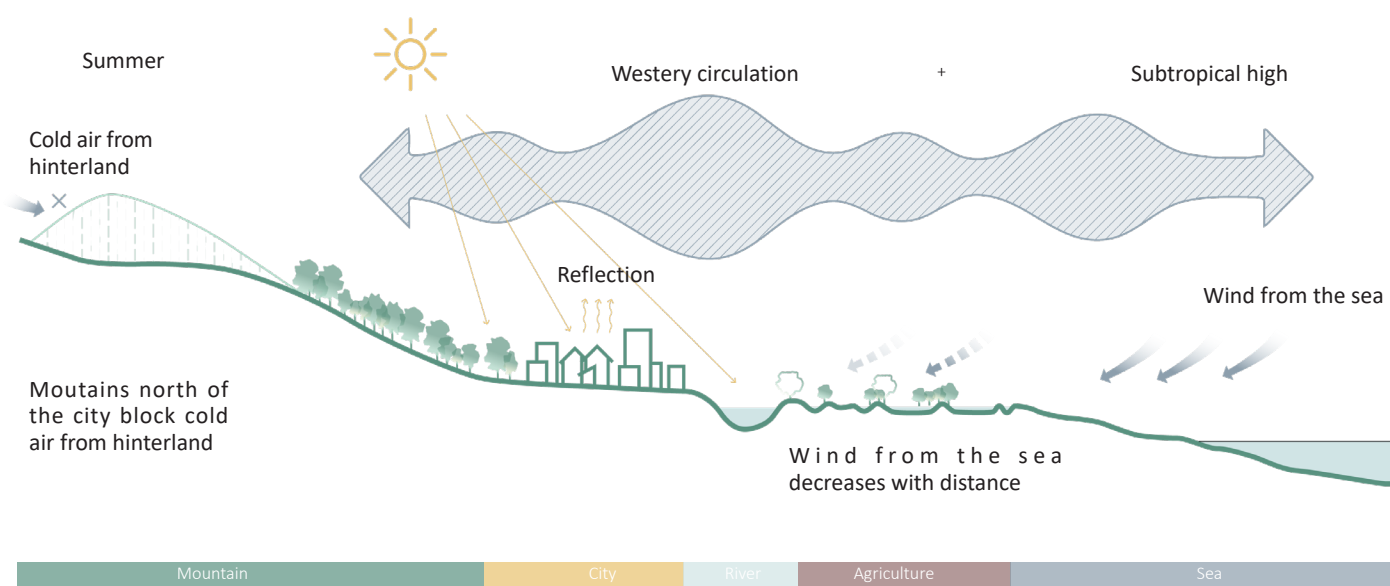
Flooding mechanism

City scale



Picture 3.2 Flooding mechanism
By author

Reasons for high temperature



Picture 3.3 Reasons for high temperature
By author

History--city was always part of landscape and nature

Guangzhou is a city with a long history and rich culture. The recorded history of the city has been more than 2,000 years. It has been the political, transportation, and economic center of this region since very ancient times.

The mountain in the north forms a natural barrier between Guangzhou and the traditional “central area”, which is known as the general political social center of ancient China. This barrier helps Guangzhou to develop its own culture and traditions in many aspects. Thus, Guangzhou could become an old commercial city and the only treaty port of China during the Qing dynasty. The study of history is not only to better understand the history itself but also to clarify what has been changed in history and why the changes lead to the problem. In this exploration, the research will try to understand what the landscape-nature network in the past was and what role it played in the city. Furthermore, how to help with the situation now and what can be learned from the past will also be discussed.

In the history analysis, the old landform and the site choice of the city establishment will be explained. Important changes of the city will be mentioned and classified into four stages, establishment, expansion, arrangement, and replacement. The history of city development, water system regulation, and green space change will be the main topics in each stage. The drawing on the right page is an old drawing of Guangzhou city in the late 19th century. At that time Guangzhou was still not a very big city with city walls. It has already shown the old landform of Guangzhou city clearly. Although it abstracted the elements to some extent, it still shows the clear relationship between the city and nature at that time. The city was built among nature and landscape. They form very close connections. In other words, the city was part of the landscape and nature.



Picture 3.4 羊城山水形胜, 1892 (Mountain water landscape of Ancient Guangzhou city)
Retrieve from:https://news.dayoo.com/guangzhou/202108/29/139995_54033673.htm

The drawing was completed in 1892. It described the mountain and water pattern of the Guangzhou city, also called "Shanshui" in Chinese. The drawing shows the city, topography and busy water traffic in Pearl River at that time.

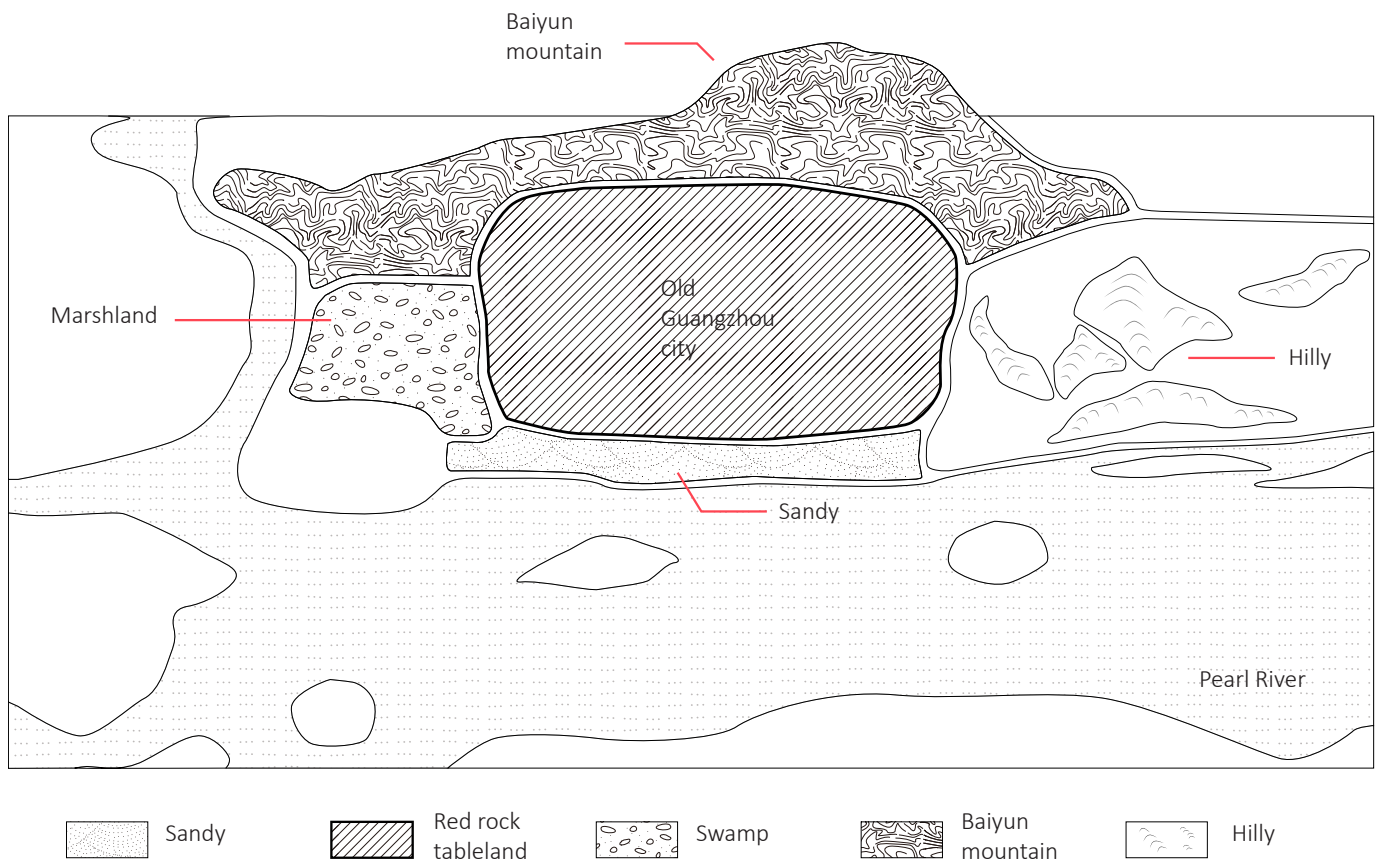
Landform

To understand the landform of Guangzhou city, the study analyzes the motivation for Guangzhou's establishment and the background reason for Guangzhou's stable and influential development. The old Guangzhou city was established on the tableland. North of the city is the famous Baiyun Mountain. The tableland is made up of hard red rock series. It provides solid underground support for city construction.

"Baiyun Mountain is the oldest topographic area in Guangzhou. By the end of the Tertiary period, both sides of the Baiyun Mountain were faulted to form lowlands, that is, the ancient lake basins where the ancient red rock series were deposited. Under the action of climate, it is cemented by iron oxide and becomes a hard stone, that is, a red rock series".Guan,(2010)

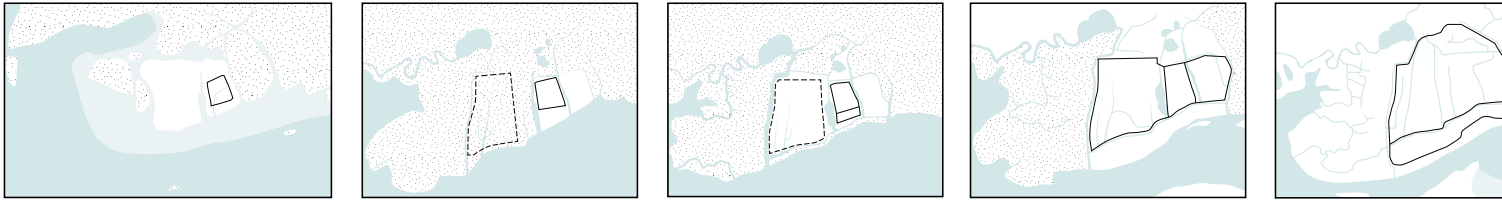
Guangzhou developed and expanded generation by generation on this tableland. Guangzhou was situated on the north side of the Pear River. Since the northern bank of the Pearl River grows annually, the area between Guangzhou city and the Pearl River also grows. This growing land is mainly made up of sand sediment. The area west of the ancient Guangzhou city was a swamp. Lakes and rivers took up this relatively wetter area. In between the northern mountainous area and Guangzhou city used to be a series of low-lying areas, where flooding happens often and water ponds were formed because of poor draining conditions. And to the east were plenty of small hills. This hilly area also added difficulties for the first settlers to set up their homes.

This landform determines the development base of ancient Guangzhou city. Since it was difficult to construct on the land outside the city, Guangzhou got the most suitable place for long stable development. That's part of the reason for Guangzhou to stand thousands of years and become a regional cultural and political center. In recent decades, construction skills improved largely. The city expansion relies less on the landform than before. Guangzhou city expanded more to the west and south.



Picture 3.5 Landform of old Guangzhou city
By author

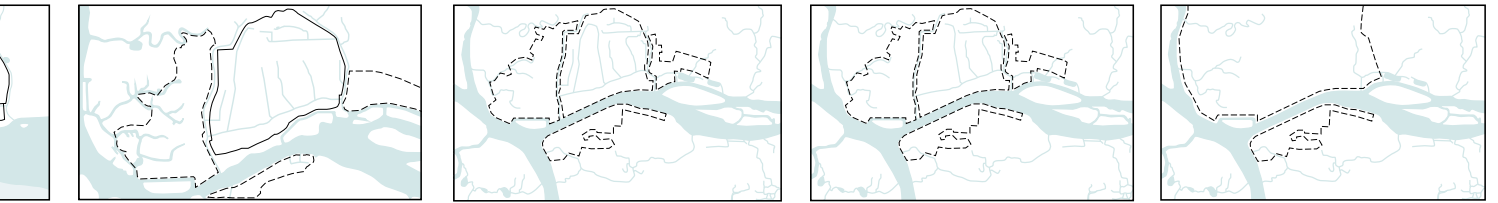
History line



ESTABLISHMENT

EXPANSION





1636-1912

Qing

1932

Republic of China

1949

PRC.

Now

ARRANGEMENT

REPLACING



Picture 3.6 History development
Made by author

Establishment of the city -- from the beginning to Tang dynasty

Guangzhou has a long history of human activities, which dates back to the Neolithic age. More than 4000 years ago, Guangzhou already has residents. They were called the Baiyue people. They settled down on the higher place between Fan Mountain and Yu Mountain. Around the ninth century BC., Guangzhou already had lots of interaction with the hinterland. It is said that Chu state, a vassal state of the Zhou dynasty in the Yangtze River Basin, sent many people here once and set up Chuting, the initial form of Guangzhou city. In 214 BC., the Emperor of the Qin dynasty sent General Zhao Tuo to attack the Lingnan area. After the victory of the Qin army, Zhao Tuo stayed there and built Panyu City, another name of Guangzhou City, between Baiyun Mountain and Pearl River. The Qin Dynasty fell after fifteen years. At the end of the Qin Dynasty, disputes and battles arose nationwide in the Central area. Relying on the terrain, Zhao Tuo relied cut off the connection with the Central area, proclaimed himself king, and established the Nanyue state.

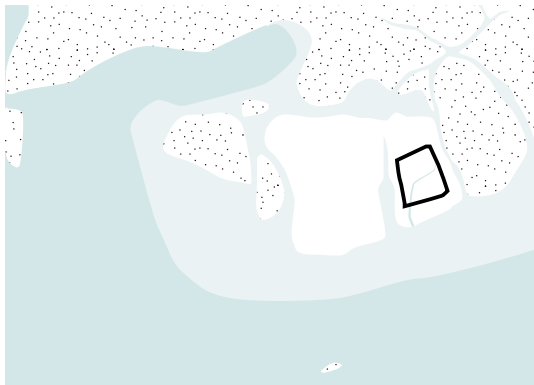
Nanyue state (618-907)

Located in the interlaced zone of the delta, Guangzhou was the key to controlling the Lingnan area in ancient times. After Zhao Tuo established his country, he imitated the Han system and built the capital and palace in present-day Guangzhou (Panyu at that time). The Nanyue state lasted for 93 years. In 112 BC, Emperor Wu of the Han Dynasty sent the army to the Nanyue state and regain control of the Lingnan area. During Nanyue State, the city was relatively small. Outside the side was a large area of wild natural area.

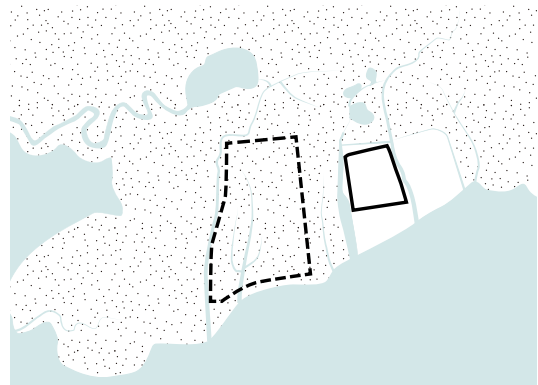
At that time, people's ability to harness nature was still weak. The situation was wetter. more rivers and wetlands could be found. The pearl river was also wider than now. The main rivers, the Gan River and Wen River originated from the northern mountains. They were the main freshwater resources for Guangzhou since saltwater intrusion was more serious in the Peal River. Inside the city, they created a complex drainage system to avoid flooding.

Although people at that time still did not have the concept of "green space", They still made use of natural resources and created a royal garden inside the palace. The royal garden had artificial lakes for recreation. The waterways were well-designed. The relics could still be found nowadays. gardens for hunting were also part of the royal garden. Along with the large wild natural area outside the city, the royal garden formed the basic landscape-nature network of Guangzhou during Nanyue state.

City

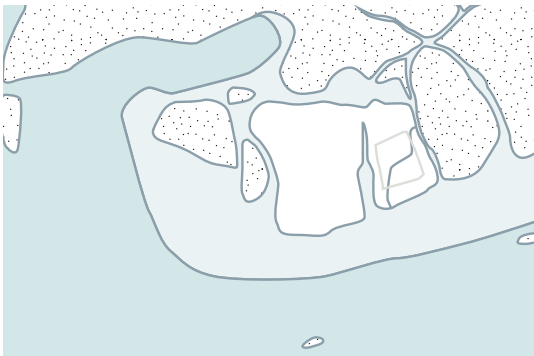


Nanyue state



Tang dynasty

Water system



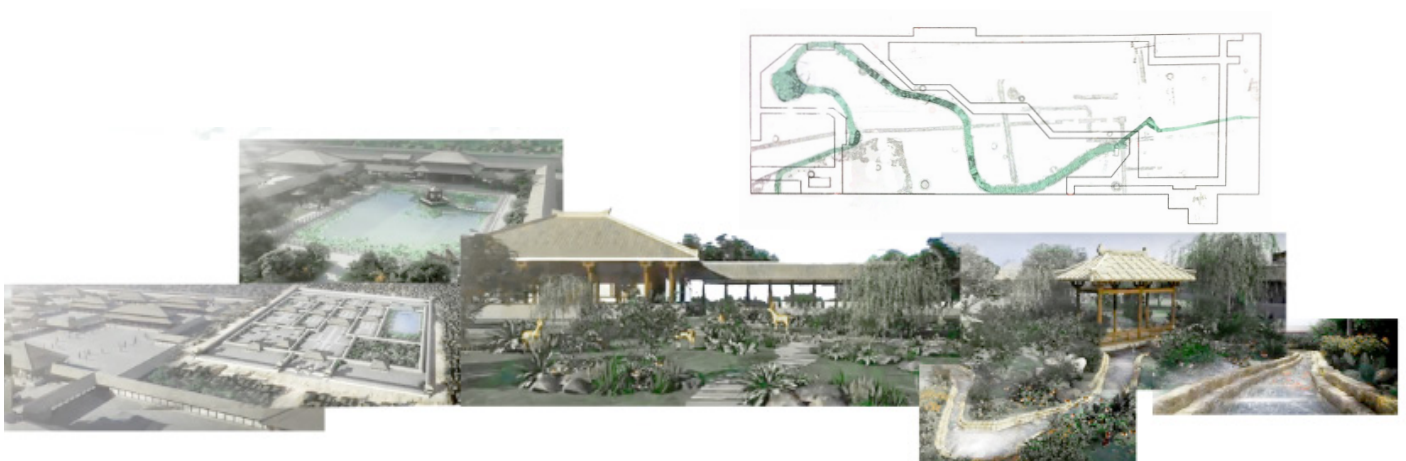
Nanyue state



Tang dynasty

Picture 3.6 city and water in Nanyue state and Tang dynasty
Data source: (Liu, 2015); Historical maps of Guangzhou; (Guan, 2010)
Redrawn by author

Park & Green space



Picture 3.7 Royal palace in Nanyue state
Data source: Nanyue historical museum
Redrawn by author

Expansion of the city -- from Tang dynasty to Ming dynasty

Tang (618-907)

During the Tang dynasty, Guangzhou city was still quite small. It expanded a little to the south. That was because of the northern bank of the Pearl River growth. Guangzhou started to become a commercial city because of the transportation convenience. Lots of foreign merchants came to Guangzhou, especially Arabian merchants. They gathered outside the city and set up new settlement west of the city, which finally became commercial and living blocks called the "Fanfang area". But the newly developed area did not have protection from the formal city wall. The water systems were more carefully regulated. Under the influence of rainfall and terrain, a series of lakes formed at the foot of the northern mountains. Among these, one of the largest was called Ju Lake. They were connected by the Yue River. Besides, in the Fanfang area, canals for transportation had developed. The Lan Lake also came into being and was connected to the Pearl River by canals.

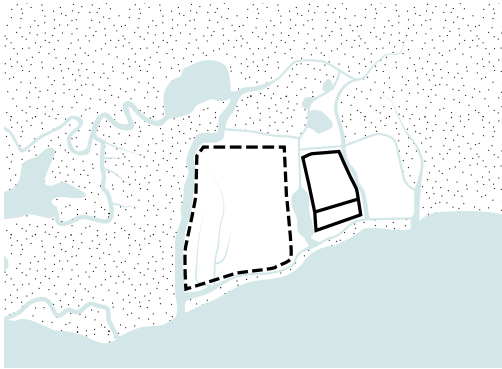
Nanhan (917-971)

At the end of the Tang Dynasty, the whole country fell into chaos and strife again. Local forces were seeking separation and fought with each other for more land and power. In 917, the Nanhan state was established, mainly including present-day Guangdong and Guangxi provinces. The Nanhan state largely inherited the urban layout and water system structure of the Tang Dynasty. The king of the Nanhan state built a palace in the city. He also developed the artificial lake, West Lake, to the west of the city. He created the Yaozhou Royal Garden inside the West Lake for recreation.

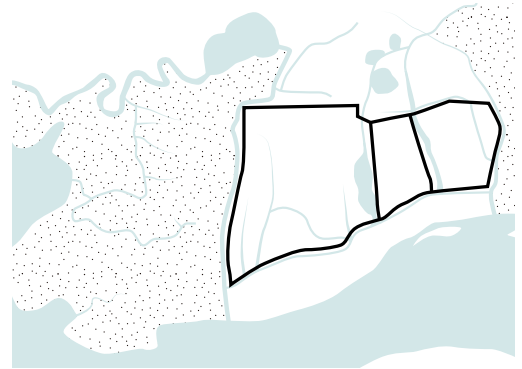
Song (960-1279)

In 971, Song's army conquered Guangzhou and ended the rule of Nanhan state. Guangzhou's status in commercial development stands. As the most important harbor of southern China, Guangzhou city experienced a large-scale expansion in the Song dynasty. In 1044, Guangzhou city expanded to the south. The original part was the political center and the southern part became the commercial area. In 1069, They build an east city on the east side of the Wen River. The new eastern city was mainly for salt storage. Build along with it was some other official offices. In 1073, the western city started to be constructed. It turned out to be the largest of the three. Both the southern part of the old city and the western city were constructed for the protection of the business (Guan, 2016). Besides, more rivers were connected for better transportation. Some artificial canals were also built at that time. Since there was no longer any royal group in Guangzhou anymore, the royal garden gradually became more public. It then became a summer resort for scholar-bureaucrats to go boating and play poem games.

City



Nanhan state



Song dynasty

Water system



Nanhan state



Song dynasty

Picture 3.8 city and water in Nanhan state and Song dynasty
Data source: (Liu, 2015) ;Historical maps of Guangzhou; (Guan, 2010)
Redrawn by author

Park & Green space

From Royal palace to public defined " Eight Views"



Picture 3.9 Old drawing of Yaozhou garden
Retrieve from: <https://zhuanlan.zhihu.com/p/412572169>

Regulation of the waters -- from Ming dynasty to Qing dynasty

Beginning in the Song Dynasty, there were publicly recognized eight views in Guangzhou. Guangzhou has a relatively wetter condition at that time. The pearl river was much wider than it is today. It was nearly 1100 meters wide (Liu, 2015). The eight views also reflected the social and natural characteristics of different times. In the Song dynasty, most of the views were related to waters, for example, the Pearl River.

Ming (1368-1644)

In 1370, the co-existing three cities merged into one larger city. Four years later, given the Fengshui pattern, the city expanded northward to the Yuexiu Mountain. They tried to create an urban pattern surrounded by mountains and rivers.

During the Ming dynasty, many lakes and swamps were filled up. Before, river systems and canals were the main traffic way for commercial and daily activities. While in the enclosed city, the original function of the waterways was lost. The old waterways were no longer motivators of city development. In 1467, The oldest river of Guangzhou, Wen River diverted. It also accelerated the degradation of canals inside the city. Residents started to take up the space of water and build their houses more and more close to the water system, in some cases even above the waterway. The growing population also increased the pollution and degradation of the canals. Inside the city, districts along rivers were no longer bustling business centers. Consequently, the commercial activities changed to the south and west area outside the city, where waterways and transportation situations were better. The tidal flats to the south of the city turned into land and became a new commercial center of Guangzhou. The prosperity of business in the southern area called up the need for urban expansion. In 1565, Guangzhou expanded southward again and built a new south city.

The tradition of eight views was kept. At that time, the views also reflect the character of the development stage and people's life. Most of the views were about city life, urban construction, and commercial development. During the Ming dynasty, a new landmark building, the Zhenhai Building, was built on Yuexiu mountain for the "Feng Shui" concern, which is part of traditional Chinese supernatural belief. They believed this type of arrangement could bring good luck and get rid of disasters.

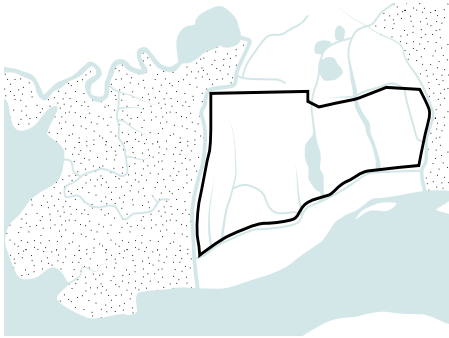
Qing (1636-1912)

The Qing Dynasty implemented the policy of closing the country. Nearly all communication with foreign countries was forbidden. However, Guangzhou was the only international trading port for a long time. The city of Guangzhou kept most of the previous look and area. Since the Qing dynasty was ruled by one of China's minority ethnic groups, the Manchu people, Many Manchu officials, and local gentry took up large space in the city. There are clear class divisions in the city in terms of living conditions. The commercial center moved outside the city. Xiguan area came into flourish.

During Ming and Qing dynasties, the famous Six-vein canals emerged. It was the main water system inside Guangzhou city. Guangzhou's landform was a gradient from high to low from north to south. The Six-vein Canal was an important drainage system for Guangzhou. Due to the business outflow, water systems did not act as the main transportation means. The bond between water and people's life gradually broke. Rivers became increasingly easy to degrade. Daily life pollution made the condition of the canals even worse. Reclaiming land downstream of the canals affected the logging ability of the canals. The reasons above caused the deterioration and narrowing of the waterways. Thus, in the Qing dynasty, the Six-vein Canals were re-regulated several times. It experienced several stages, for example, Six veins in Qianlong time and Ten veins in Jiaqing time. However, the efforts did not stop the trend of degradation. The situation was not improved completely. The water systems were gradually perceived as negative space in the city abandoned by the people because of the conflicts between demand for construction and water system protection.

In the Qing dynasty, the tradition of eight views was protected. People selected their best views both inside and outside the city. They were mostly about the beautiful mountain and water scenery. For instance, Yuexiu Mountain, Pazhou Island, Yu Mountain and waterfalls. Cultural landscapes were also popular. Among them, they also listed the temple and Zhenhai building on top of the Yuexiu mountain. It reflects people's appreciation of both cultural and natural beauty. It also shows the important role of landscape and nature in people's leisure life.

City



1370



1374



1565



1796-1820

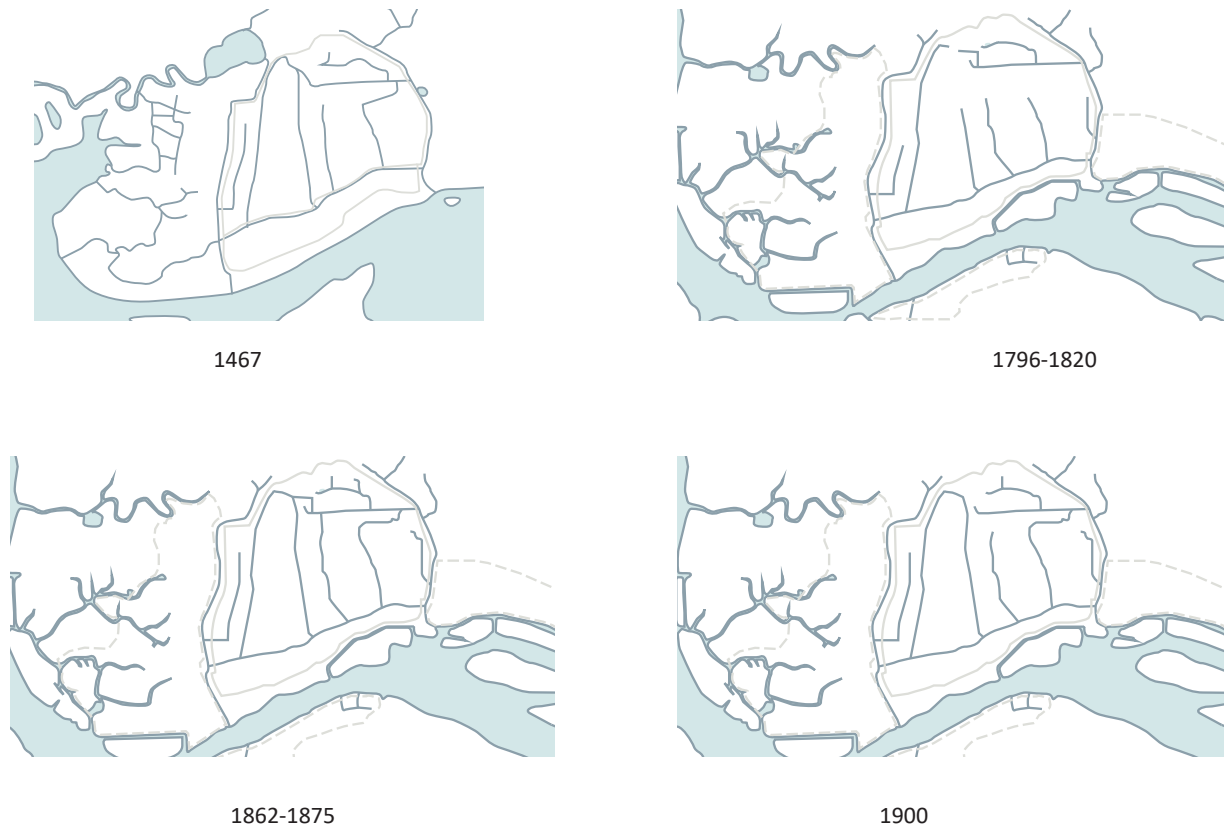
Park & Green space



Wenxi was diverted, and the commercial center gradually shifted to Yudaihao in the south of the city and Shibafu in Xiguan

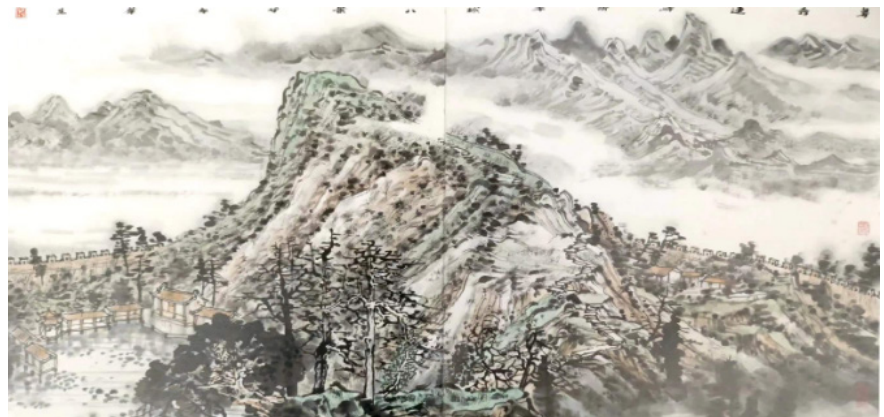
Picture 3.11 Commercial and city development in Eight view
Retrieve from: http://www.gznews.gov.cn/202205/26/160914_54272820.htm

Water system



Picture 3.10 city and water in Ming and Qing dynasty
 Data source: (Liu, 2015) ;Historical maps of Guangzhou; (Guan, 2010)
 Redrawn by author

The inside of the city is administrative, and part of it is assigned to the Manchu regime; the outside of the city is the commercial center, and the Xiguan area is densely populated.



Picture 3.12 Eight view in Qing dynasty
 Retrieve from: http://www.gznews.gov.cn/202205/26/160914_54272820.htm

Replacing old systems -- development over the past century

Republic of China (1932)

During the Republic of China, Guangzhou was one of the first cities in China to be influenced by new ideas. It was also the birthplace of the Chinese Revolution. Since 1921, Guangzhou had a large-scale urban transformation. The Urban Planning and Construction Office was established in 1921. The city wall of Guangzhou was demolished (Liu et al., 2021). Meanwhile, massive road construction was launched. Although the developing speed was affected by world war II, important changes still took place in the city. The city gradually turned into a modernized city, which is more similar to the look of the city today. The traditional look and layout of the city has been changed. Without the block of the city wall, the built-up area was connected as a whole. Urban development was no longer limited to the north bank of the Pearl River. Some areas on the southern side were gradually flourishing.

The urban construction also brought changes to the water system in Guangzhou. In the sixteen years from 1933 to 1949, part of the Six-vein Canals disappeared. As shown in the drawing, two main branches in the west have been replaced by underground drainage systems by 1947. Although the initial idea was to consider the preservation and improvement of Six-vein canals, the pollution and encroachment on river space were too serious at that time. The difficulty of revitalizing and managing was far more than covering the polluted canals with concrete surfaces. As a consequence, road systems started to replace the canals.

During this time, the idea of city parks emerged in Guangzhou. The city started to construct its parks based on previous cultural landmarks and famous natural view sites. Among them, People's Park built in 1918 was the first public park in Guangzhou. Besides, China was in a hard time fighting against invasion. Frequent wars brought many sacrifices. Lots of martyrs' cemeteries and memorial parks were also built at that time.

More recent development

After 1949, China finally got rid of the long-term internal and external war. A relatively stable environment for development was formed. Guangzhou was still one of the most important cities in China and the regional center. Under this condition, the urbanization steps continued. At that time Guangzhou was mainly planned as an industrial city. The suburban area was constructed as an industrial zone(Liu et al., 2021). The constructed area extended to the north and east gradually. However, this trend of urban expansion sped up after the late 1970s. The opening-up policy attracted many investments from home and abroad. People migrated from the hinterland to Guangzhou and Shenzhen for working opportunities. The city not only expanded largely to the north, east and south but also became denser and more crowded.

The increasing population leads to problems in living conditions arose. Because of the informal constructions above and near the canals, the water quality was seriously influenced. Not enough space was left for the canals. At that time, considering the difficulty to improve the water situation, replacing construction became the priority. From 1952 to 1959, the six-vein canals have been gradually replaced by road systems. By the end of 1959, the Six-vein Canal and Chenghao (canals around the old city wall) were replaced by concrete sewers. Only Donghaochong remained (Liu, 2015). However, although Donghaochong was kept, two layers of highways were built above the canal.

The construction of public parks did not stop. Besides the ones preserved and constructed before, increasing numbers of new city parks were planned. In the 1950s, 12 city parks were constructed (Guangzhou Municipal Bureau of Landscape Architecture,n.d.). Different types of parks, like wetland parks, nature reserves, and forest parks, together form the public park system in Guangzhou.

City



1936

The city wall of Guangzhou was demolished. Road construction started in large scale.

Since the 22nd year of the Republic of China, some of the six vein canals have been changed to underground drainage system, namely the Yousanmai Canal and the Youermai Canal. However, these efforts have not solved the urban land conflicts and flood problems in Guangzhou



1960

The urbanization continued. More nature area and suburb area was occupied. City started to expand rapidly. Most of the space near city was replaced by industry, commercial and residential, etc.

Park & Green space

Public park system

building

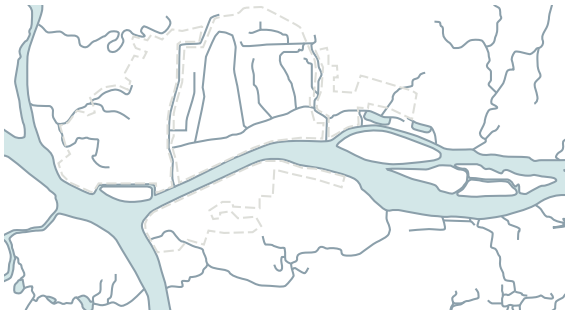
monument

city park



Picture 3.14 Collage of parks and landmark in early 1900s
Retrieve from: http://www.gznews.gov.cn/202205/26/160914_54272820.htm

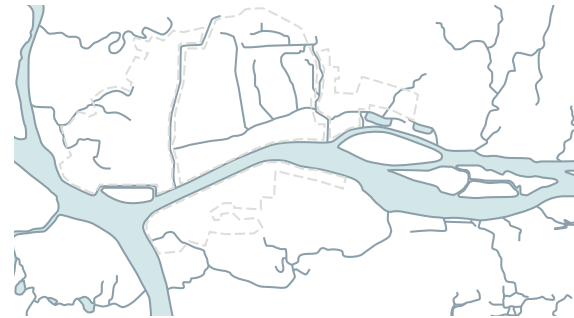
Water system



1932



1960



1947

Since 1952, the canals have been gradually replaced by road canals. By the end of 1959, Six vein Canal and Chenghao were basically replaced by concrete sewers, and only Donghao remained.

Picture 3.13 city and water in in more recent time
Data source: (Liu, 2015) ;Historical maps of Guangzhou; (Guan, 2010)
Redrawn by author



Picture 3.15 Park development after 1950s
Retrieve from: http://www.gznews.gov.cn/202205/26/160914_54272820.htm

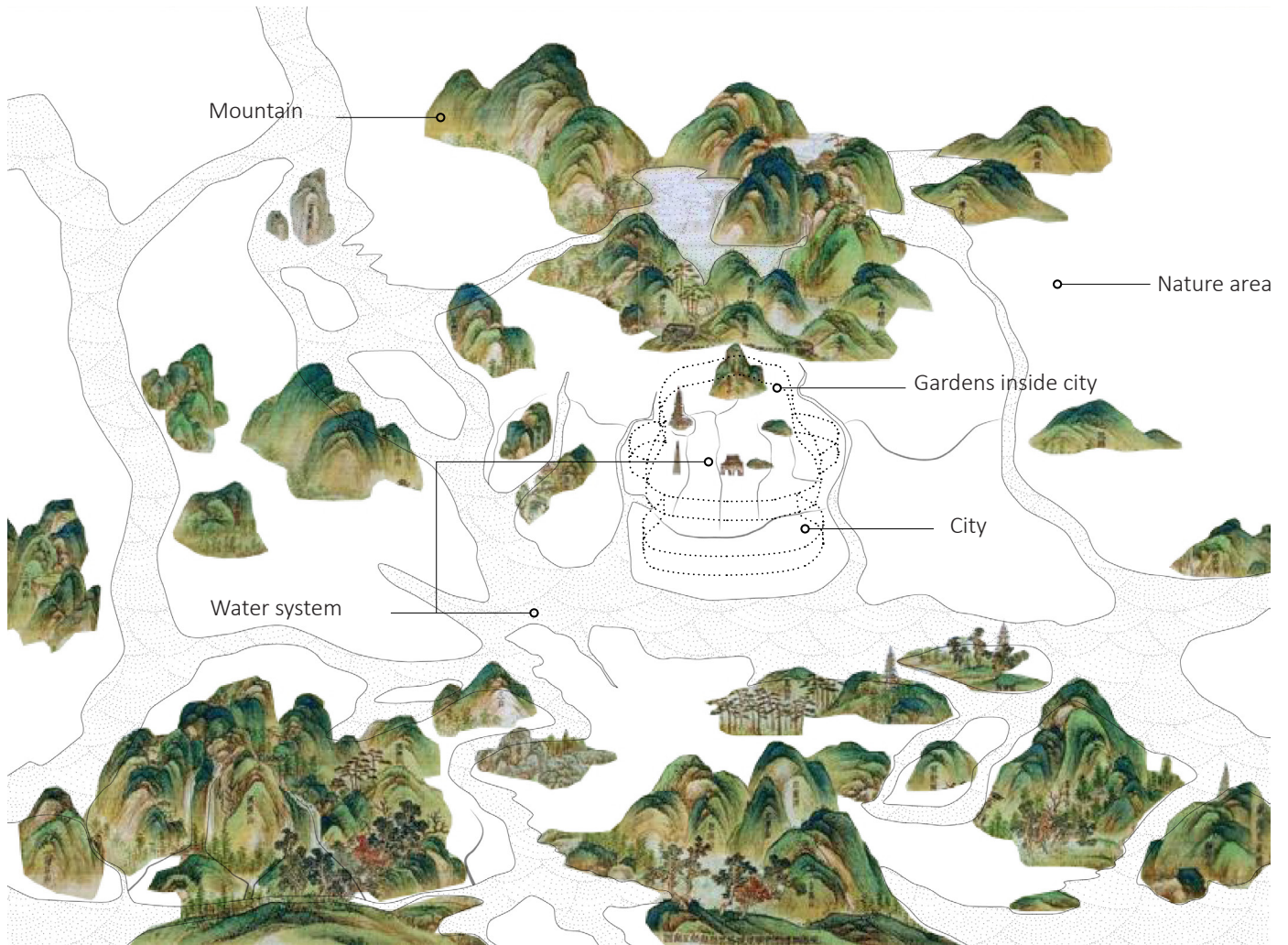
Conclusion--Landscape-nature network in the past

In the very long history of Guangzhou, city-people-nature relationship was more coherent. This largely contribute to the traditional philosophy thinking about nature. People believe that there are natural laws in the world, which means that mountains, rivers, and everything in the world has its own balance. Human and nature are interdependent. This thinking reflect on many social aspects, literature, agriculture, arts, etc. The mountain-water (Shanshui) thinking is the product of this traditional idea. It was deeply involved in the city construction.

Landscape-nature network in the past has a very clear structure. As shown in the drawing, It has mountain in the background of the city. It also includes water (river) in front of the city. In the past, they thought a site with this landscape pattern normally is an ideal location for city. Consequently, this pattern is very wildly applied in ancient Chinese city construction, for example Guangzhou, Beijing, etc. Besides, old Guangzhou city also had large wide nature and agricultural area outside the city. In the past, the construction skill is not as strong as nowadays. People show more respect to nature in terms of taming nature compared with now. Inside the city, they had fresh water flowing from the background mountains to the big river in front of the city. These canals and small rivers normally not only could be the water source, but also will be the system for flood water management and, in some cities, for transportation. Recreational green space is also important in ancient city life, especially for higher classes. They would build private gardens inside the city. The traditional Chinese garden focus on creating a natural shanshui painting-like atmosphere. They sometimes imitate natural creeks and use stones to symbolize mountains. The idea is to create the natural view, although the garden is artificial.

With this mountain, river, wild natural area outside city and canals, traditional gardens inside city, a clear landscape-natural network for old Guangzhou city could be found. This system closely bind with people's life. The commercial development in Guangzhou heavily rely on the well-developed water systems. People from different social classes also make use of its recreational function in their spare time. This system also help with flood protection, food production, military use,etc. In a nutshell, a landscape-natural network in Guangzhou existed in the past time and played important role in the city.

Landscape-nature network in the past



Picture 3.16 landscape-nature network in the past
Image source: 广州府舆图, 1685 (old map of Guangzhou)
Redrawn by author

Now--the city to embrace landscape and nature

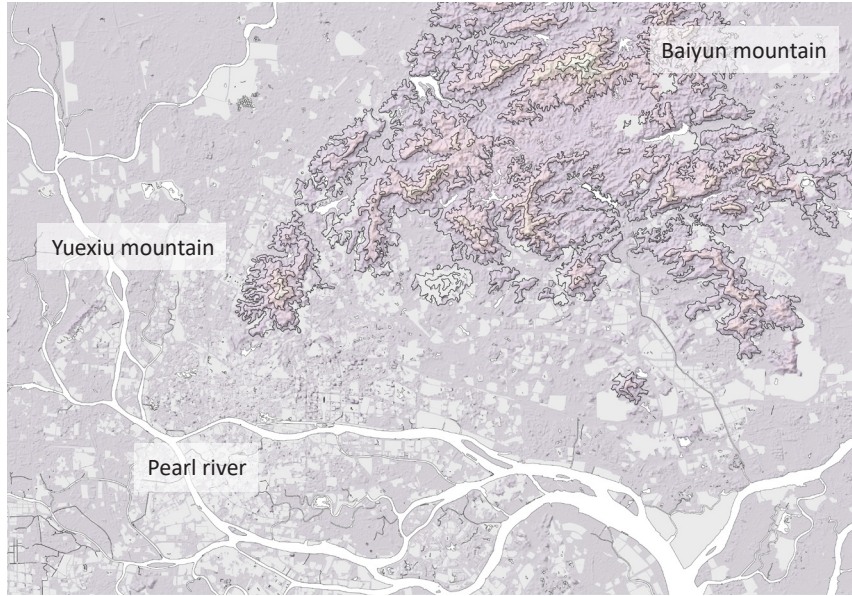
Guangzhou has experienced fast urban expansion for decades. As the picture shows, the new construction created a modernized, high-density city here, which is still seeking opportunities for future expansion. This development not only brought opportunities for both the city and people from all over the country but also challenges to the environment.

As mentioned in Chapter 1, the urban green space has been greatly reduced with the development of the city. The urban green space is facing dual challenges of ecology and society. The analysis of the current situation could help with the understanding of the urban system. The analysis is mainly for identifying the more problematical area and more critical space. Compared with the history analysis, a better understanding of the current situation will help with demonstrating what has been changed in the process and what has been sacrificed for the development. This could show a more clear overview of the problems from a spatial perspective.

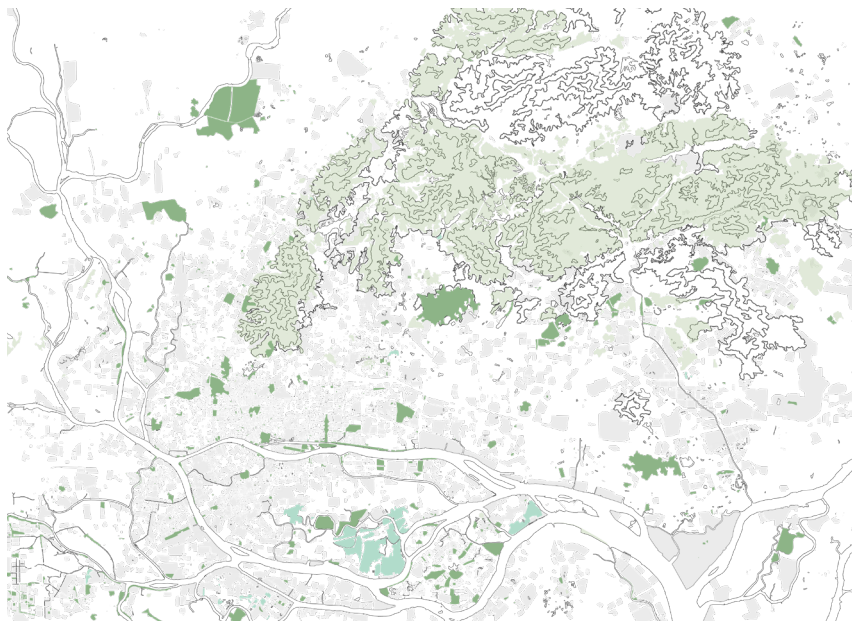
The following part will elaborate on the current situation of Guangzhou in both natural and social aspects. In natural aspects, the study will map four main characteristics of Guangzhou--the topography, water system, green spaces and flooding points of the city on a regional scale. And for the social part, the study will look into the traffic system, including road systems and railway systems. The spatial distribution of the population will also be shown to better tell the social condition. Besides, this part will also show the recreational and historical spots inside the city, which have higher value and potential for design exploration. The analysis of social and natural aspects will elaborate on different layers of the city, which will clarify the most urgent interventions.



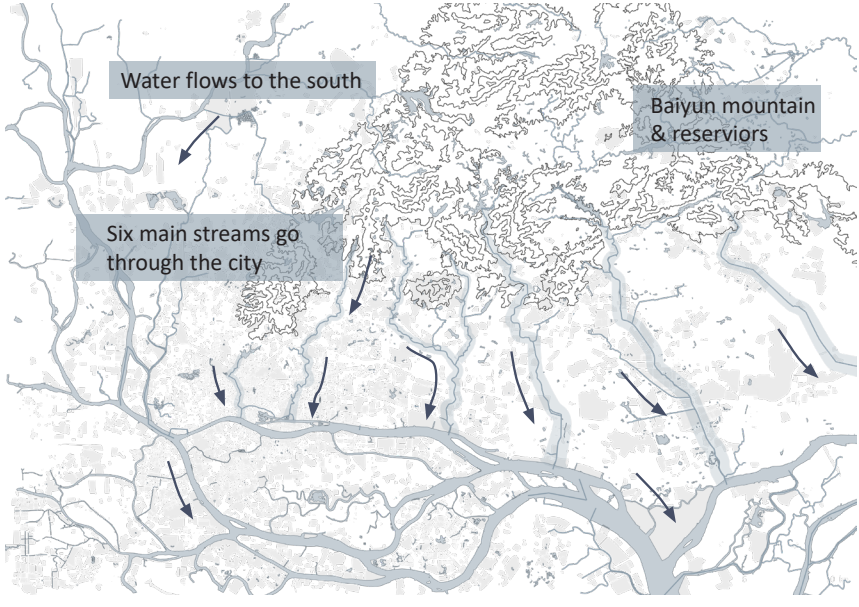
Picture 3.17 Guangzhou metropolitan city
Image source: Google picture, unknown



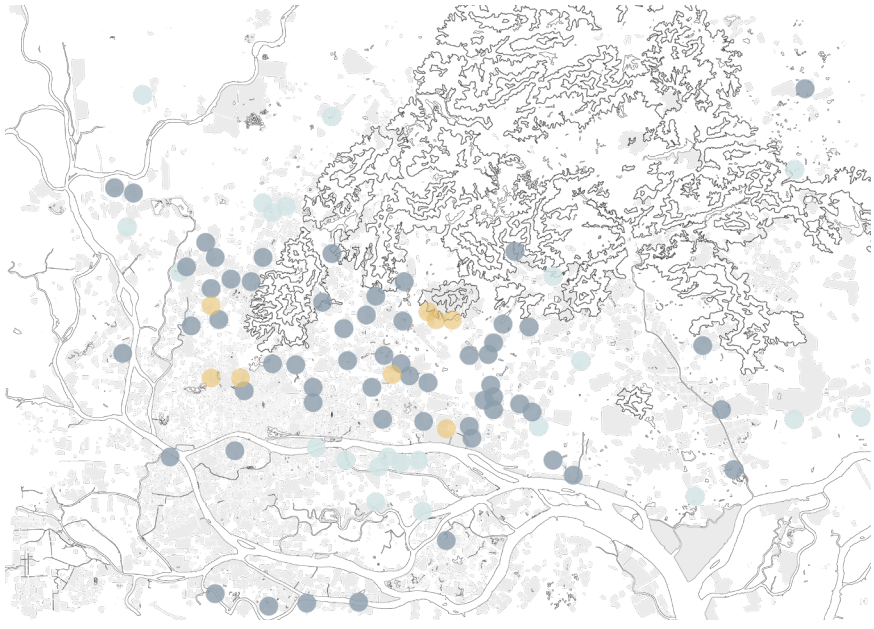
Topography



Green space

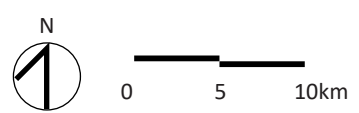


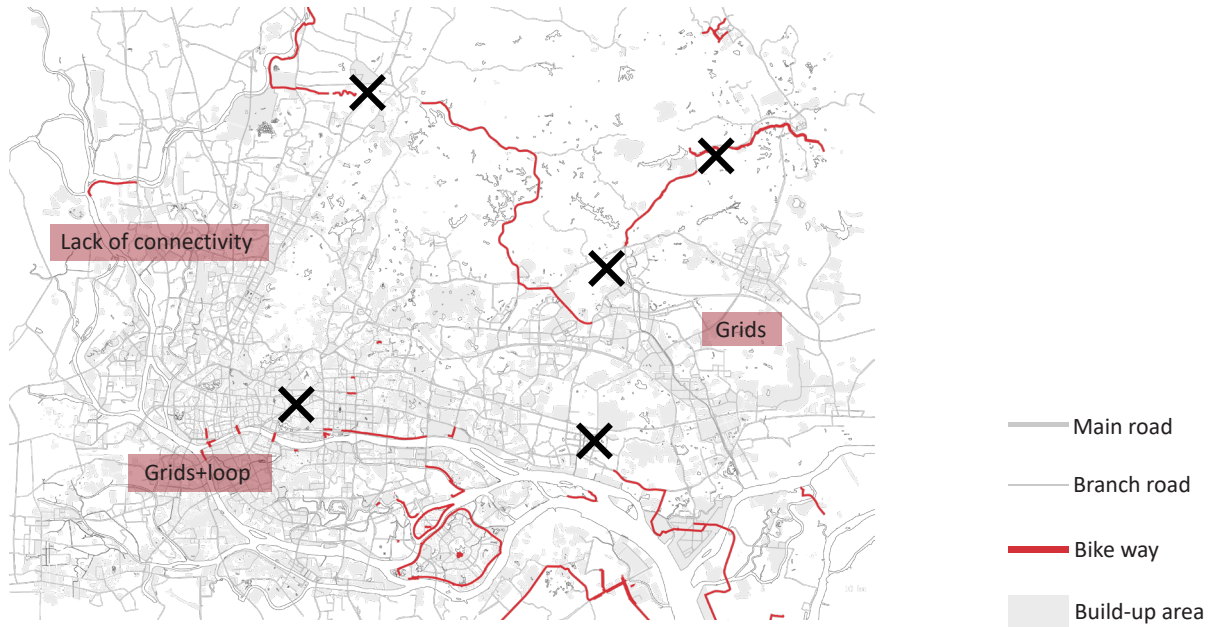
Water system



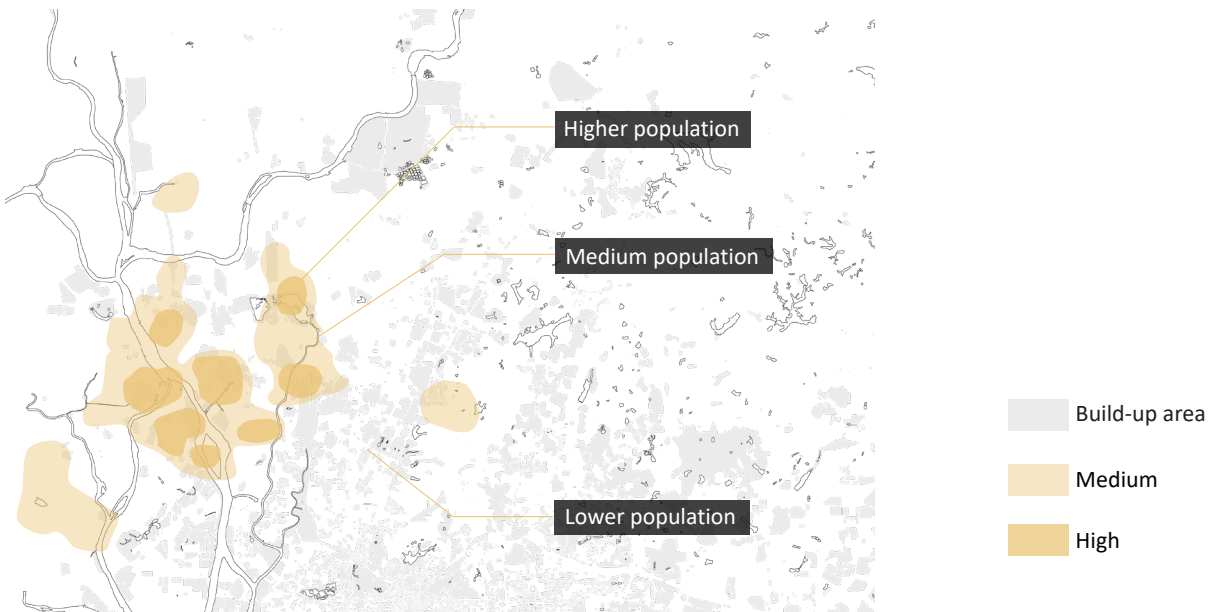
Flooding spots

Picture 3.18 Topography; Picture 3.19 green space; Picture 3.20 water system; Picture 3.21 flooding spots
Image source : Google map; Arc gis; <https://zhuanlan.zhihu.com/p/39240522>

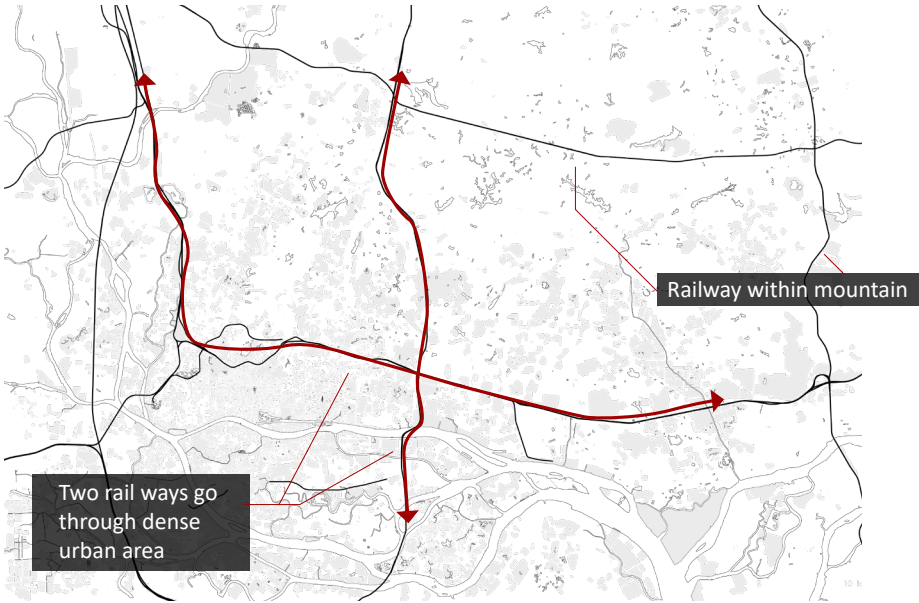




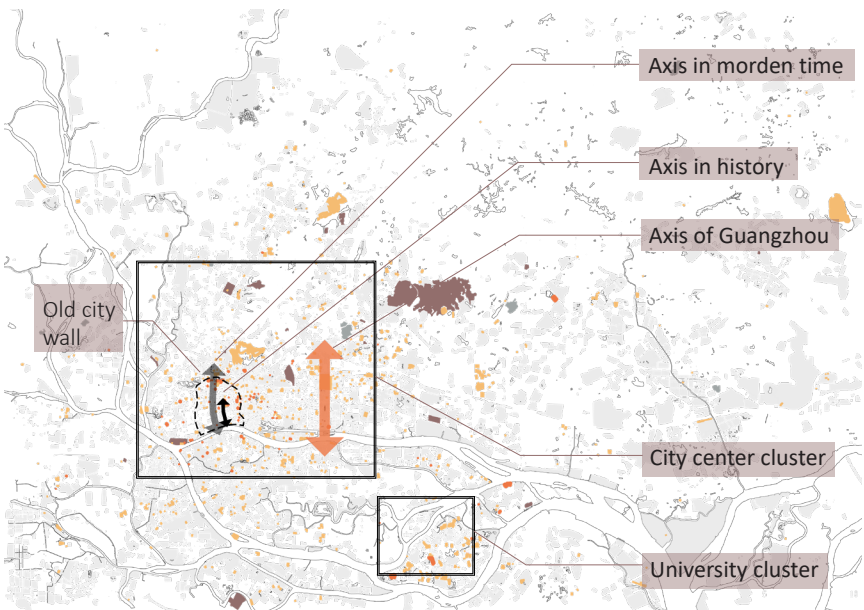
Road system



Population

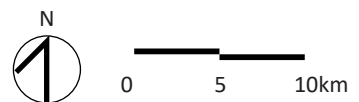


Railway



Recreation & historic spots

Picture 3.22 Road system; Picture 3.23 Population; Picture 3.24 Railway; Picture 3.25 recreation & historic spots
Image source : Google map; Arc gis



Current situation of Guangzhou

The central city of Guangzhou has a superior geographical location and rich natural resources. Its unique history also brought many historical remains for the city.

Natural aspect

When it comes to the natural analysis of the city, the mountain, water, green space are all essential. The central city of Guangzhou is situated in-between the Pearl river and a series of mountains in the north, called Baiyun mountain. This location has been the center of Guangzhou for thousands of years. The topography shows a gradient from high to low, from north to south.

The green space could be generally classified into several types, namely, forest reserves, city parks and wetland natural reserves. The forest reserve area are in the northern mountainous area. City parks distribute among the urban tissue. Some of them area based on the lake, others has historical values or maybe memorial spaces. They are all multi-functional areas, which provide ecosystem service for citizens.

Among the north mountains, there are many water reservoirs. The main inner city rivers nearly all originate from the Baiyun mountain. They flow from north to south to the Pearl river. Some of the tributary in Liwan region flows from east to west to the Pearl river. Now most of the inner city brunches do not work as transportation way, but the are still important space for decreasing flooding risks.

The flooding spots map is to show places with higher risks. The distribution of flooding spots inside city describes the old city area suffers more from the urban flooding. More serious urban floods could be recorded in the city center for its high density and insufficient infrastructure. The flood prone area also tend to have less green space nearby.

Social aspect

For the social part, the traffic system takes up a large amount of urban space. Different hierarchies of road system help with people's urban life. They have potential to be linear green connection for the city. However, as the map shows, the slow traffic way (the bicycle way) is unconnected. To create a complete slow travel System, there's still a long way to go.

The rail way lines are part of the urban transportation system, but is more for regional transportation. The railways now act more as barriers inside the city. Every coin has two sides. They also has potential to be transformed as corridors for the city, meanwhile.

People are important for a city. The spatial distribution of the population shows more people live inside the old city. These areas although have higher vulnerability to the risks, they holds more citizens. It mains ast the same time these places have higher demand for green space.

The recreational area and historical areas scatter inside the city. They concentrate more in the old city region and the huangpu region. Besides, in the city center, two main axis of Guangzhou exist. The west one is the historical axis of Guangzhou. It is not very obvious in the city now. it is consisted of Haizhu square, Renmin park, Zhongshan park and goes to the north towards Yuexiu mountain. The east one is the contemporary axis. It is a very dominant axis of the city. It looks very modernized and connects the new landmarks of Guangzhou.

Potential and challenges

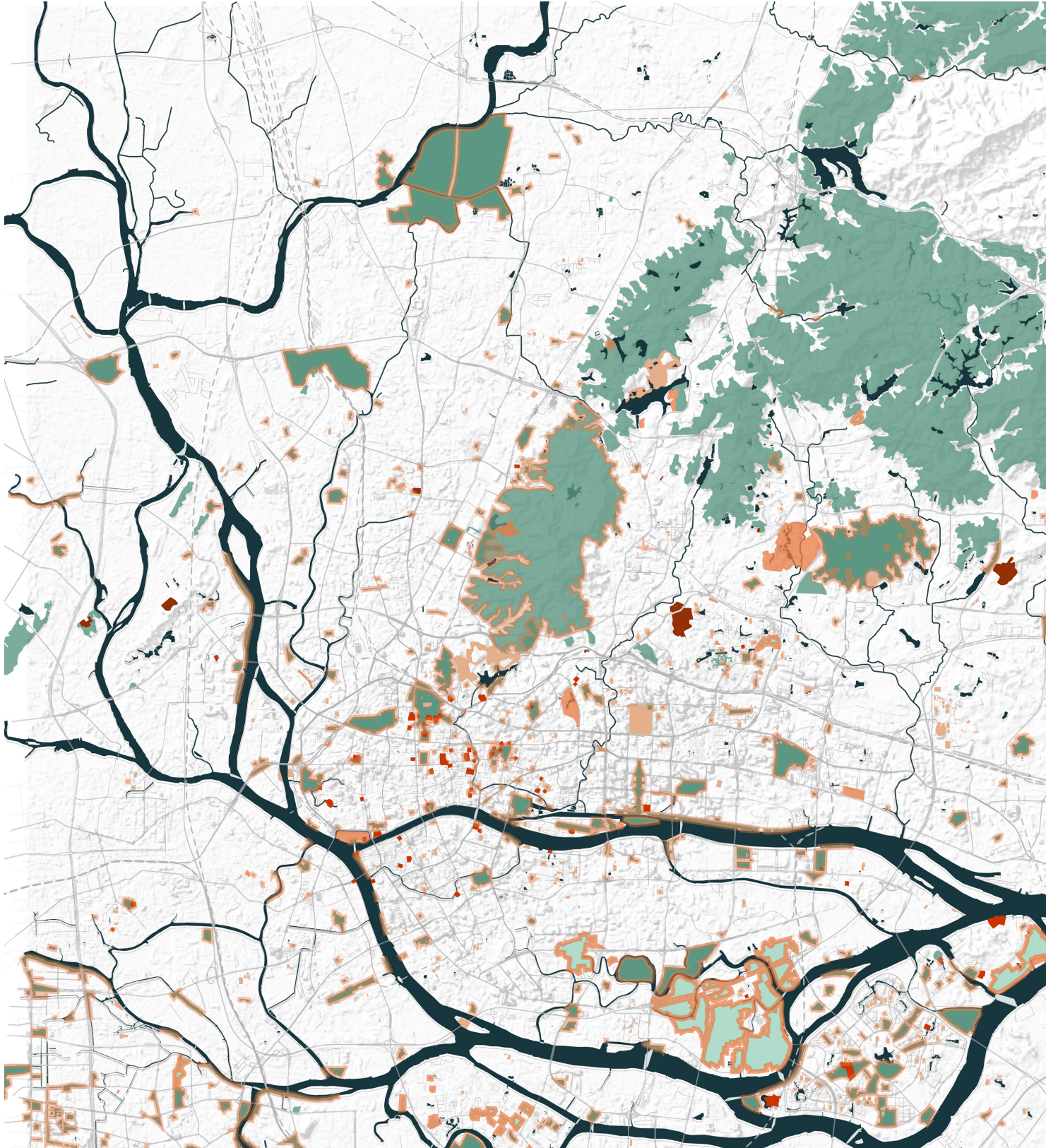
All the analysis of the site provide a more clear picture of Guangzhou city center area. Overlying them with each other and concluding them a little bit provided the challenge map and the potential map for this area.

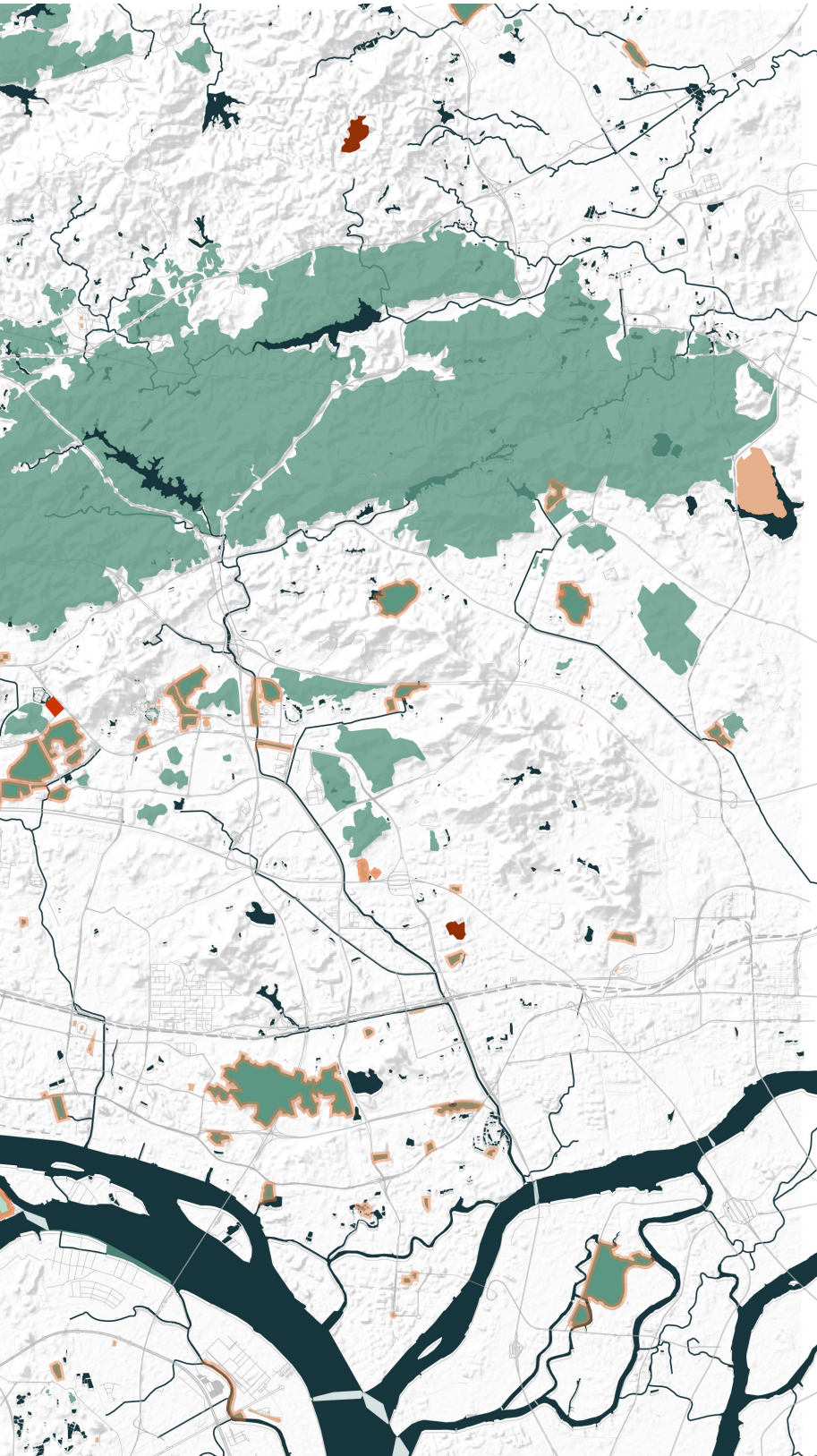
The main challenges shows the unconnected slow traffic way in city center scale. The discontinuity of the slow traffic system is not only distributed in urban areas, but also in mountainous areas. The old city area faces challenges from different aspects. It is easier to suffer from floods. It is denser but has higher demand for green space and ecosystem service.

This region also has many potentials to be utilized. The main potential here are multiple resources. The city has many types of green patches, which shows the potential to become a more complete green network. The existing rivers inside city also could be the backbone of the city and potential carrier of green connection. The scattered recreational and historical spots also could be future activity space, the carrier of city vitality.

The landscape structure of this region is shown in the structure map. The large area of mountain is the base of the city. It provide many fundamental support for the city in water, natural, biology and social aspects. The tributaries are backbones, which help with flood water management, recreation and production. The activity spaces inside city provide potential for more social inclusive environment and are potential elements for design exploration.

Potential map





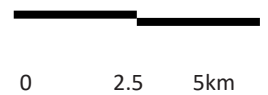
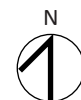
The potential carrier of green connection:
Water system
&
Transportation system

The potential carrier of change: Multi-scale green patches

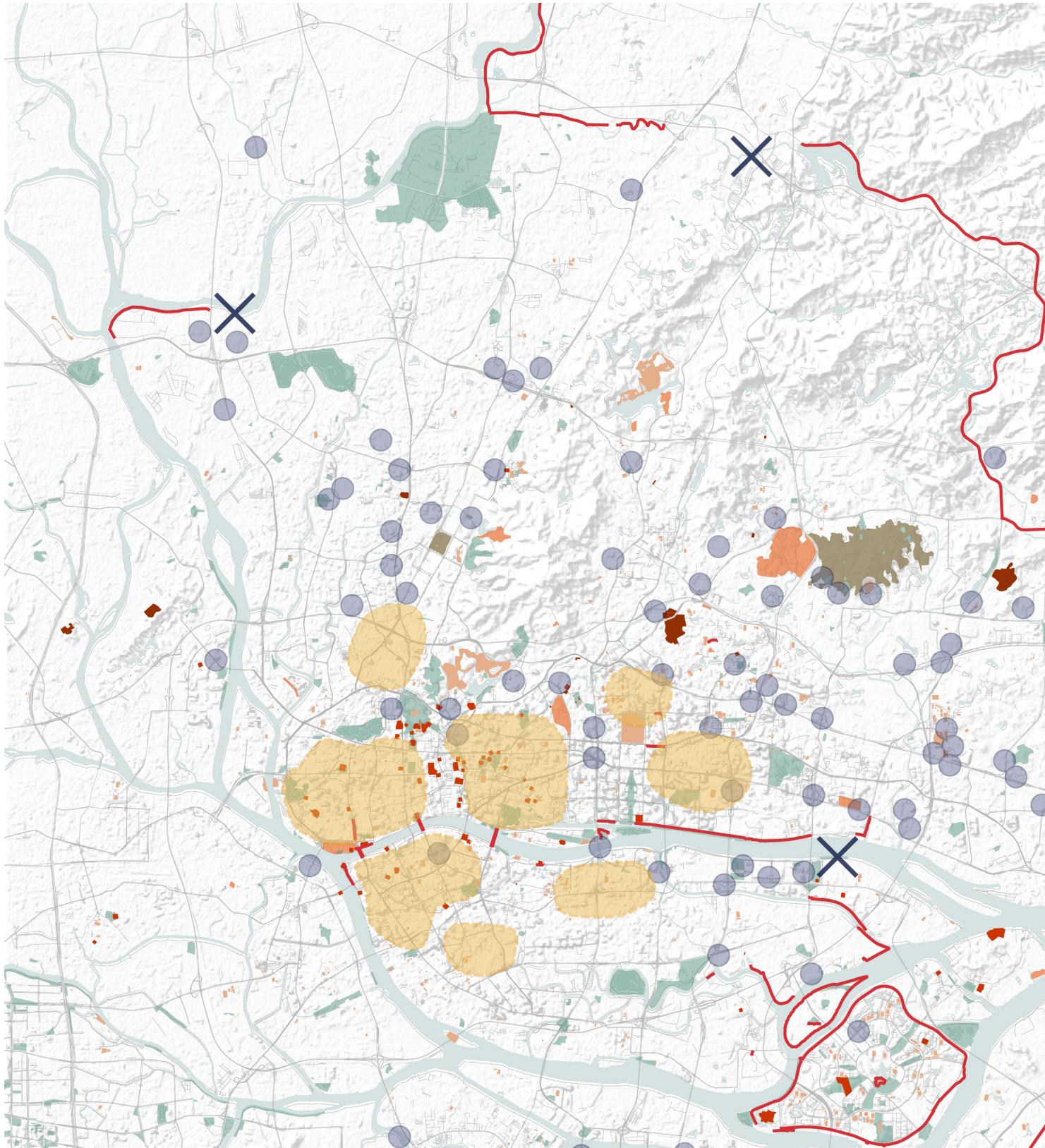
The potential carrier of city vitality: rich cultural nodes

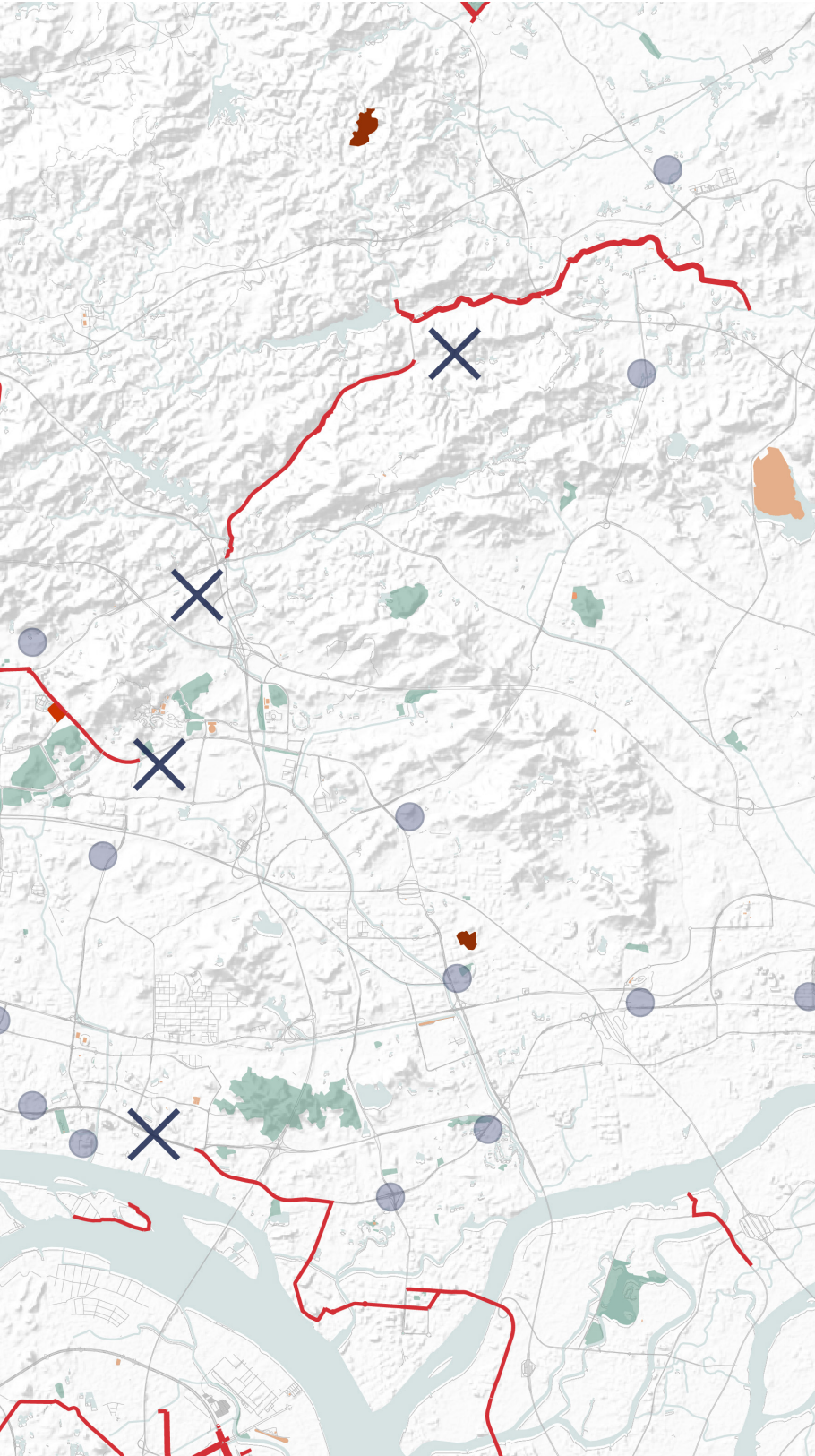
-  Historical spot
-  Sports
-  Recreation
-  Green space
-  Water

Picture 3.26 Potential map
Image source : Google map; Arc gis
by author



Challenge map





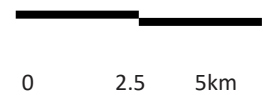
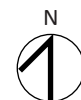
The potential carrier of green connection:
Disconnected slow traffic system

The potential carrier of change: Green islands & Flooding spots

The potential carrier of city vitality: Denser urban area

- High density area
- Historical spot
- Green space
- Recreation
- Flooding spots
- Slow traffic way

Picture 3.27 Challenge map
Image source : Google map; Arc gis
by author



Structure map



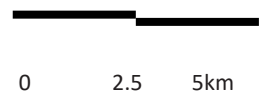
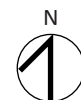


Green as Base

Water as Backbone

Recreational & Historic nodes as Highlight

Picture 3.27 Challenge map
Image source : Google map; Arc gis
by author



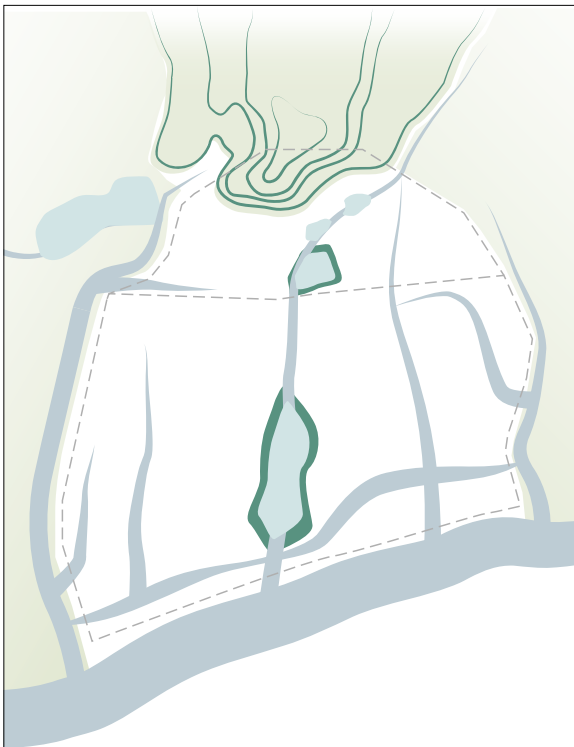
Conclusion

This chapter analyzes the situation of Guangzhou in detail. It first elaborates on the basic situation of the city to provide a background introduction. The history analysis provides a solid knowledge base for planning and design in Guangzhou. The current situation depicts a more real image of Guangzhou.

In conclusion, the changes between now and the past are clearly shown in the drawing. In the past, a landscape-nature network could be more clearly told. Human and nature are quite coherent with each other. The city was part of the landscape and nature. While nowadays, things have changed. The modern urban system, like the traffic network, became the dominant system in the city. The balance between human, nature and the city was broken, which led to many side effects. The urban system took up too much natural space and is still getting rid of the remains of the past. This did harm to the whole system. The changing and harm of the system lead to the decrease of the resilient capacity of the city and contribute to increasing urban problems, such as urban flooding, extremely high temperature and loss of biodiversity. In order to help with the situation, the design should try to recover the balance between human, city and natural. This does not mean recovering all the history look. This means helping with fixing the system and creating a more sustainable landscape-nature network for the city.

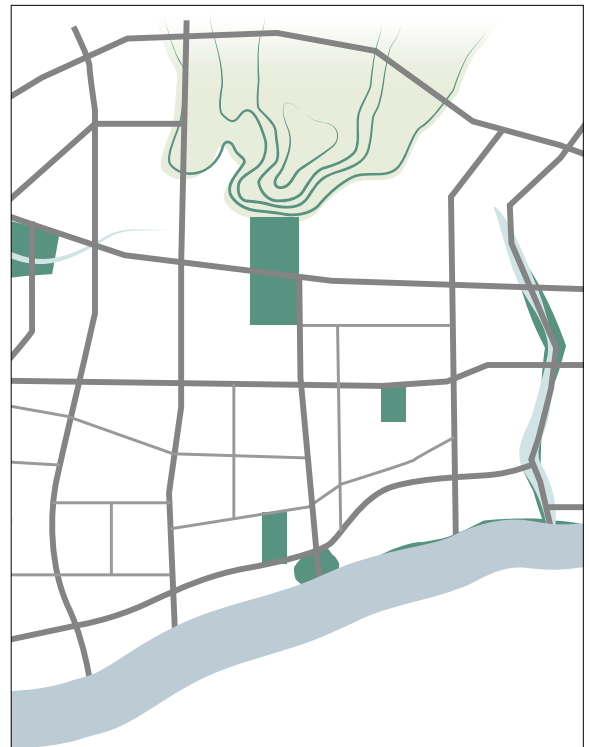
The analysis in this chapter is a response to sub-question 1. It not only provides the knowledge base for understanding the site but also helps with identifying critical challenges, potentials and critical areas for future planning and design.

Past



nature system

Now




urban system

Picture 3.28 System of past and now
by author



Chapter 4

How to create a resilient landscape-nature network



Boston's practice of metropolitan park
History wisdom
Strategies and Principles
Conclusion



Chapter 4 talks about the relative case-Boston Metropolitan Park. Inspired by the case and history wisdom of Guangzhou, possible strategies and principles will be proposed. This chapter will respond to sub-question 2, What are the principles and strategies to develop a metropolitan landscape-nature network?

Boston's practice of metropolitan park

Boston Metropolitan Park is one of the most famous practices of the metropolitan park in large urbanized cities. It is the first regional park system in the US. From the map of 1892 to 1902, the big changes in the main structure of the landscape system could already be perceived. The planner and designer preserved and enlarged green patches inside the city. Linear green connections along main waterways help to create a complete green network. More small patches of green could also be found inside the city. This metropolitan park system has significant influence till now. Nowadays, The Metropolitan Park System of Greater Boston connects seven forested reservations, three river reservations, and ten ocean reservations through 162 miles of parkways, totaling nearly 20,000 acres of parkland in 37 Boston-area communities (Metropolitan Park System of Greater Boston (U.S. National Park Service), n.d.).

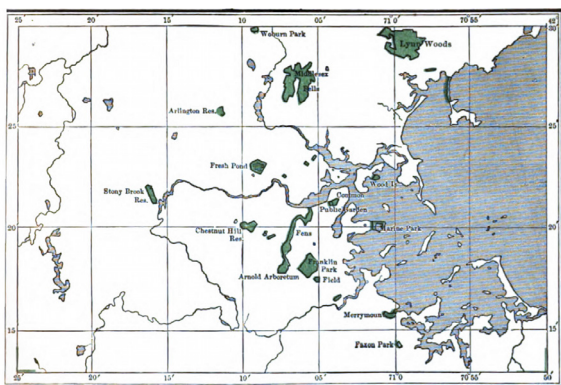
Reasons for building the park

Boston got rapid development in the late nineteenth century because of the “streetcar suburbs”(Moga, 2009). Boston transformed from a small commercial city into an industrial metropolis with over a million inhabitants within 50 years. The fast and massive urban expansion brought about many problems. The suburban area encountered more challenges. However, the “field and tree districts” had the potential to become the basis for planning, such as parks along rivers and the protection of forests (Moga, 2009). Besides, Pollution was one of the most important reasons for creating this metropolitan park. Industry pollution brought heavy burdens to the rivers, for example, the Charles River. It has “ink-black” banks, sewage waste and other types of waste (Haglund, 1993). Rivers and beaches still had marshy or shabby-built-up shorelines. The designers saw the opportunity to transform all the wild tracts, forests, and riverfront areas into more picturesque parks. Instead of controlling suburban development, the designers propose this metropolitan park system.



Picture 4.1 Boston metropolitan park
 Retrieve image from: <https://collections.leventhalmap.org/search/commonwealth:wd3768116>

1892



1902



Picture 4.2 Changes of Boston
 Retrieve image from: https://commons.wikimedia.org/wiki/File:The_open_spaces_of_Boston_in_1892_and_1902_compared.png

Ways to build the park: patches; connection; systems

The Boston metropolitan park is made up of several main elements, main patches and different types of parkways as connections. The planner and designers first defined large patches as nature reserves, including forest patches, riverfront patches, oceanfront patches, Inner bay shores and island and tidal estuaries and Small squares and parks in a densely populated area. The surveying and establishing of the boundaries of the south section of the Beaver Brook Reservation was finished on November 3, with an area of 58.61 acres. Then, it is the Blue Hills Reservation in December. The other large patches are the Revere Beach and the Stony Brook Reservation (The Board of Metropolitan Park Commissioners, 1893). Then, they use parkways as internal and external traffic systems, which refers to Motorways with good picturesque landscape views. They defined 5 types of parkways. First, it is the border parkway, which is mainly for defining edges and boundaries, for example, the Middlesex Fells Reservation Parkway. This parkway acts as the border between Middlesex fells reserve and surrounding neighborhoods. The second type is the internal roads. This type of parkway is for the internal circulation and connection inside the parks and nature reserves, for instance, the Stony Brook Reservation Parkway. The third type is the connecting parkway. Just like the Neponset Valley Parkway and the Hammond Pond Parkway, they are used for linking separate units and regional connections. The fourth type of parkway is the riverfront parkway. In the design, they created a linear green connection along the main rivers, e.g. the Charles River. This type of parkway provides people with good landscape views along the river. One example could be the Alewife Brook Parkway. Last but not least, they have oceanfront parkways. They were designed along the shoreline, the same as the riverfront parkways, for better landscape views. Winthrop Shore Drive Parkway could be one of the parkways.

The Boston Metropolitan Park came to be seen as a model plan for cities and regions in the United States after the publication of the report(Moga, 2009). Some parts of the Metropolitan Park System in the early 1890s are listed in the National Register of Historic Places (Metropolitan Park System of Greater Boston (U.S. National Park Service), n.d.). The Metropolitan Park system is made up of four systems, the water system, green patches, parkway systems and the recreational and historical system. It gives inspiration for the design of the Guangzhou Metropolitan Park, by utilizing the existing resources and designing from a system perspective.

5 types of patches



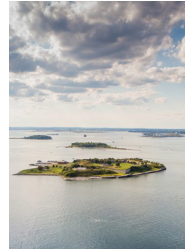
Oceanfront



Outer rim forest



Riverfront



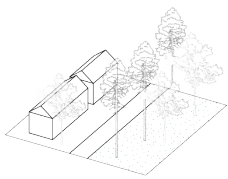
Innerbay shores
and island and
tidle estuary



Small squares
and parks in
dense populated
area

5 types of parkways

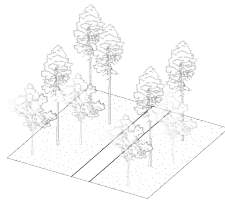
Border Roads



define the edges and
boundaries

eg: Middlesex Fells
Reservation Parkway

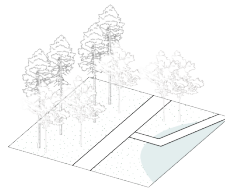
Internal Roads



circulation system
within the parks and
reservations

eg: Stony Brook
Reservation Parkway

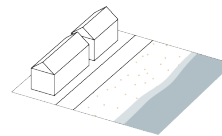
River Parkway



along rivers

eg: Alewife Brook
Parkway

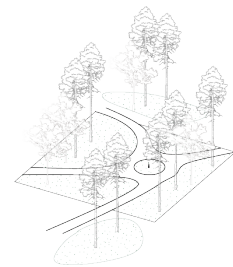
Ocean Parkway



Along shoreline

eg: Winthrop Shore
Drive Parkway

Connecting Parkway



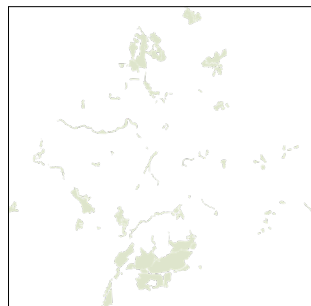
link discrete units

eg: The Neponset Valley
Parkway
Hammond Pond
Parkway

4 systems



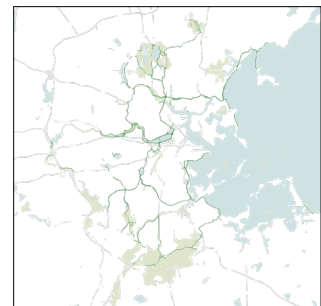
Water



Green patches
(historic landscape)



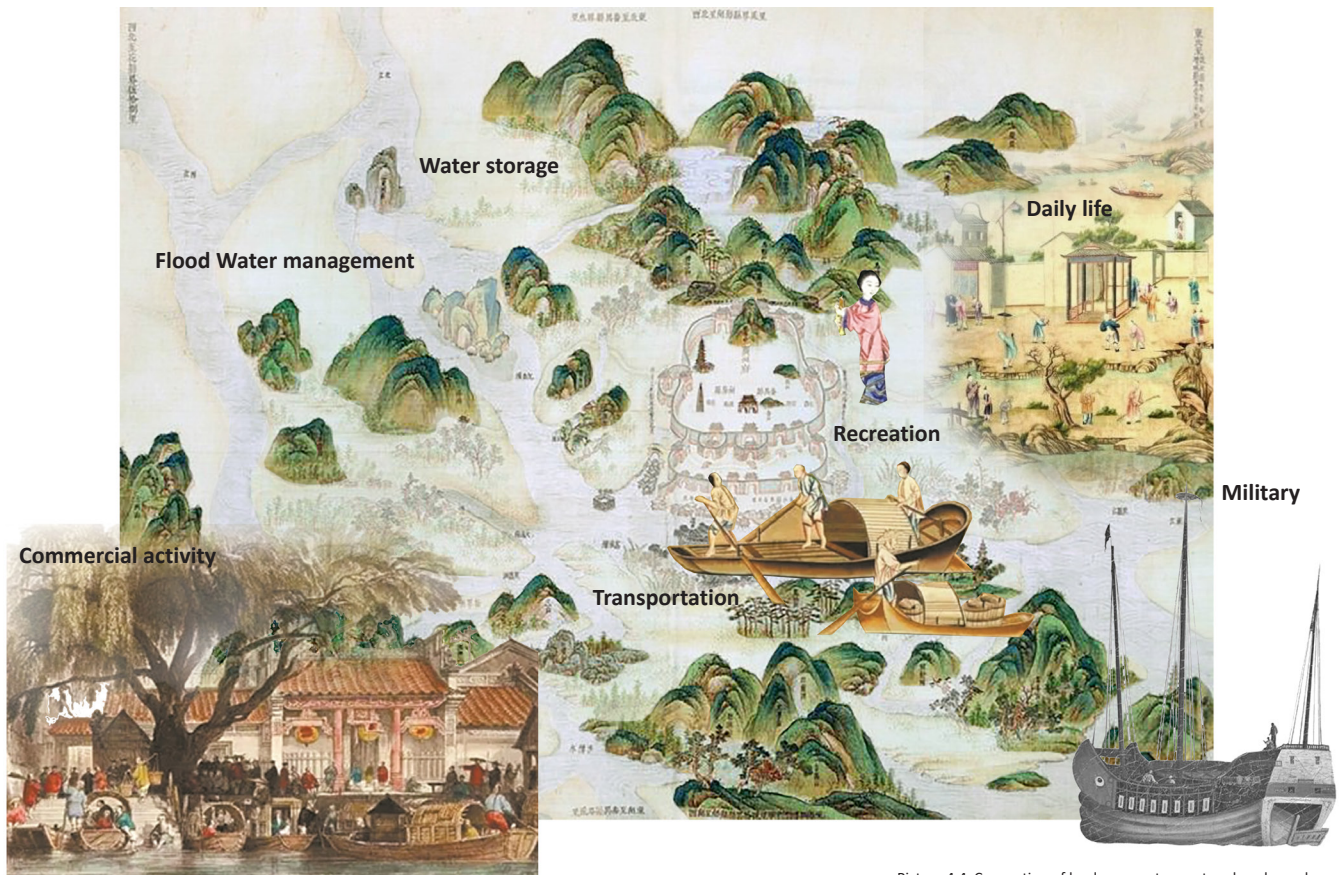
Parkway system



Recreation; historic landscape

Picture 4.3 Patches and conncion of Boston metropolitan park
Data source: <https://www.nps.gov/places/metropolitan-park-system-of-greater-boston.htm>
Image source: google picture

History wisdom



Picture 4.4 Connection of landscape-nature network and people
Image source: 广州府輿图, 1685 (old map of Guangzhou)
Redrawn by author

Landscape-Nature Network closely connected with people

The landscape-nature network in the past, as introduced in the previous chapter, is made up of mountains, rivers, natural areas, canals and traditional gardens. It's a complex social natural network. It is closely connected with people. The well-developed water network is the main traffic system for the ancient Guangzhou people. The mountain area is the origin of freshwater resources and provides good nature views. Urban life is connected to artificial canals and traditional gardens. The traditional ways of city construction show a more coherent nature-human relationship. The Landscape-nature network not only gave more space but also has multiple functions, like water storage, flood water management, recreation, commercial activities, military and transportation.

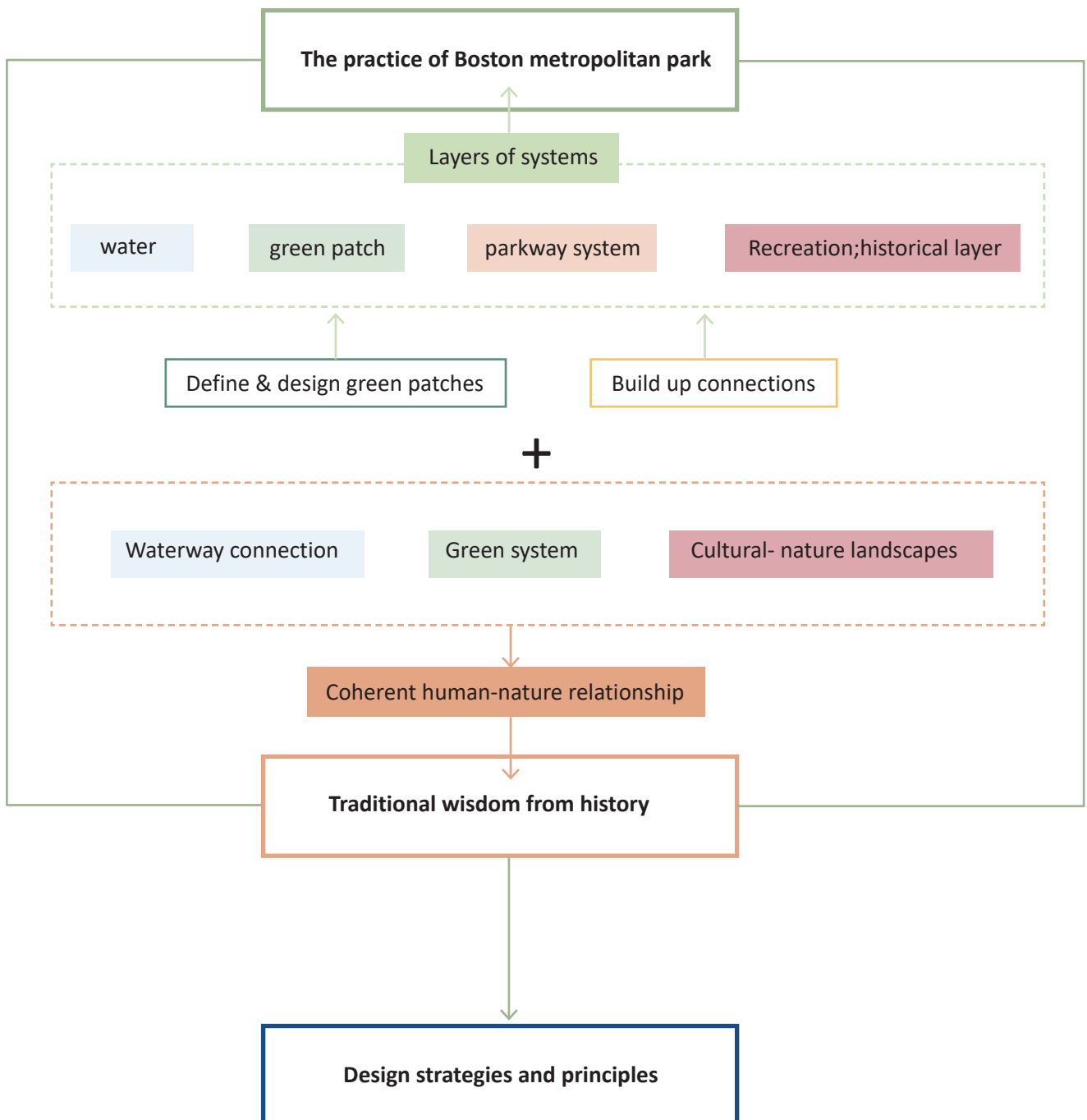


Diagram 4.1 Process for summarizing strategies and principles by author

Strategies and principles

The Boston Metropolitan Park and traditional wisdom from history provide lots of inspiration for this design project. For the Guangzhou Metropolitan Park, several strategies could be applied.

The first strategy would be preserving green patches and blue space. The landscape-nature network will be developed based on the existing green and blue space. So the first step would be preserving and ecological recovery of the green patches.

The second strategy is adding connections and neighborhood penetration. It means that different green connections (or blue connections) will be formed. Consequently, this strategy helps with creating the network. It also means that this network will benefit surrounding neighborhoods.

And the third strategy is to increase the resilience capacity of the network, which means that the design will transform the more decorative green space into more resilient spaces.

For the last strategy, the project will involve recreation and historic spots. The network will connect the historical sites and recreational areas inside the city using slow traffic way.

Related principles could be divided into three types. The principles for patches, the principles for connections and the principles for neighborhood penetration.

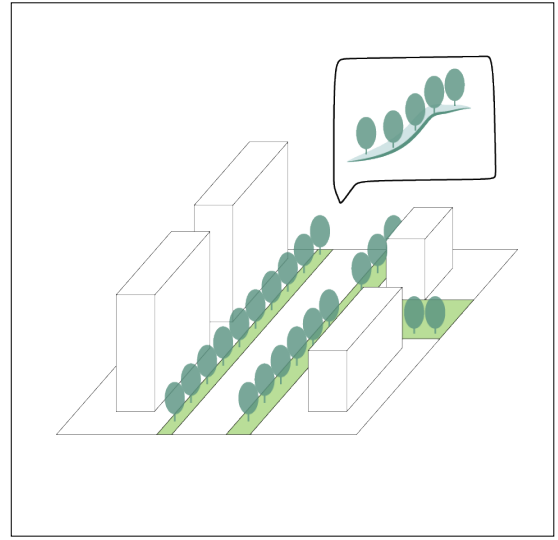
The principles for patches are related to water bodies, parks, informal greens and mountain areas. For the water body, the connection of the water system and softening the water edges are two principles. Other principles are about increasing biodiversity and stormwater management. The principles for connections are about the connection along the traffic system and the connection along the water, for example, increasing the sponge capacity along the road and softening the river bank. The principles for neighborhood consider making use of the space in the districts. Rooftop green, eco-parking lots and community gardens are among the principles.

Strategies

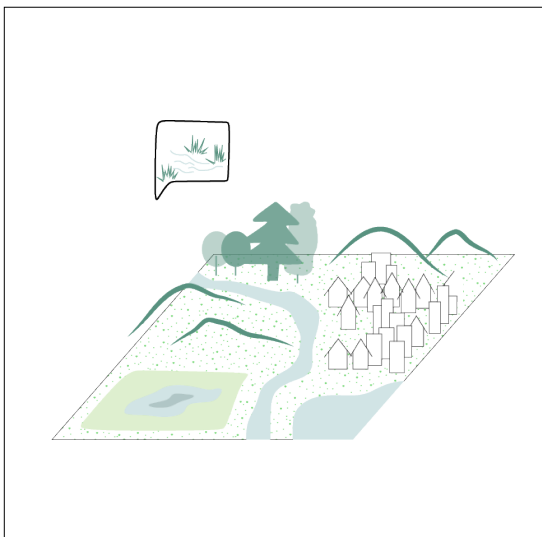
Preserve green patches and blue space



Add connections and neighborhood penetration



Increase the resilience capacity Ecological concern



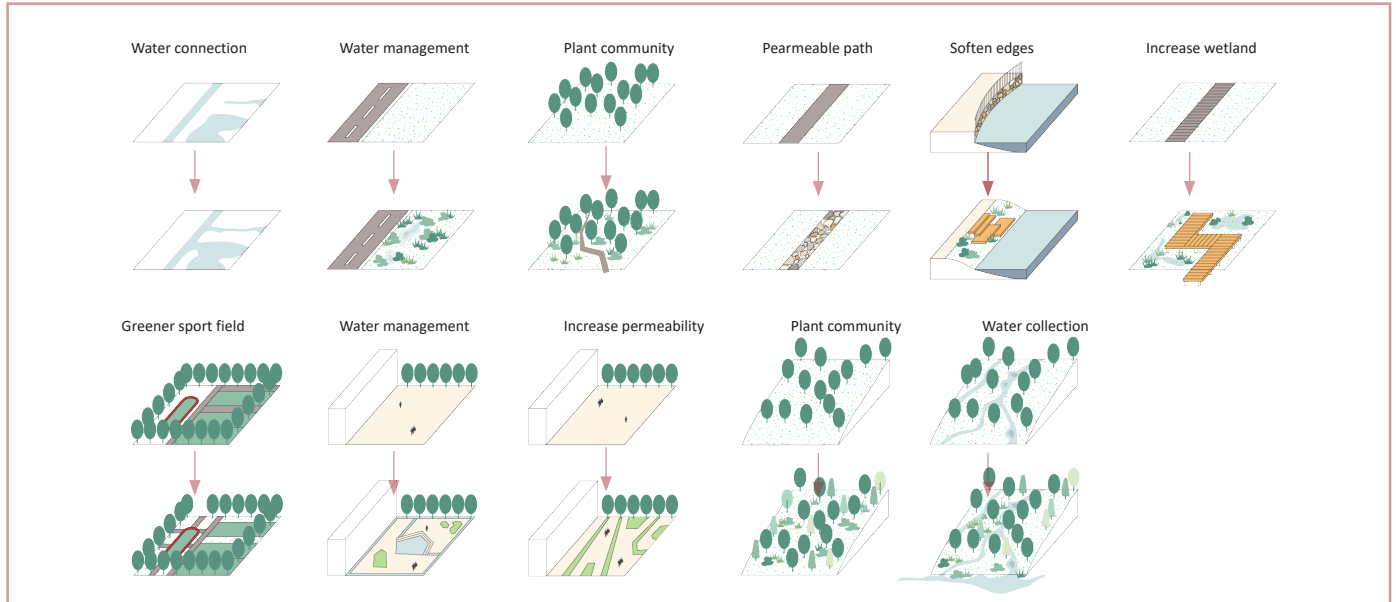
Involve recreation and historic spots



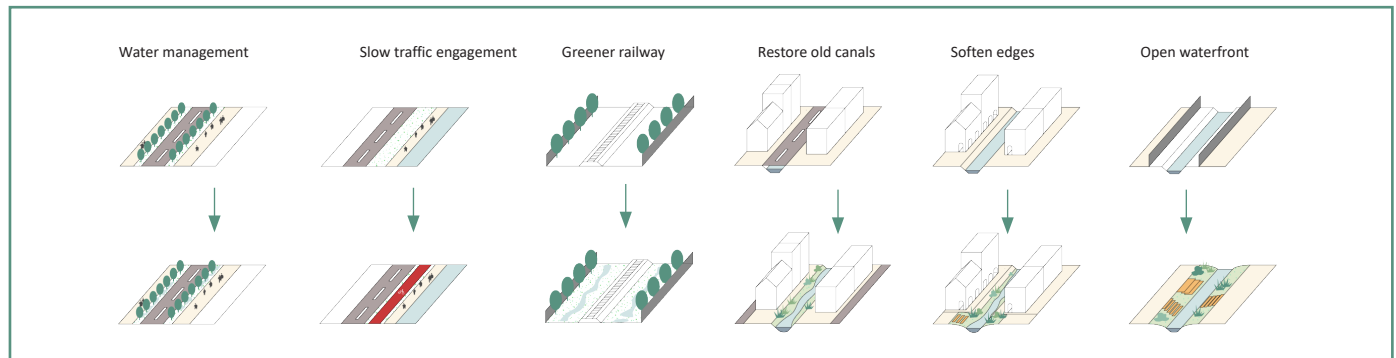
Picture 4.5 Strategies for Guangzhou metropolitan park
by author

Principles

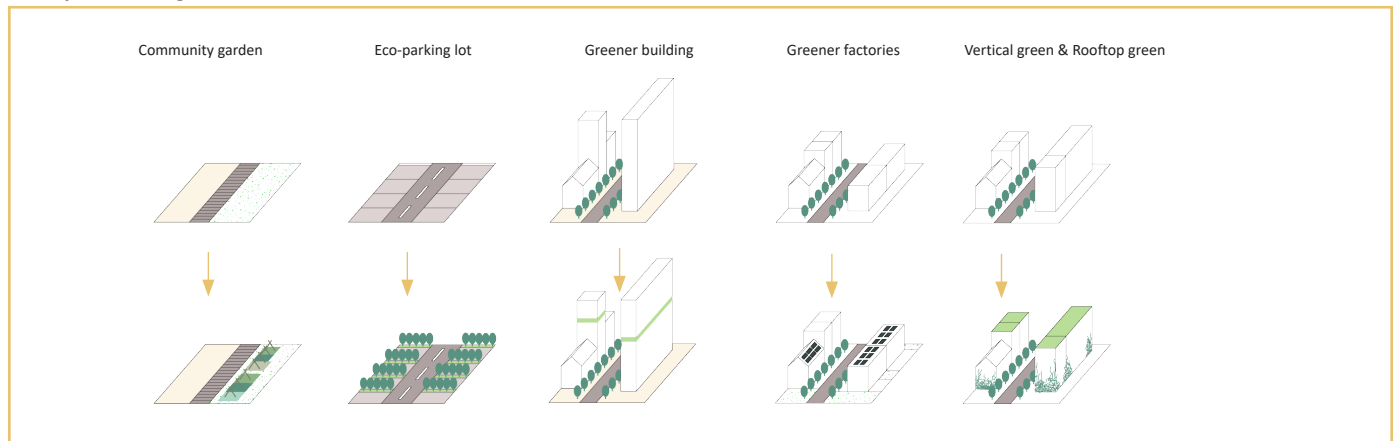
Principles for patches



Principles for connections



Principles for neighborhood



Picture 4.6 Principles for Guangzhou metropolitan park by author

Conclusion


This Chapter focuses on explaining how to create a resilient landscape-nature network. In this Chapter, the Boston Metropolitan Park is used as a case study. Boston and Guangzhou share some similarities. They both grow from a small commercial city into a metropolitan city. They are faced with problems like pollution and irrational urban land use brought on by fast urban expansion. These similarities make Boston Metropolitan Park an ideal case. This case shows how to utilize the existing natural resources of the city and how to create a metropolitan park system with the resources. To be more specific, it needs the reservation of forests, water bodies, and wildlands inside the city. It also requires a linear connection based on the water system or traffic system. For a metropolitan city, it is important to have this idea of creating a landscape system for future-proof development.

Based on the case study and other traditional wisdom from history, some general principles and strategies for creating a metropolitan park are proposed. Different strategies focus on preserving the resources and making connections in both natural and social aspects. Principles aim at practicing the strategies in different ways, in patches, connections and neighborhood penetration. This chapter is in response to Sub-question two. With the knowledge of principles and strategies for creating the Landscape-nature network, a more in-context explanation of the research will be explained in the next chapter.



Chapter 5

How to apply resilient design within context



Toward landscape-nature network in Guangzhou
Structure and strategies
Design exploration
--Pearl River waterfront corridor
--Cultural-historical center
Conclusion

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Chapter 5 will be the main design exploration part. From a regional scale to more local scales, the design exploration will show how the principles would work in different scales. It will explain how the design concept fits into the context of Guangzhou. This chapter aims at answering the sub-question 3, How can applying the landscape-nature network improve the urban environment and living conditions in Guangzhou through design?

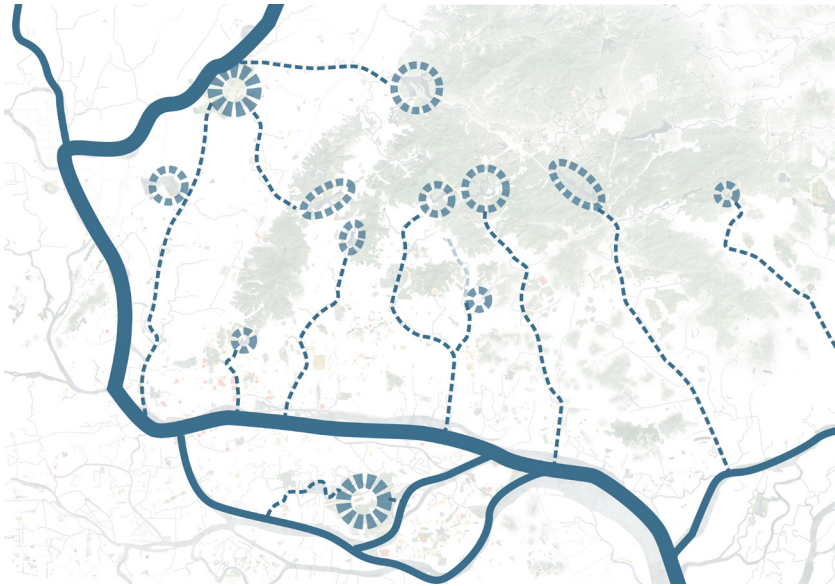
Toward Landscape-nature network in Guangzhou

With the knowledge base in the previous chapter, this chapter will introduce the design exploration of the landscape-nature network in Guangzhou. This Chapter will first show the regional planning of the Guangzhou Metropolitan Park. Then, it will explain the main structure of the regional plan. Then, it will use explain two of the more critical and problematical parts of the structure more in detail. The rest two parts will also be demonstrated with more general regional interventions.

The Landscape-nature network in Guangzhou is made up of three layers, the water layer, the green layer and the recreational & historical layer. Altogether, they create this Metropolitan park system in Guangzhou. For the water system, The design will create a blue system based on the rivers and reservoirs of the city. The water system will be connected, including the water bodies inside the city parks. This creates the backbone of the Landscape-nature network.

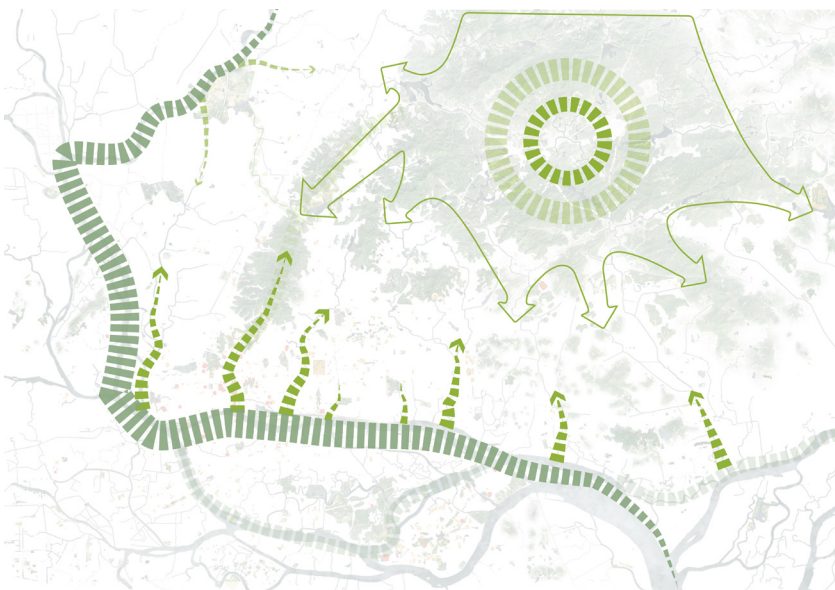
The green layer consists of mountain forests, parks inside the city and new green connections along the water or transportation system. The green layer will help with solving problems of green loss inside the city center. It is also an important way for improving the resilient capacity of the city to urban flooding and biodiversity loss. It also provides ecosystem service to the citizens in urban ecology and mitigation the negative effect of climate change. The northern mountain area will be the regional eco-habitat protection area. The green extends into the city from this big green core. The Pearl Riverfront will be a green corridor. This corridor also penetrates the city through green connections

As for the recreational and historical layers, the design will fully make use of Guangzhou's cultural characters. This layer will use slow traffic way to connect the cultural remains and recreational spots. The connection will use the green and blue layers as the base. City parks and the old city area will be the nodes of this layer. The regional map will be gotten by combining the three layers.



Water as the backbone

Picture 5.1 Water strategies for Guangzhou metropolitan park by author



Green patches and connections

Picture 5.2 Green strategies for Guangzhou metropolitan park by author



Culture identity and activity space

Picture 5.3 Social-cultural strategies for Guangzhou metropolitan park by author

Regional plan





Picture 5.4 Regional plan by author

Structure and strategies

The Landscape-nature network in Guangzhou contains four major elements as the basic structure, the eco-habitat protection area, Inner city riverfront connections, the Pear River waterfront corridor and the cultural-historical center in the old city of Guangzhou.

The eco-habitat protection zone in the northern mountain area is critical forest nature reserves and water resources of the city. Eco-habitat recovery in mountains and water collection are important in this area. The design aims at decreasing surface runoff and increasing the biodiversity in the eco-habitat protection zone.

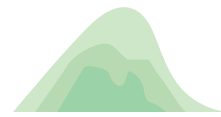
For the inner city riverfront connections, life along the water is the main concept. Many rivers run through different living blocks. Opening up the riverfront to people living nearby and ecological transformation of the banks will be considered as the methods for this part.

For both the mountain area and the inner city riverfront area, different stakeholders need to cooperate. The government and departments need to make policies for preserving and eco-recovery. Slight intervention for a better experience is also possible. This requires urban planners, designers and NGOs to work together.

The cultural-historical center, one of the more problematic areas for more detailed design, needs to arouse the historical memory. The design will relieve urban problems caused by the loss of green loss and create a slow-life historical city.

For the Pearl River waterfront corridor, flooding proof, green connection along the river and recreational line along the riverfront will be the main purpose. The Pearl River waterfront is one of the most important and representative waterfront spaces in Guangzhou. It also confronts severe problems. Thus, it will be another example of design exploration in detail. It will show how to implement the concept in regional planning into specific space design through scale.

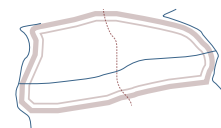
Eco-habitat
Protection
Zone



Life along
Water



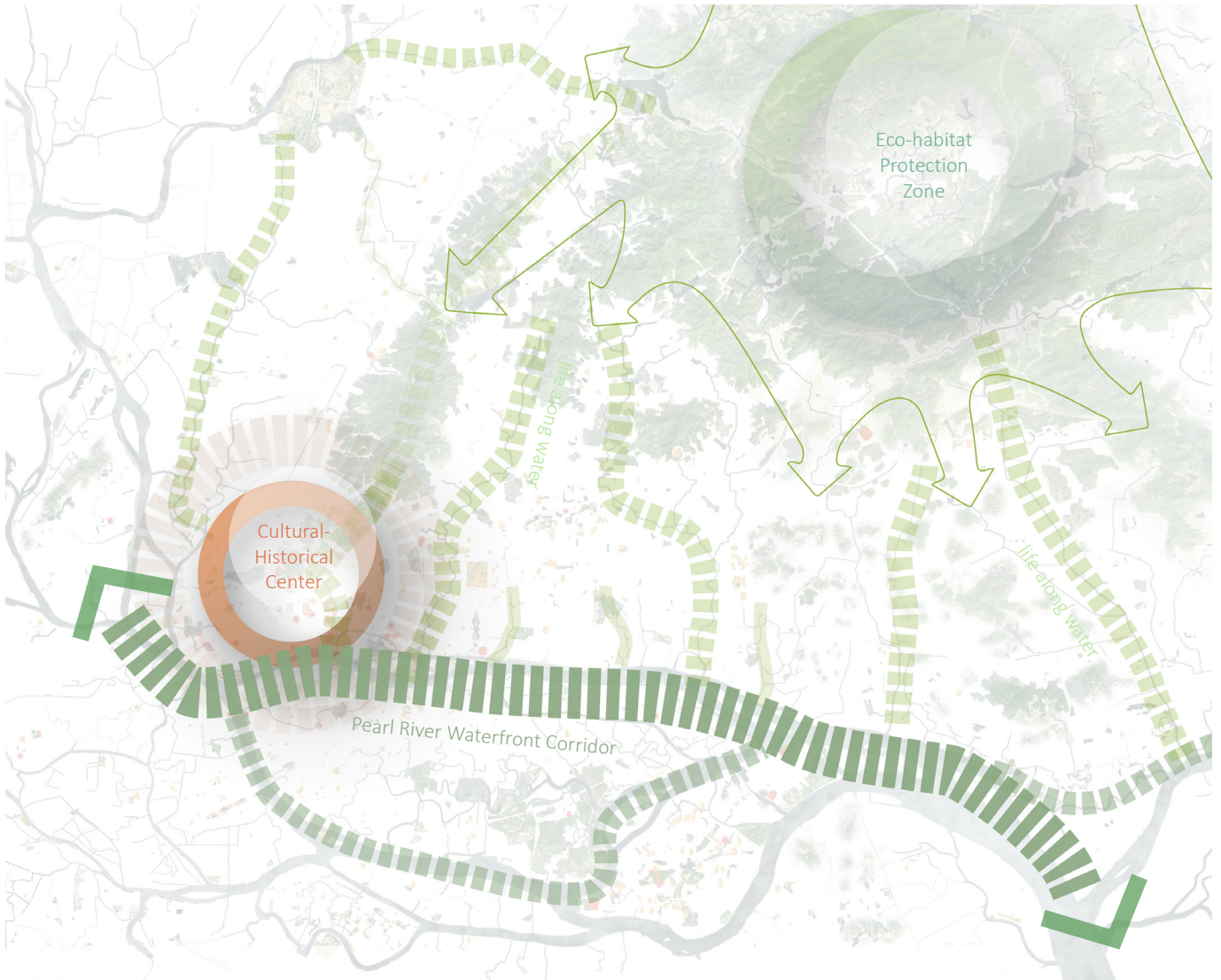
Cultural-
Historical
Center



Pearl River
Waterfront
Corridor



Structure of the Landscape-nature network



Picture 5.5 Structure of the regional plan
by author

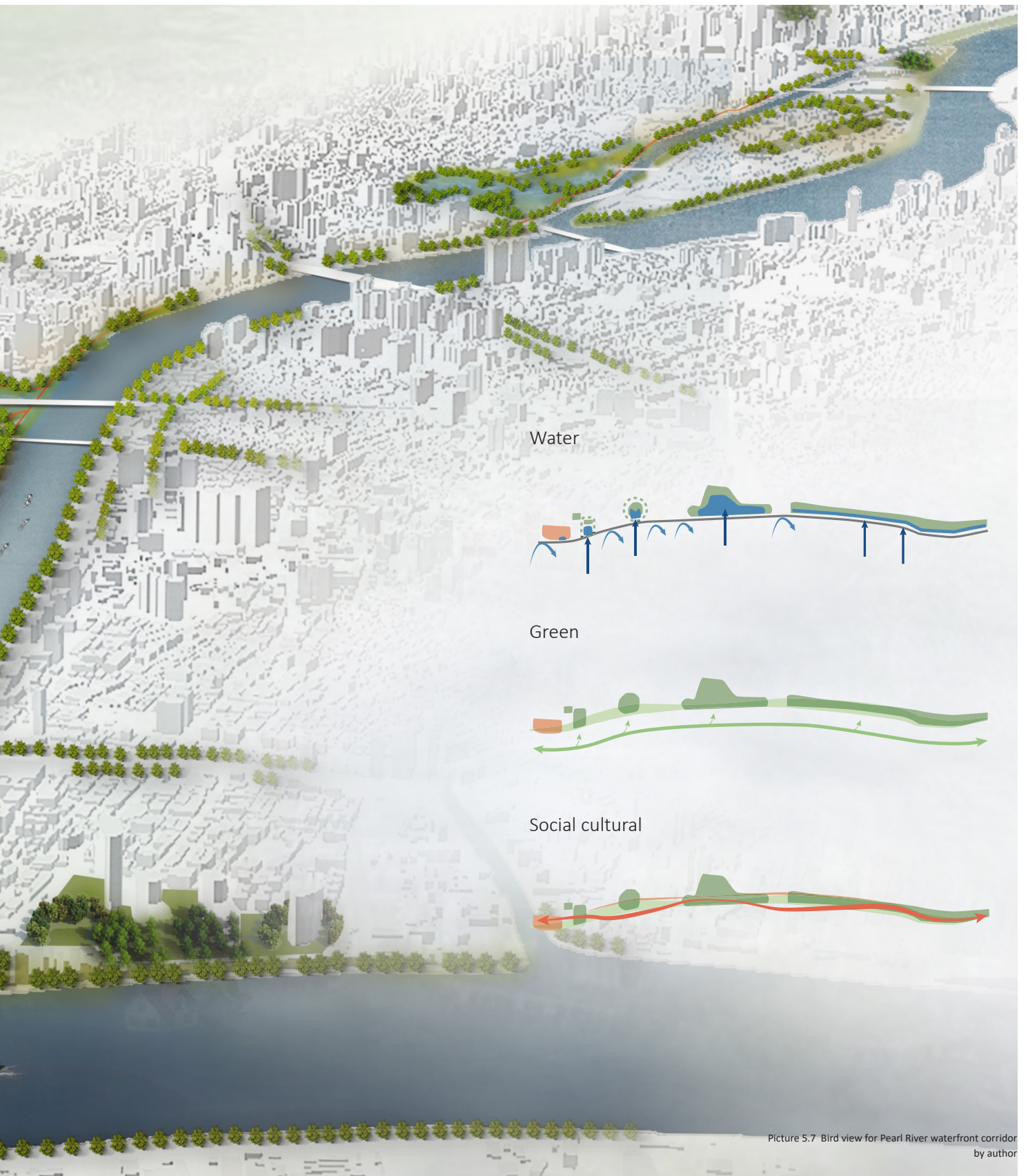
Strategies for the mountain and inner city rivers



Picture 5.6 Strategies for mountain and inner city riverfront
by author

Pearl River waterfront corridor





Water

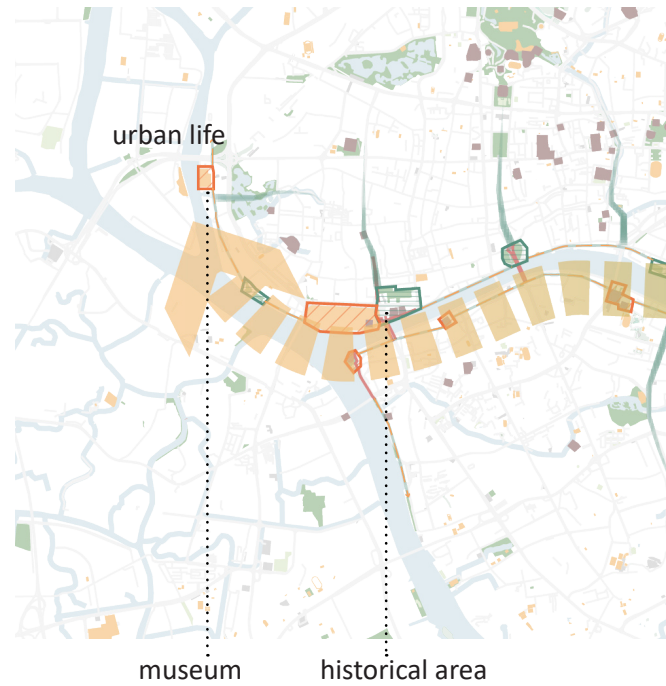
Green

Social cultural

Picture 5.7 Bird view for Pearl River waterfront corridor
by author

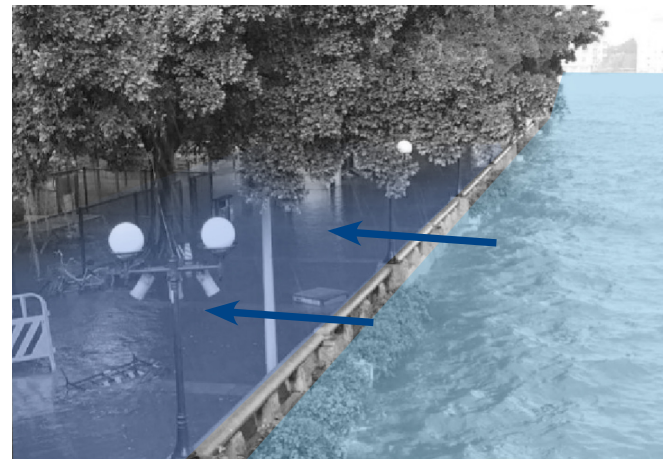
Pearl River waterfront corridor

The Pearl River waterfront corridor will create a linear riverfront park with multiple functions. Now the Pearl River waterfront area has mainly three problems. The first one is the flooding threat. Pearl River has a relative fluctuate water level. In high water level periods, roads and buildings along the river are at high flood risk. Especially on Typhoon days, the water will overflow the embankment along the river, causing floods to the riverfront area. The second problem is the impermeable surface. This increases drainage pressure in rain seasons. Besides, although there are open spaces and pedestrian ways along the river, they have relative mono-function. So, this new Pearl River waterfront corridor is needed in Guangzhou.

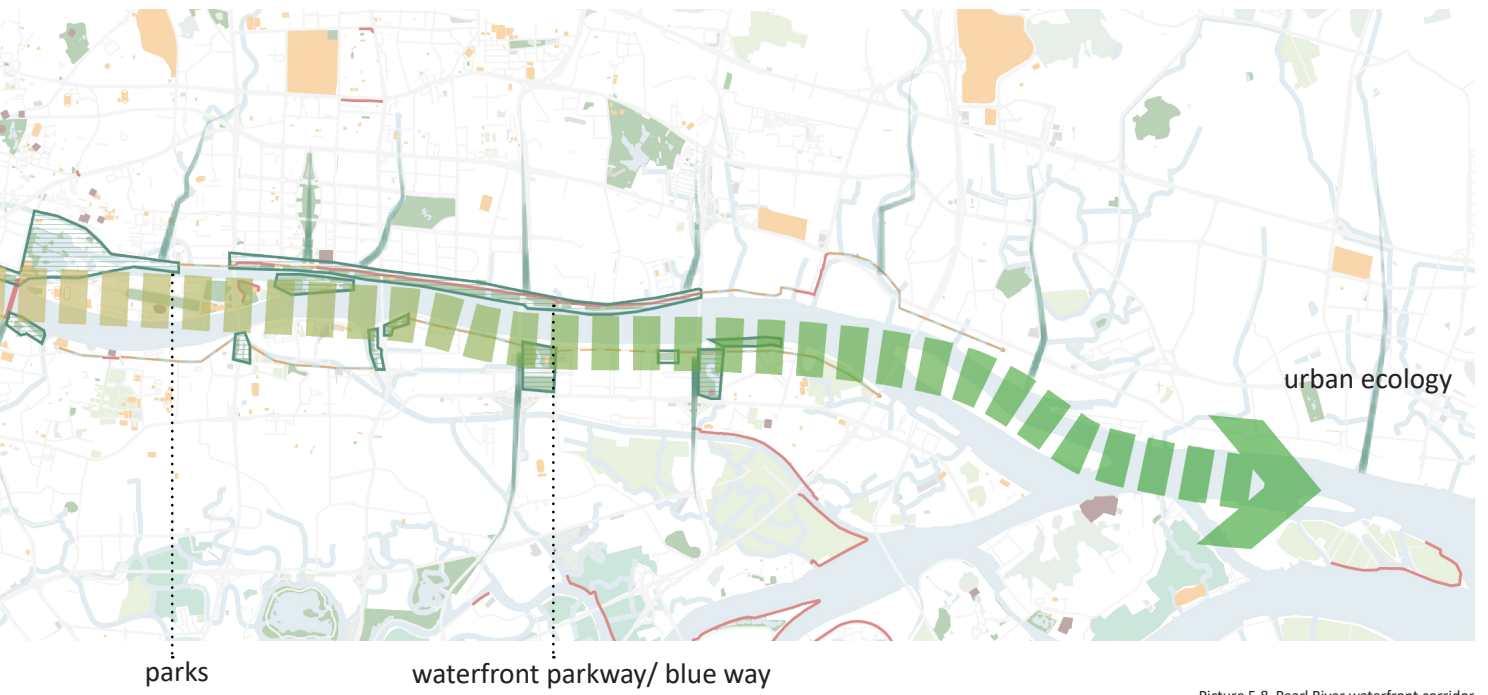


Strategies

The design strategy of the riverfront corridor echoes that of the regional design. It will intervene in the site from three levels of water, green and recreation. From the water perspective, the design will create more room for water and provide stronger protection against river floods. From the green perspective, the design will create green connections along the river to form a riverfront linear park. And for the recreation part, the design will also try to create diverse public spaces for citizens and recreational functions in this corridor. The new linear waterfront park will provide a stronger connection along the Pearl Riverfront area.



Flooding



Picture 5.8 Pearl River waterfront corridor
by author



impermeable surface



Monofunction

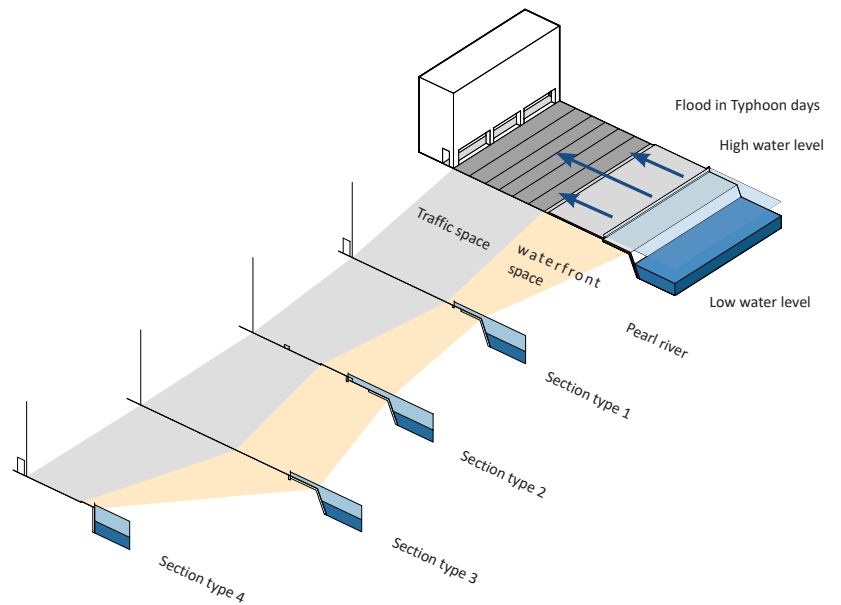
Picture 5.9-5.11 Pearl River waterfront problems
Image source: Google image
Redrawn by author

Pearl River waterfront corridor-protection

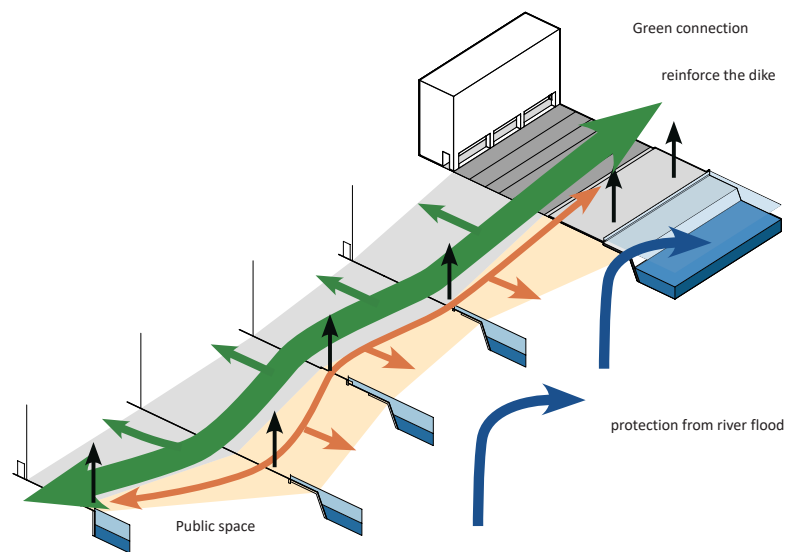
For the protected area, the research talks about four types of riverfront space, as shown in the sections. The Riverfront area is long and diverse. More possibilities still could be explored here. The design experiments with the four representing types, which means more flexibility for real situations.

The dike road along the river will be promoted for stronger protection against river flooding. A green connection will be formed along the dike. The riverfront area now mainly has traffic space and pedestrian space. The design aims to create a multi-function riverfront linear park, including traffic space, green space, recreational space and more public space. This could not only help with increasing the water infiltration but also create more livable space and improve the spatial quality.

The design here needs the collaboration of different stakeholders. The government along with the traffic department and water department need to make policies for the riverfront area. They also need to work together to reinforce the dike and provide financial and construction support. Designers and urban planners should help with design and provide a knowledge-based transforming plan. With the collaboration of different sides, the design could help the riverfront area to create a resilient waterfront corridor.



Picture 5.12 Pearl River waterfront current situation by author



Picture 5.13 Pearl River waterfront strategies for intervention by author

Traffic department



Water department



Government



Reinforce the dike

Policy making for riverfront area

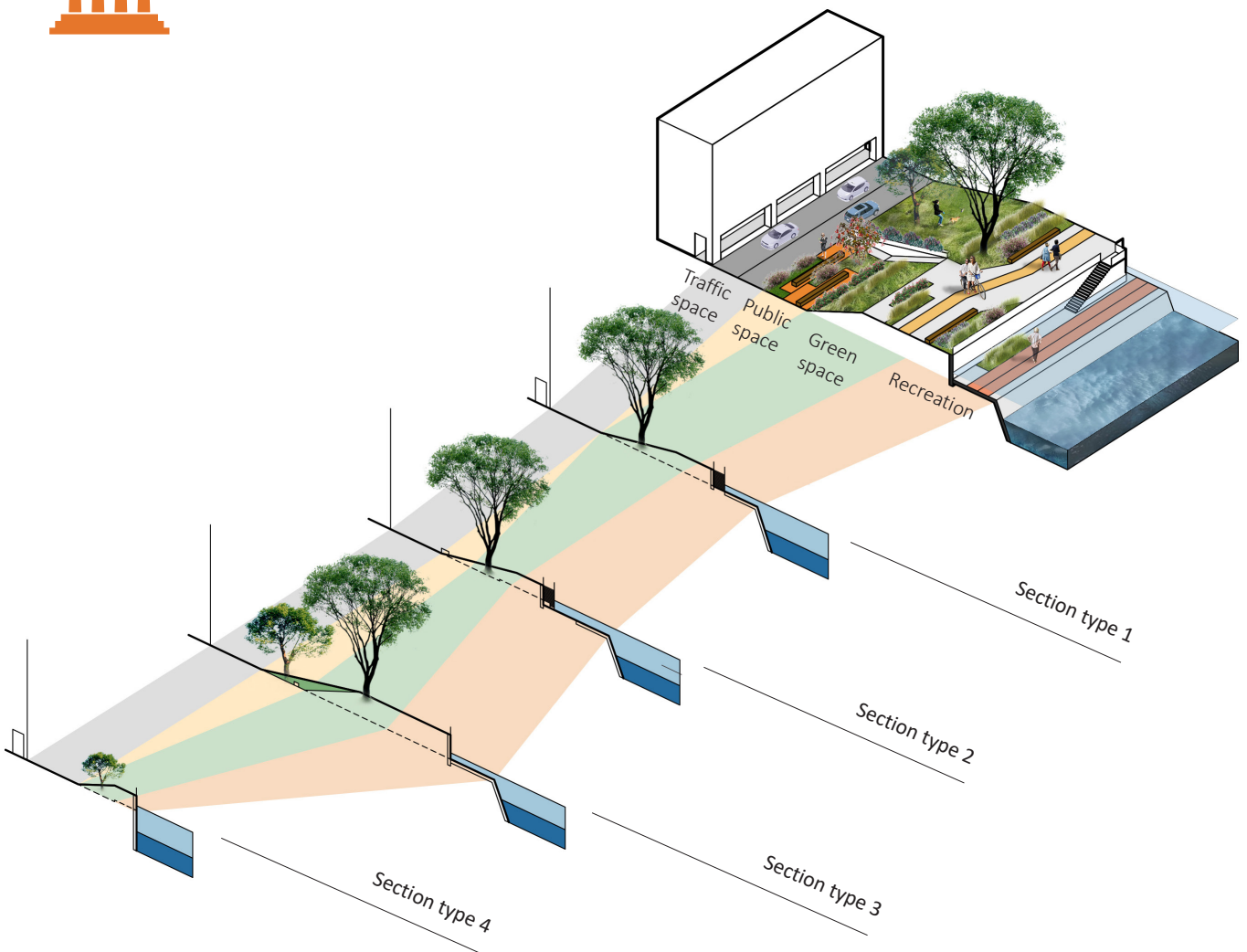
Financial and Construction support

Urban planner & designer



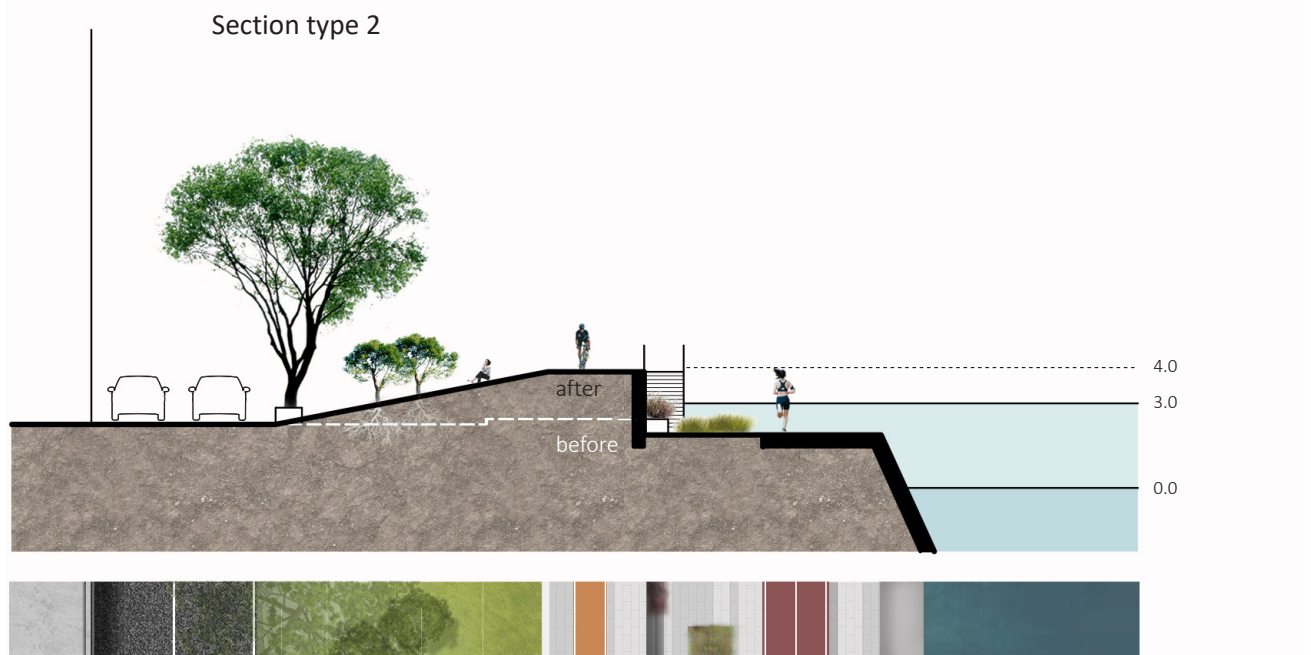
Design and educate

Knowledge and technical support

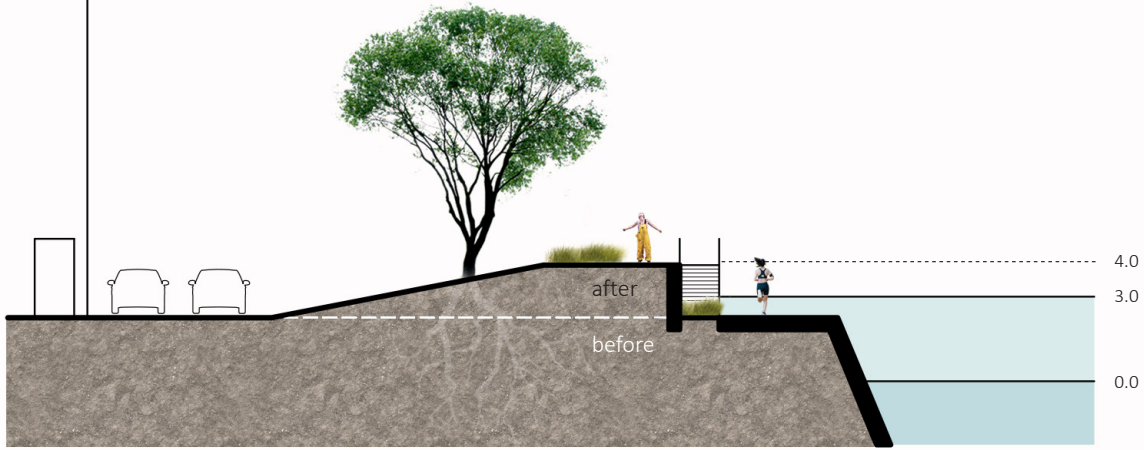


Picture 5.14 Design of Pearl River waterfront by author

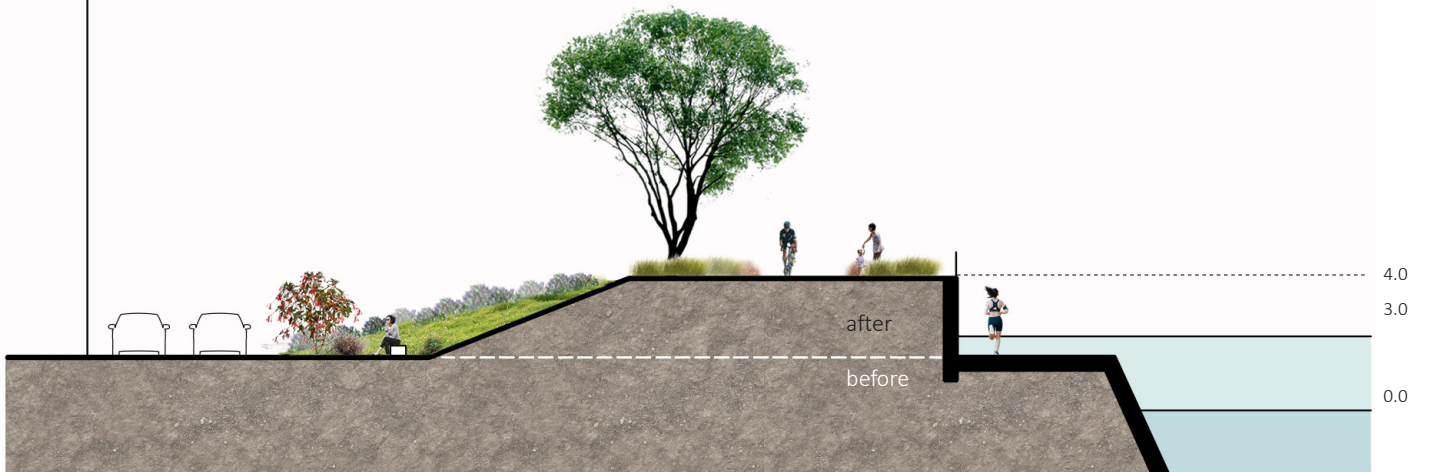
Pearl River waterfront corridor-Protection



Section type 1



Section type 3



0M 1M 5M

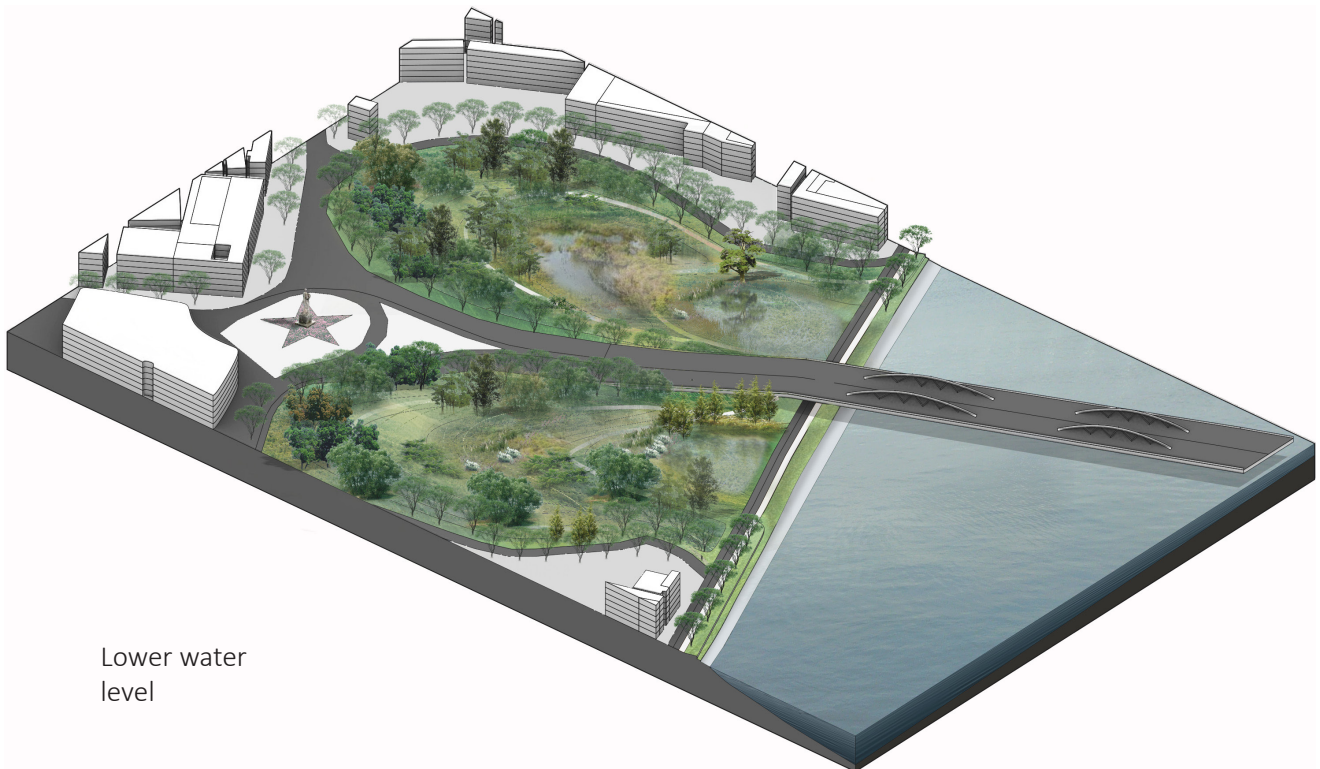
Picture 5.15 Design plan and detail sections of Pearl River waterfront by author

Pearl River waterfront corridor-floodable area

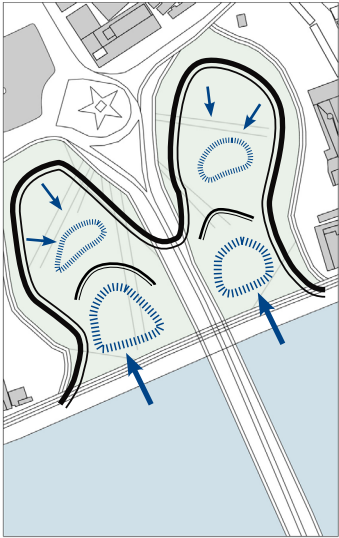
The floodable area will utilize the open space along the river, for example, the parks, squares and sports areas. This type of intervention is to give more room for water and to create a more resilient waterfront area. Haizhu Square is one of the most famous park-like squares in Guangzhou. It will be transformed into a floodable waterfront park. It will show different appearances with different water levels. It will also become a recreational wetland park that can provide multiple ecosystem services.



Current situation



Lower water level



Water



Green

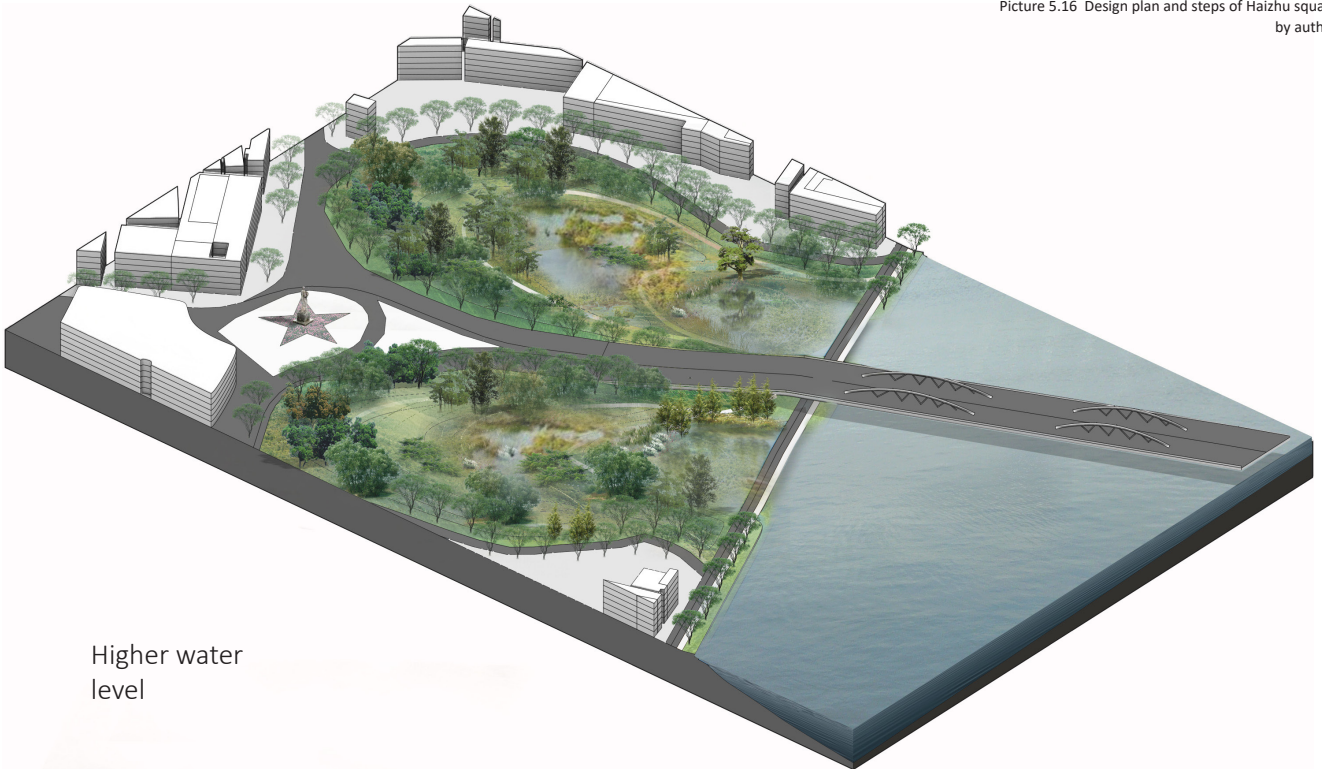


Recreation



0M 10M 50M

Picture 5.16 Design plan and steps of Haizhu square by author



Higher water level

Picture 5.17 Design of Haizhu square in flooding and dry situation by author

Cultural-historical center



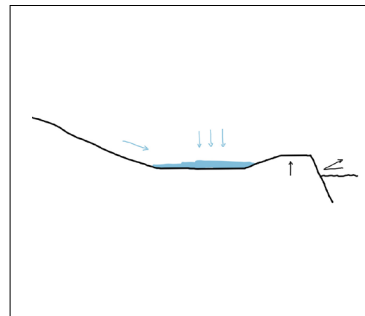


Picture 5.18 Bird view for Culture-historical city center
by author

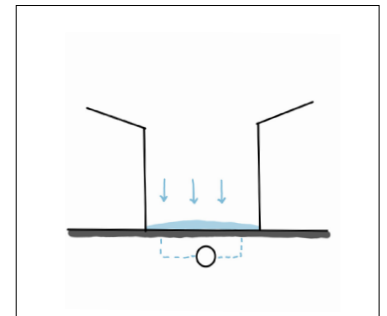
Cultural-historical center

The old city of Guangzhou has a very long construction history. However, it encounters lots of problems. Stormwater flooding is one of the most serious problems. Besides, the old city center of Guangzhou also suffers from lacking green connection and historical memory loss.

There are many reasons behind this. The old city center is relatively lower than the surrounding mountains and river dikes, which makes the area easy to flood. The urbanization of the old city center happened early. As introduced in the previous chapter, many canals were transformed into paved pedestrian roads. And when they started to build this modernized city in the last century, they did not concern about the sponge capacity of the city. The old infrastructure is also incapable to undertake increasingly strong pressure of flood threats. The reasons mentioned above show the insufficient green-blue infrastructure in the old city. The need for a stronger landscape-nature network inside the old city center is urgent.



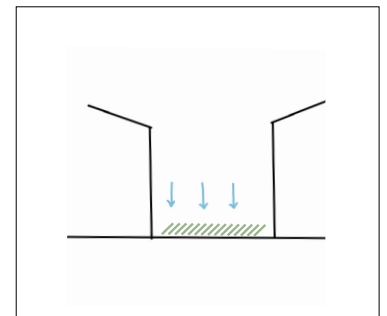
Topography



Old infrastructure



Covered waterway



Lack of sponge capacity

Picture 5.19 Problem reasons for the old city center
by author



Storm water flooding



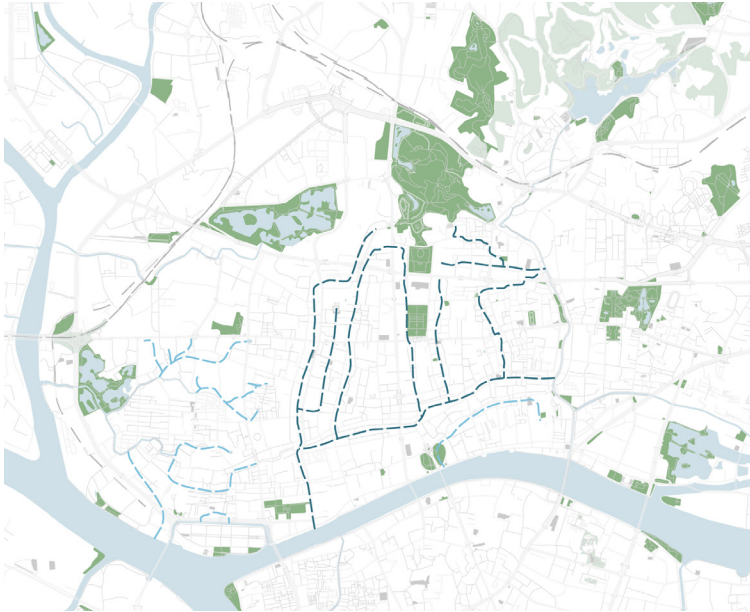
Lack of Green connection



Historical memory loss

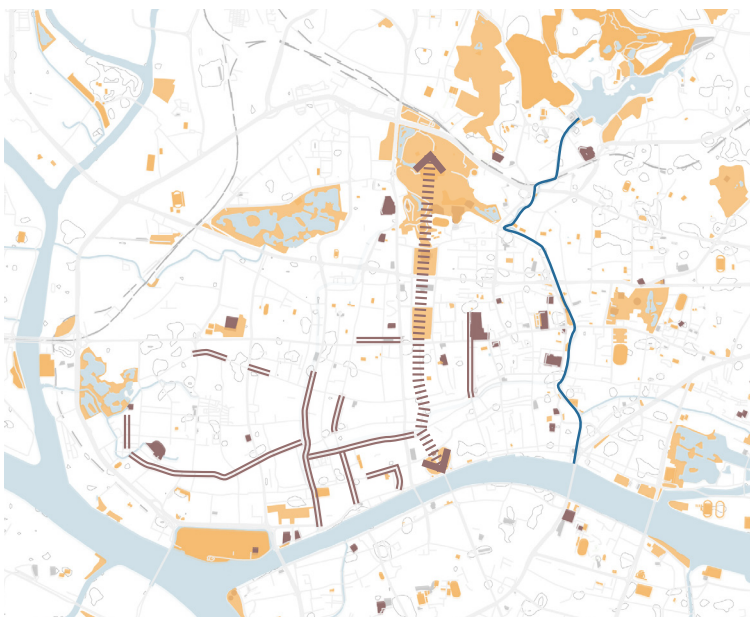
Picture 5.20-5.22 Old city center problems
Image source: Google image

Flooding & disappeared waterways



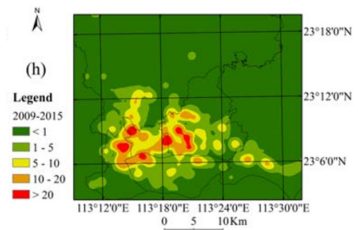
Picture 5.23 green spaces and disappeared waterways by author

historical area and recreational spots

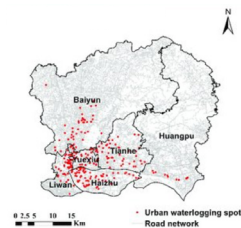


Picture 5.26 Historical area and recreational spots by author

0M 500M 1500M



Picture 5.24 Overall urban flooding area
Image source: chrome-extension://efaidnbmnnnibpajpcglclefindmkaj/https://gp.sysu.edu.cn/sites/gp.live.dpcms4.sysu.edu.cn/files/inline-files/HuangH_WangX_2018_STE_The_changing_pattern_of_urban_flooding_Guangzhou_China.pdf



Picture 5.25 Urban water logging risk spots
Image source: https://www.researchgate.net/publication/325198553_Effects_of_Impervious_Surface_on_the_Spatial_Distribution_of_Urban_Waterlogging_Risk_Spots_at_Multiple_Scales_in_Guangzhou_South_China

The places easy to flood mainly concentrate in the west and along the original Xihaochong River. As explained before, lots of canals were covered in the old city center. more space for water is needed under this condition.

The old city center has a rich culture and historical nodes. The historic relics recreation spaces and old Unique Qilou streets all add colors to the local culture. The old axis of Guangzhou is also here, which goes from Yuexiu Mountain to Zhongshan memorial park, and then to Haizhu Square. The only remaining part of the famous Six vein canal also tells the story of Guangzhou's rich and colorful history. They have the potential to be further developed into a slow-life city system.

Challenges and potentials in the old city center



Overlapping the analysis of the old city center, I got the map of the challenges and potentials in the old city center. The map shows areas easier to be flooded in light blue color. It also describes the green patches, recreational and historical patches and water bodies. It points out some linear elements inside the city, eg. distinctive streets, historical waterways and the streets.

To protect the city from stormwater floods, it is important to hold rainwater where it is to relieve the draining pressure of the west area. Because the old city has many historical remains and green patches, it's essential to emphasize the cultural identity and reinforce the recreation and green layer inside the old city.

Strategies for the Cultural-historical center

step 1 regeneration of old canals

Xihaochong River and Yudaihao River are now underground waterways. They used to be the west and connecting branches of the Six-vein canals. The design will recover the two canals to give more room for water in the urban context.

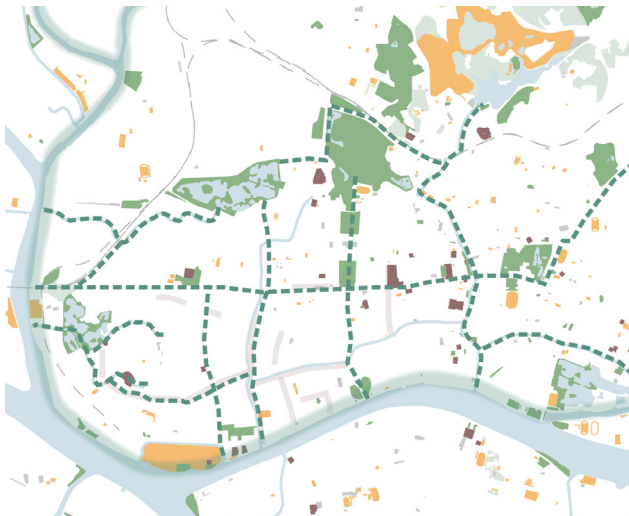
Picture 5.28 Water strategies for the old city center
by author



step 2 improve sponge capacity

Then the design will make use of the green patches and informal greens inside the city. Meanwhile, the design will try to increase the sponge capacity of some decoration greens inside the city. The green connection will be formed to connect the green patches to create a new green layer.

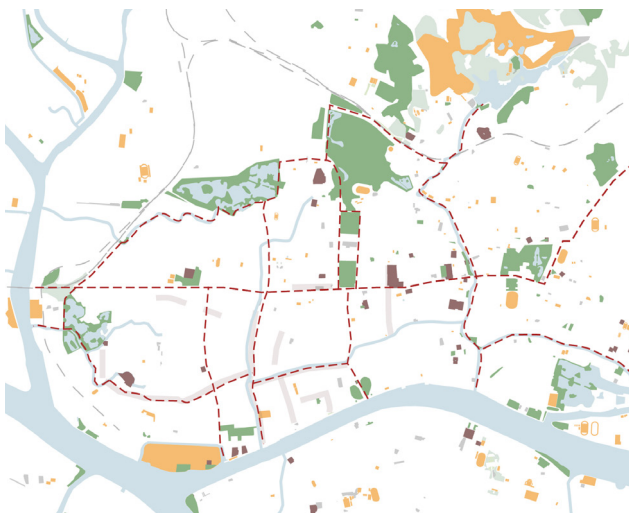
Picture 5.29 Green strategies for the old city center
by author



step 3 slow-life historical city

The design not only focuses on the green-blue infrastructure of the city. To create this landscape-nature network inside the city center, cultural-historical elements are also crucial. The slow traffic system will be created based on the blue-green layers and the historical nodes and recreational spots. The main idea here is to create a slow-life culture-historical center in the old city.

Picture 5.30 Social-cultural strategies for the old city center
by author

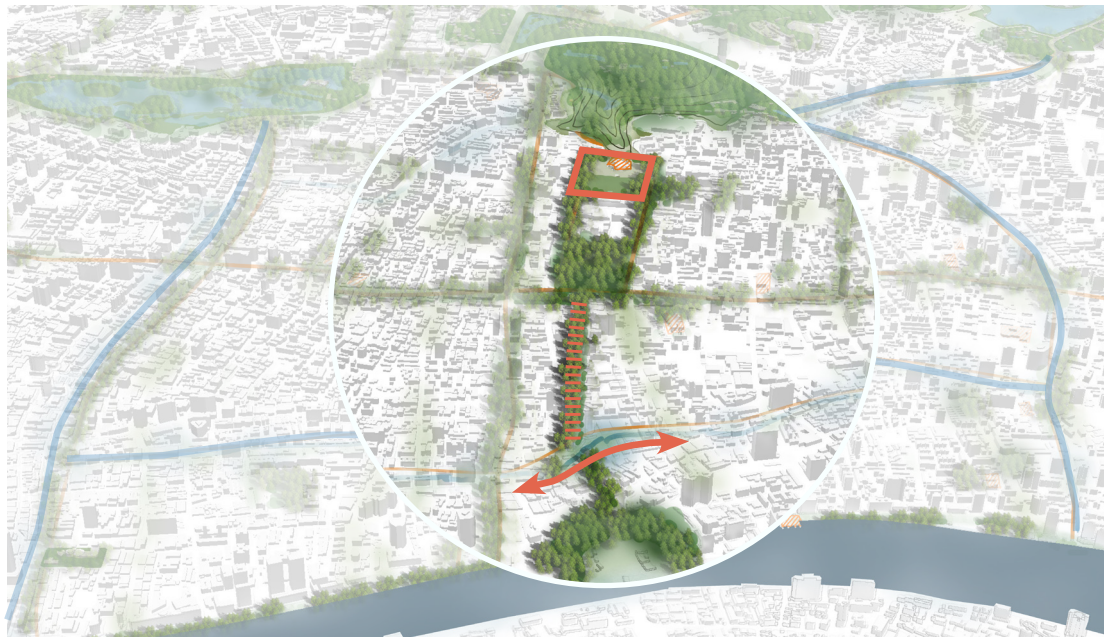


Pilot project-old axis of the historical city

Zhongshan memorial park

Street tranformation

Yudaihao recovery



Picture 5.31 Axis of the old city center
by author

In the old city center, the transformation of the old axis of the city will be the pilot project. The research will explain how the green patch, green connection and neighborhood green blue system are designed strategically with this pilot project.

The design exploration will follow the planning proposal on the regional scale and try to apply strategies and principles to different scales.

Guangzhou has a long history of managing waters. In the archaeological remains of the Nanyue palace, archaeologists have already found a well-designed recreational water system in the garden. Besides, they also had the wisdom to drain and reuse rainwater with gutters and circular drainage ducts, which could store the rainwater for other daily use, eg. watering flowers. Thus, the design will try to apply this traditional wisdom of water management.



Gutter

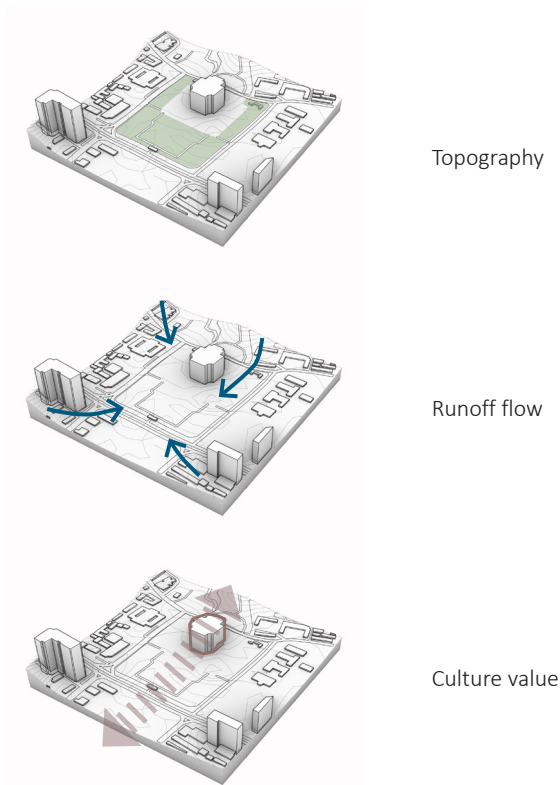
Circular drainage duct

lake

creek

Picture 5.32 History water design and storage in Nanyue palace
by author

Green patch- Zhongshan memorial square



Topography

Runoff flow

Culture value

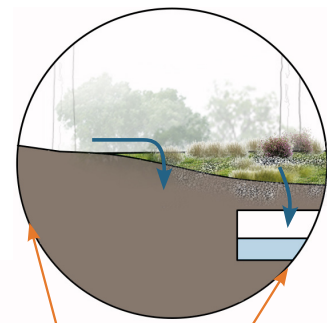


0M 10M 50M

Picture 5.34 Design plan of Zhongshan memorial park by author

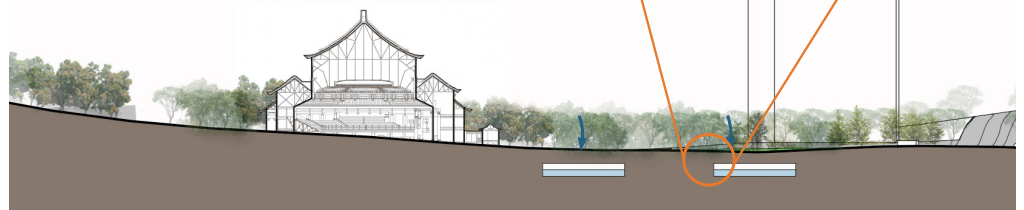
Picture 5.33 Topography, runoff and culture value of Zhongshan memorial park by author

The Zhongshan memorial park is relatively lower than the surrounding area. To increase the sponge capacity, the design will transform the well-maintained decoration grassland into a rain garden, which could hold and store stormwater. Then the water will go to the underground water tank for further use or be transported to the drainage system. These actions will relieve the pressure of the drainage system and fully make use of the urban green space.



Picture 5.35 Sections of Zhongshan memorial park by author

After



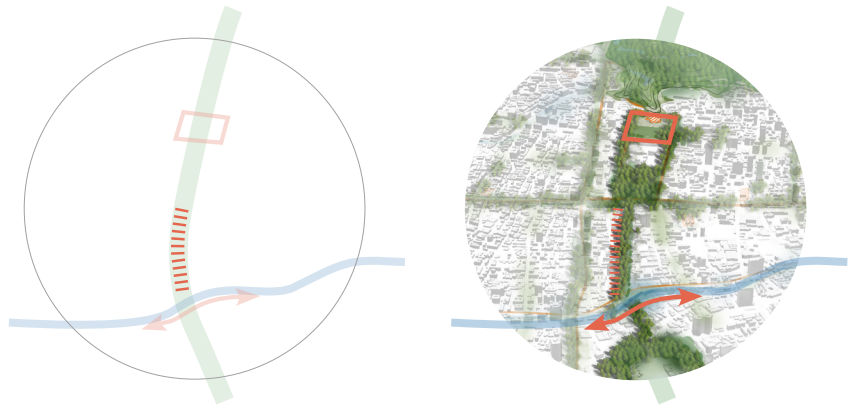
Before



0M 10M 50M

Connection- street transformation

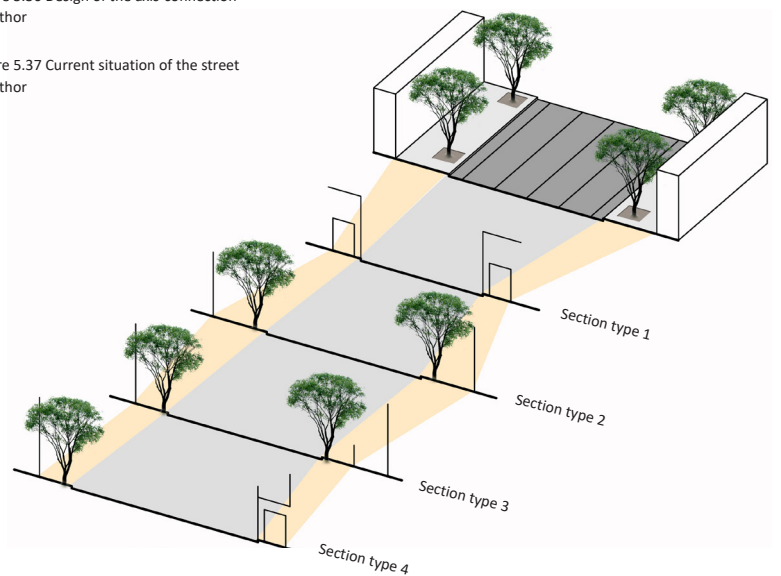
The street transformation shows how the design makes a linear green connection along the old axis of the city. The project talks about four types of traffic space and their transformation, as shown in the sections. The research aims at elaborating on possibilities to apply principles in the urban context here and tolerates more flexibility for real situations.



Picture 5.36 Design of the axis-connection by author

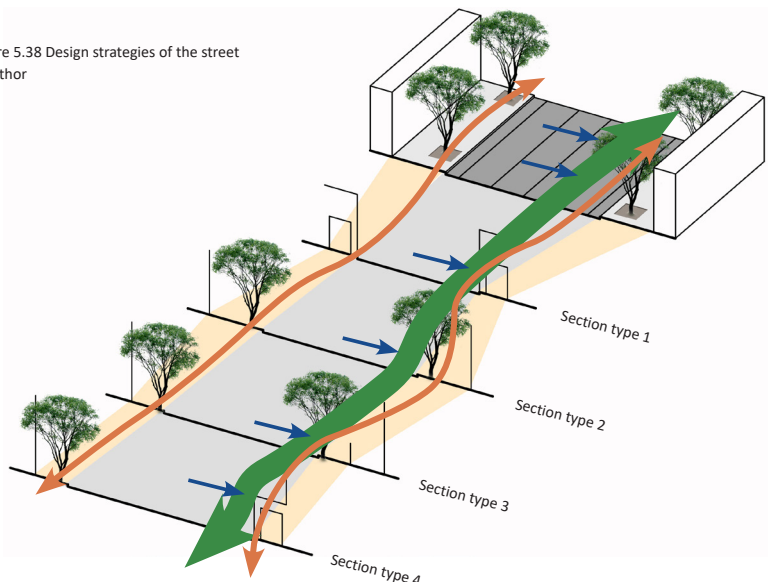
The road space has slight changes, as is shown in the sections. And the function here is to provide traffic space for vehicles and pedestrians. The design will form a new green connection along the old city axis. Considering the importance of the axis, more room will be given to green space and people instead of cars. One traffic lane will be removed. Then, the design will create a multi-function roadside linear park. This could deal with urban stormwater management by increasing water infiltration and storage. It also creates a healthier urban environment and better spatial quality.

Picture 5.37 Current situation of the street by author



Different stakeholders need to work together. The government and traffic department, forest department and water department need to work together to provide financial and construction support. Designers work on the design and provide a knowledge-based transforming plan. With the collaboration, the design aims at creating a greener and more resilient urban environment.

Picture 5.38 Design strategies of the street by author



Traffic department



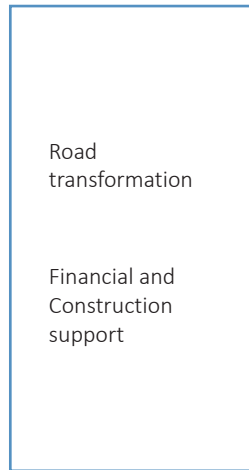
Water department



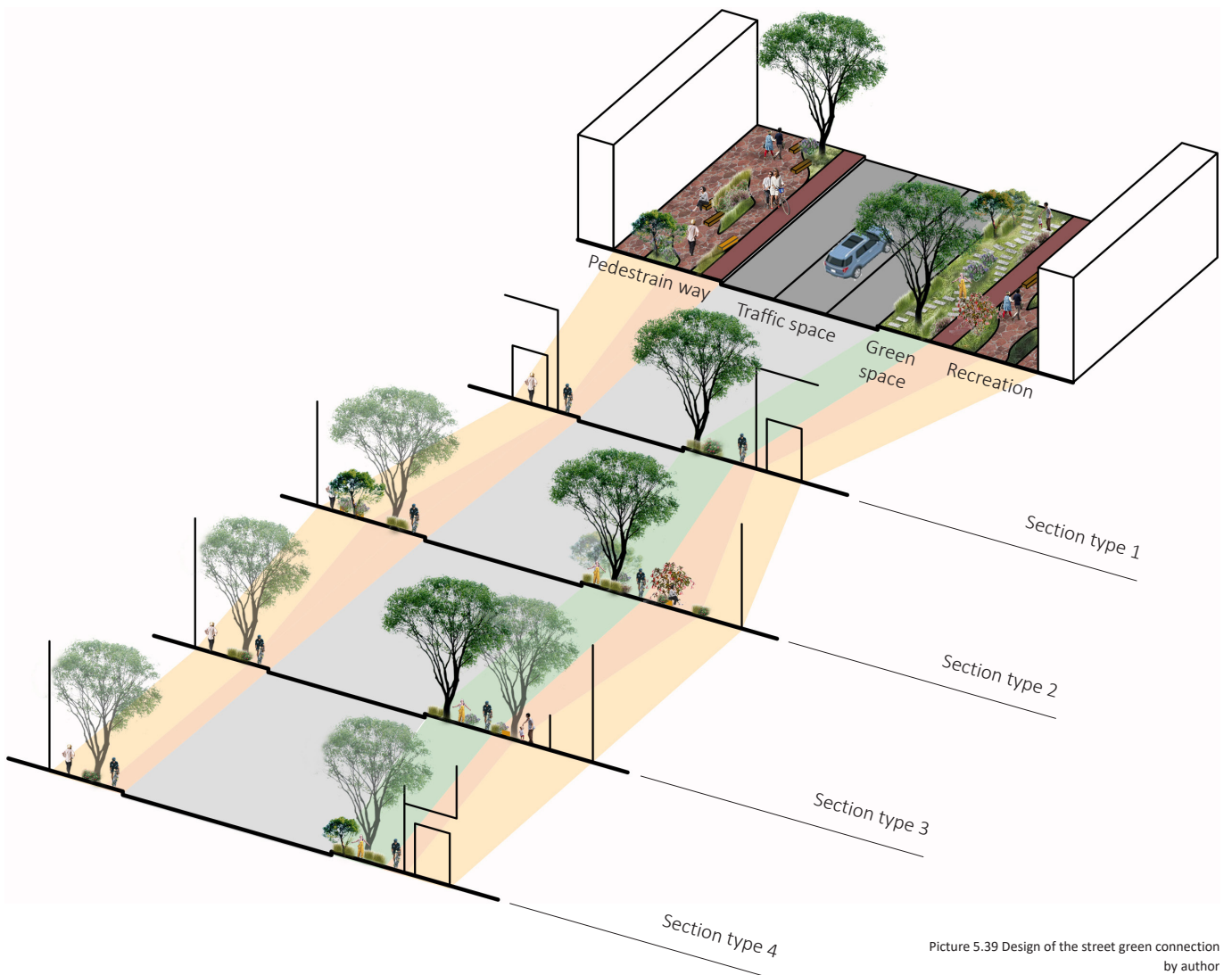
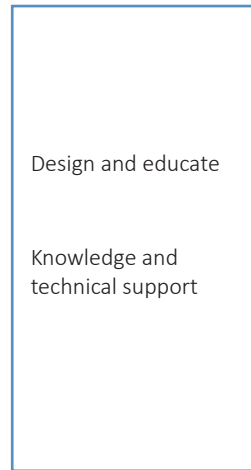
Government



Forestry department



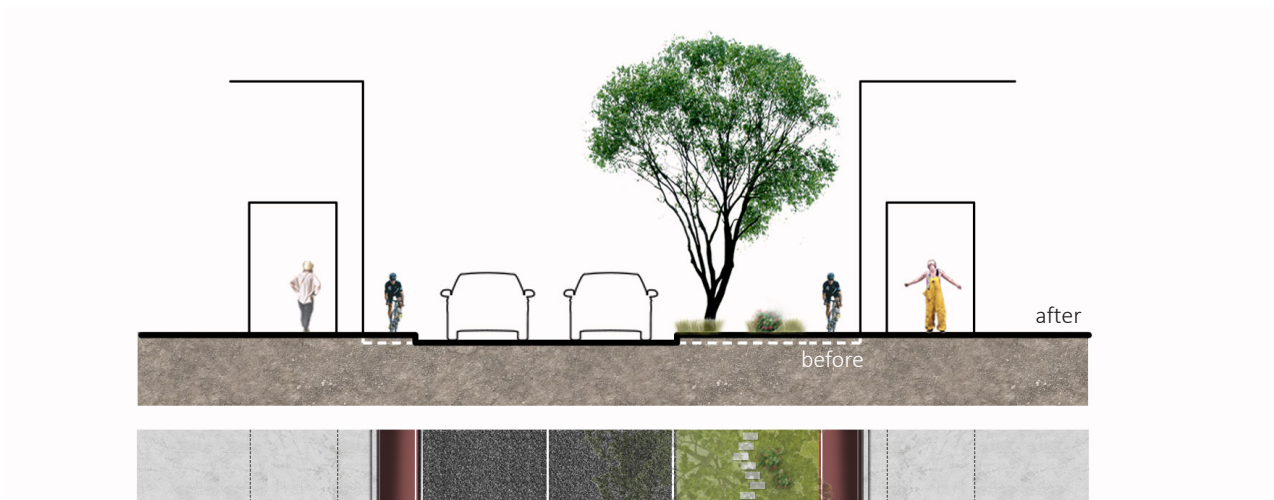
Urban planner & designer



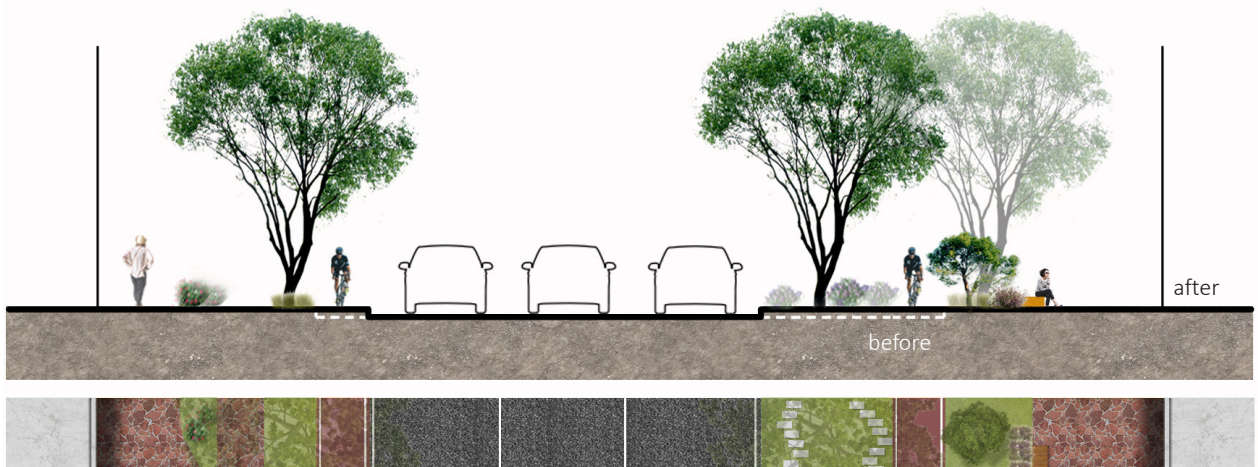
Picture 5.39 Design of the street green connection by author

Connection- street transformation

Section type 1



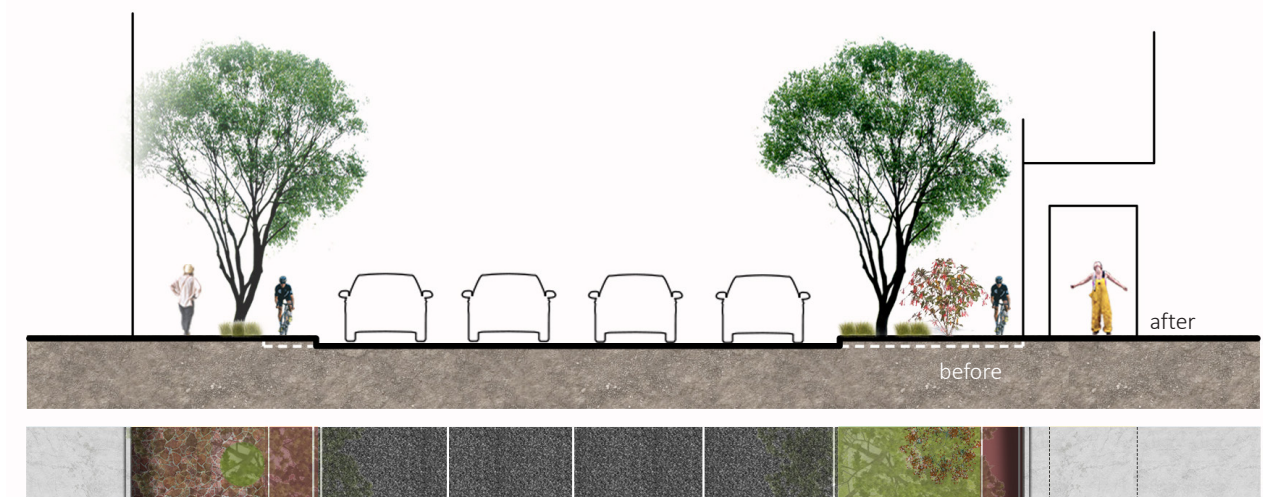
Section type 2



Section type 3



Section type 4



0M 1M 5M

Picture 5.40 Design plans and detail sections of the street green connection by author

Neighborhood green-blue system

At the transaction of the original Yudaihao Canal and the old axis lies some old communities. In response to the regional plan and strategies, the design will recover the Yudaihao Canal. At the same time, as part of the old city axis, the design aims at creating a green-blue system in the neighborhood for a more resilient urban environment.

History

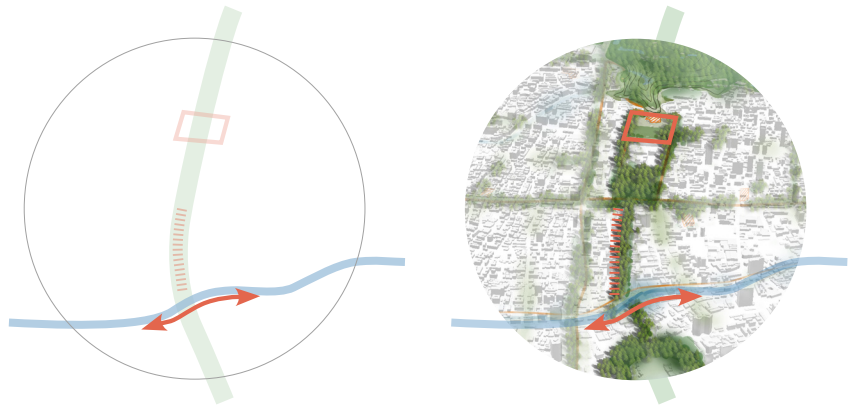
Yudaihao Canal was a very important waterway in the past. It used to connect the Xihaochong (West Canal) and the Donghaochong(East Canal). And it was a busy transportation way. Then, it degraded gradually. Nowadays, it has been turned into an underground water tunnel.

Strategies

Align with the planning strategy, the design will take into account water, green and recreation aspects. Considering the historical value and the need for holding more water, the Yudaihao River will be recovered.

As part of the old axis, green connection and neighborhood green will also be used here. The design will create linear green space along the road and the canal in the neighborhood. Rooftop greens and informal greens are also useful for improving neighborhood living quality.

This will create new connections along the old axis and the neighborhood. It will follow the regional plan, creating more recreational space and making use of the existing space. In the western part, squares and bridges are for the commercial need. In the east, natural banks and water space will be created for the community.



Picture 5.41 Design of the axis-yudaihao neighborhood by author

Picture 5.42 Canal in the past
Retrieve image from Google picture



Picture 5.43 Degrading Yudaihao
Retrieve image from: https://www.sohu.com/a/323463458_100020262

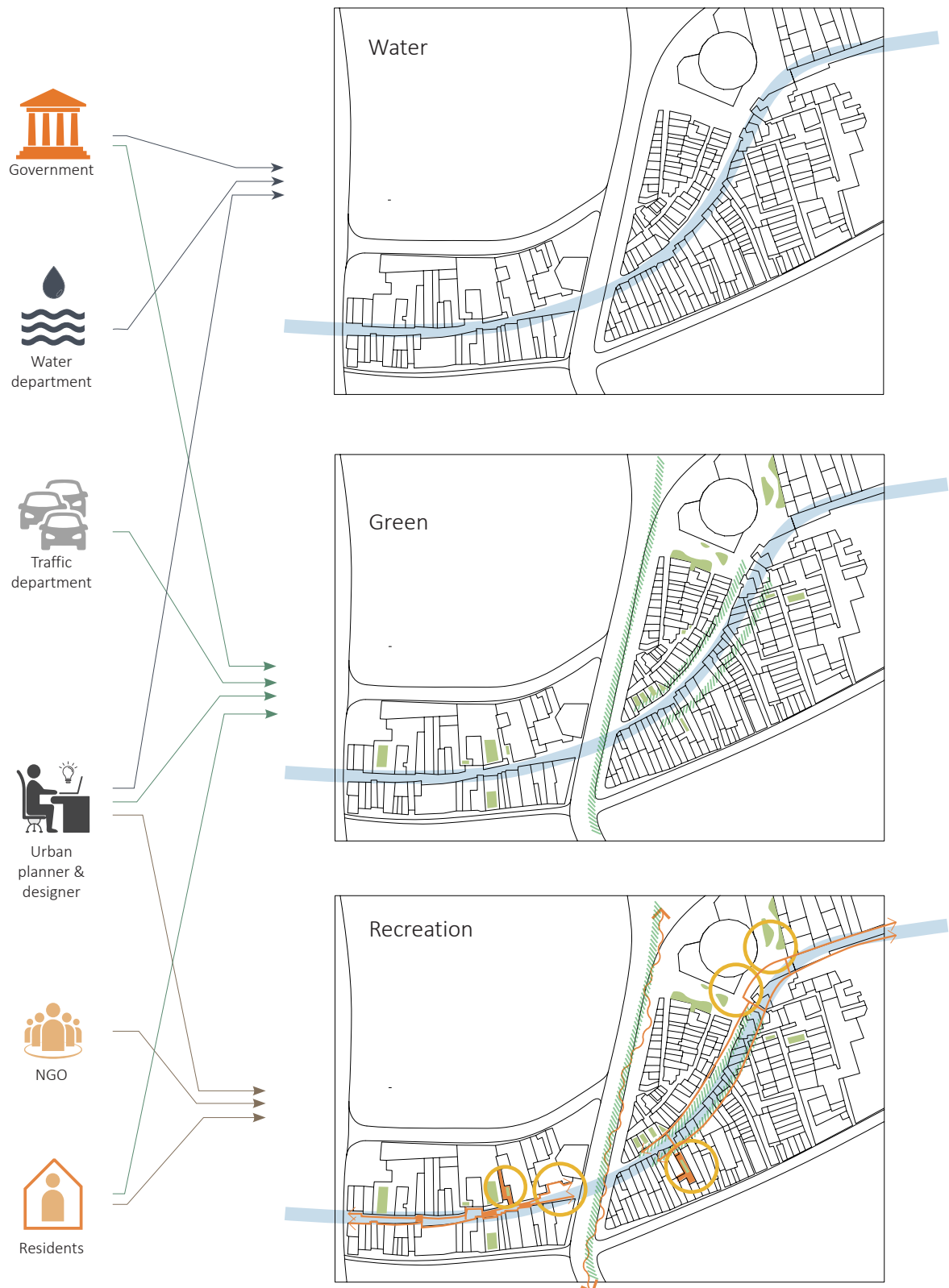
Picture 5.44 Yudaihao now
Retrieve image from: https://www.sohu.com/a/323463458_100020262



1917



Now

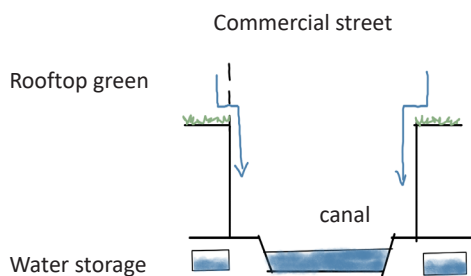


Picture 5.45 Design strategies of Yudaihao neighborhood
by author

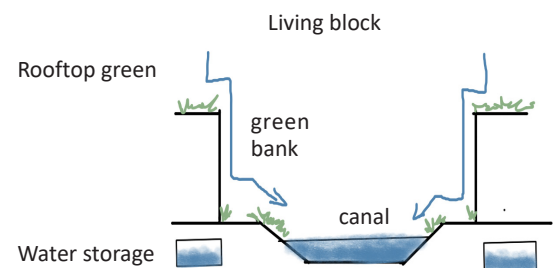
Neighborhood green-blue system



Picture 5.46 Design strategic plan of Yudaihao neighborhood by author



Picture 5.47 Design strategic section of commercial street by author



Picture 5.48 Design strategic section of living block by author

The main idea is to revitalize the axis and the historical canal to face the new urban challenges. The design focuses more on creating the landscape-nature network on a smaller scale. The transformation of the neighborhood could also be involved and still needs further development.



Living block

Picture 5.49 Design vision of Yudaihao canal in living block
by author



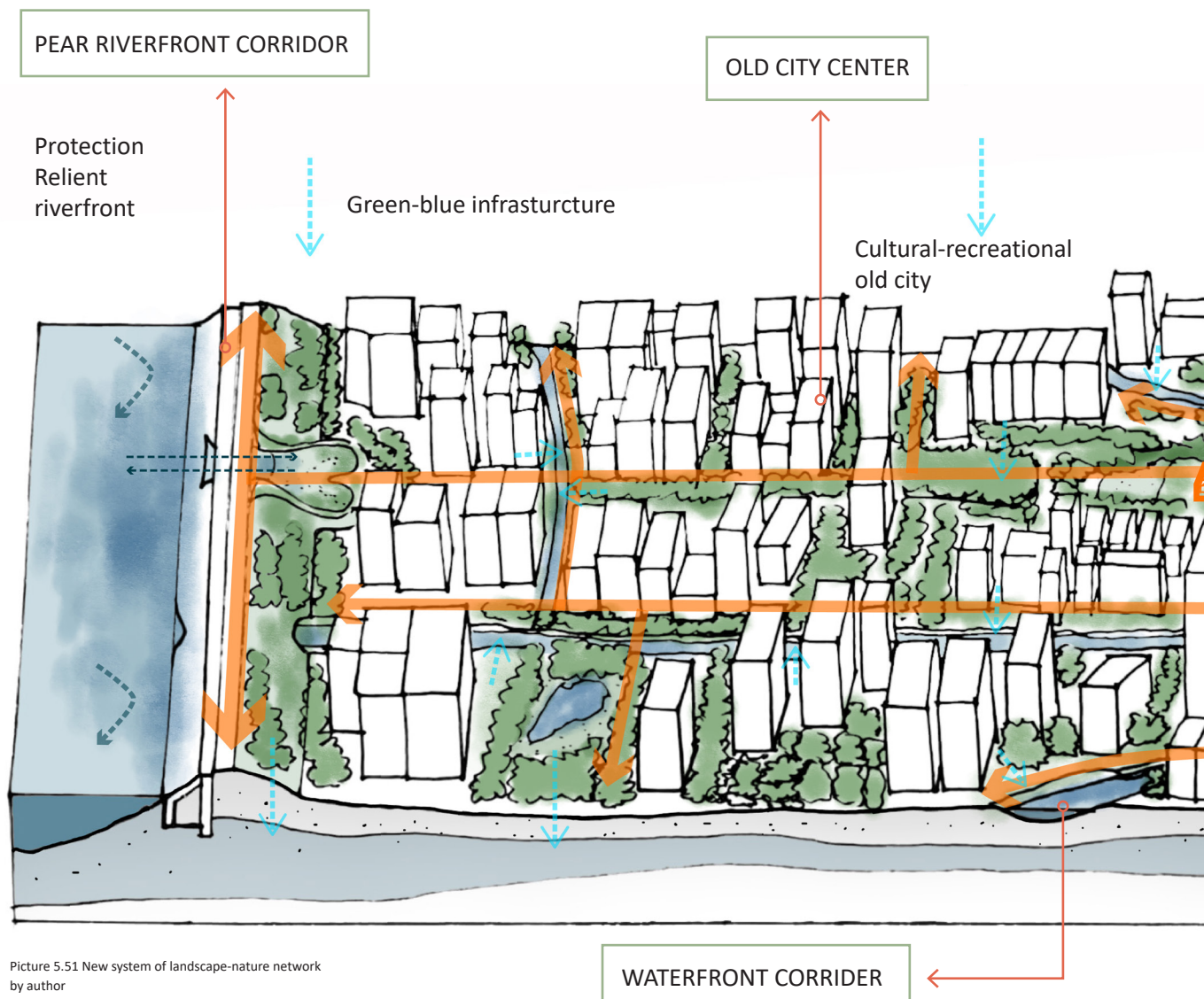
Commercial street

Picture 5.50 Design vision of Yudaihao canal in Commercial street
by author

Conclusion

This chapter answers sub-question 3, how to apply resilient design within context. It explains the design from both regional and local scales.

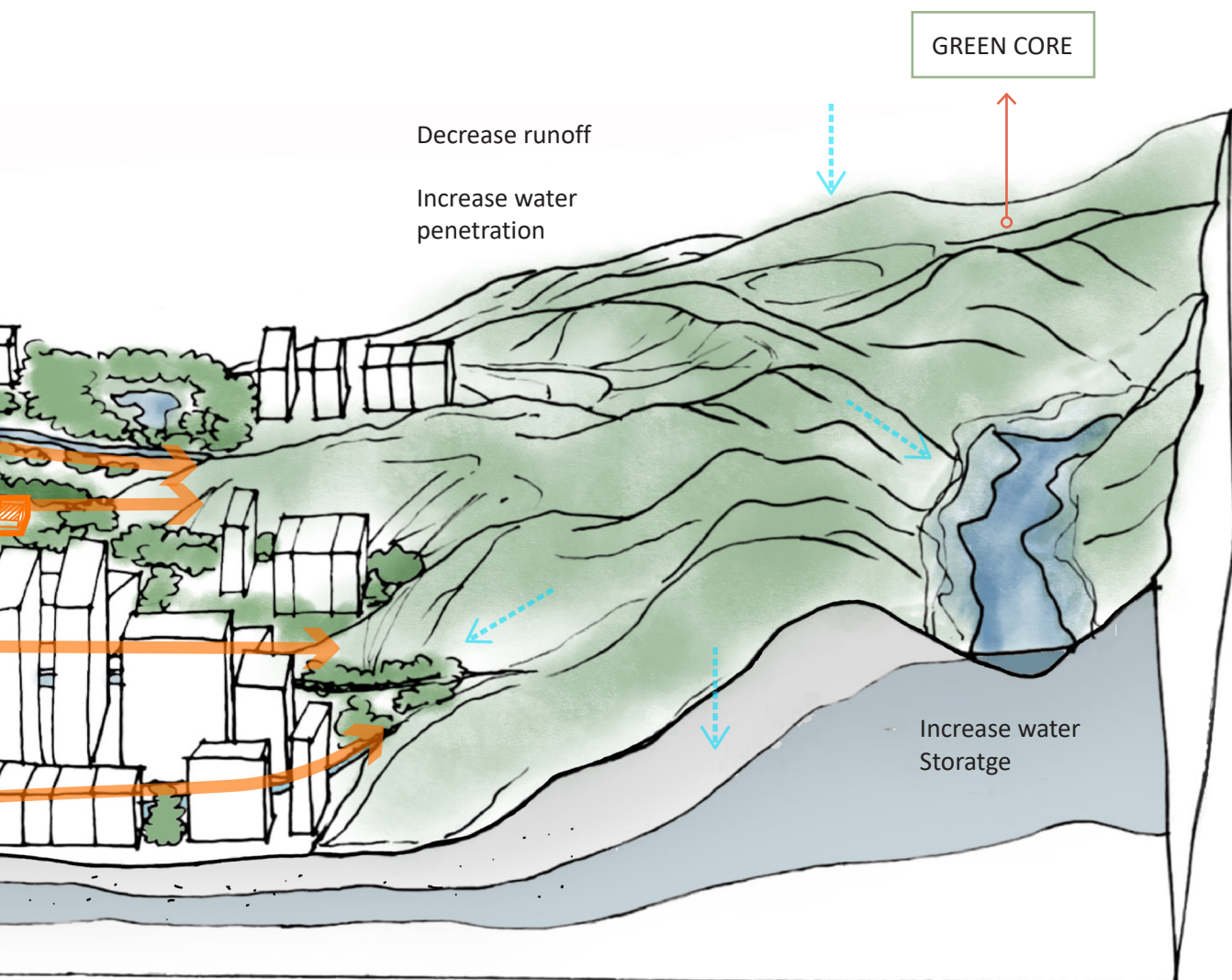
On the regional scale, the design strategies consider water, green and recreation layers. It shows how to create a landscape-nature network in Guangzhou and the idea of the Guangzhou metropolitan park. The design will propose a new system for a metropolitan city like Guangzhou, which is made up of the green core in the mountain area, the Pearl Riverfront corridor, the cultural-historical center and the inner city waterfront corridor.



Picture 5.51 New system of landscape-nature network by author

Each part of the metropolitan park contributes to a stronger capacity to deal with urban green problems and urban flooding issues. For the existing part of the structure, the research calls for protection, recovery and slight interventions. For the more problematic and missing part, the research uses a more detailed design to elaborate the strategies and principles on different scales, eg. the Pearl Riverfront and the old axis of the city.

The design exploration completes the process of design research and research through design. It shows the possibility to create a landscape-nature network in Guangzhou.





Chapter 6
**Discussion and
conclusion**



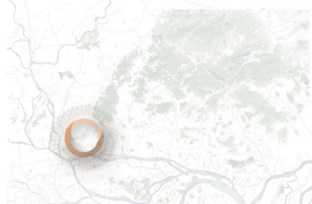
A landscape-nature network
Discussion



Last but not least, chapter 6 will conclude the report and reflect on the project. It is related to sub-question 4, What can be learned from Guangzhou for the creation of a landscape-nature network and what needs to be developed further? As the ending part of the whole report, it will summarize the main findings and expect future possibilities.

A landscape-nature network

Cultural-historical center

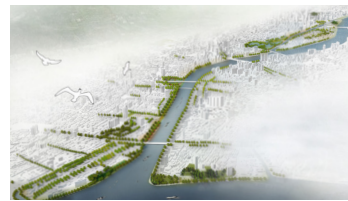
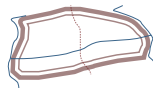


Pearl Riverfront corridor

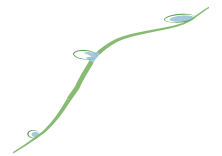
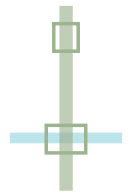


More problematical parts of the structure

Regional strategies



Detail design



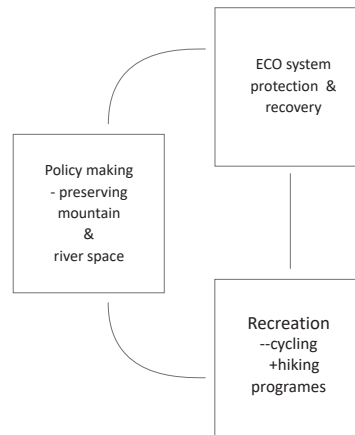
Green core



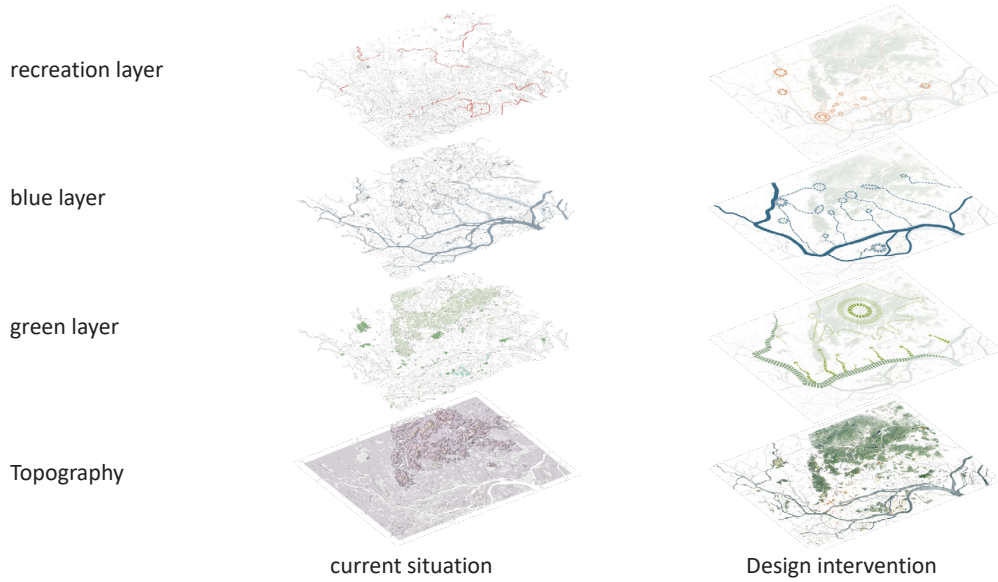
Inner city waterfront



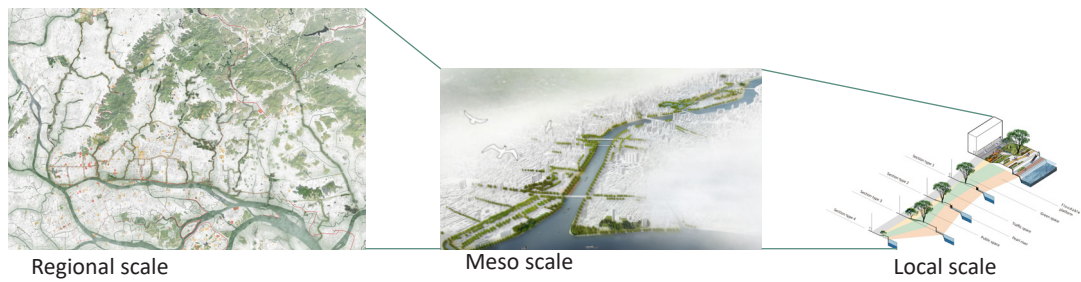
Existing parts of the structure



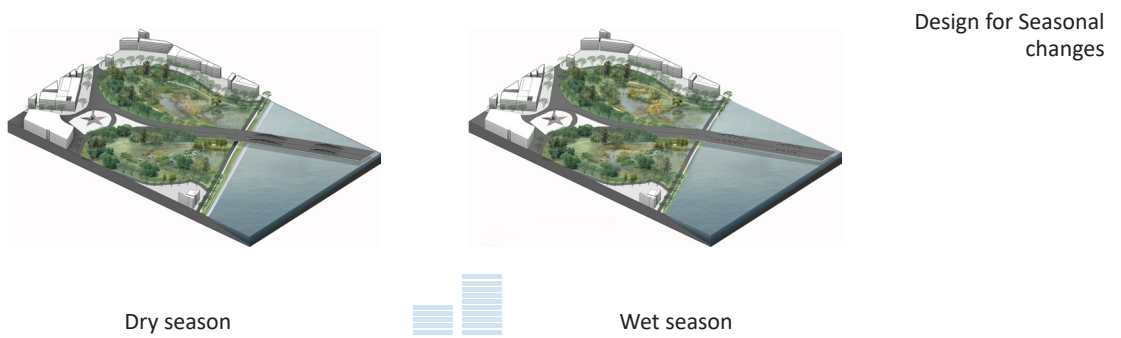
System



Scale



Process



Palimpsest



Discussion

Reflect on the Landscape-nature network design

This project creates a Landscape-nature network in the typical metropolitan city, Guangzhou. The design aims to deal with problems arising from the fast urban expansion in Guangzhou and increase the resilient capacity of the urban environment. To achieve this purpose, the project responds to four sub-questions in the research and design process. The landscape-nature network creates a more resilient system for the urban environment. It forms the green and blue connections on the regional scale and concerns the cultural value of the city. This system, while serving as an urban park system, can help the city address the multiple challenges posed by climate change, especially climate change. Mountain space not only could be nature reserves and eco-habitats but also helps with storing and holding excess rainwater in rain seasons. It could also provide freshwater supply in dry seasons. Rivers and canals could not only be green connections but also have room for stormwater. In the old city, more resilient green patches and connections assist neighborhood water management. The design helps with improving the urban environment and decreasing stormwater flooding inside the city center. The cultural value will also be promoted at the same time. The Pearl Riverfront corridor helps with relieving the negative effects on the city from river flooding. The system makes up for the city's lack of green space, unbalanced distribution and lack of ecological concern, and will effectively improve the city's ability to deal with internal and external challenges.

Design through scales is another important characteristic of the project. The project includes analysis and design through different scales. It well explained how the landscape nature network is applied from the regional scale to the local scale and to detail design. The project gives regional planning and relative strategies for different elements of the structure in regional planning. It also emphasized more problematical areas with more detailed design and interventions. It helps people to better understand the spatial design and the overall concept. It also shows how the overall concept and general principles could be applied within a certain context step by step.

The research still has some parts to be developed further. First, In the analysis part, the research sometimes will meet problems of inadequate information, for example, the transformation history of the green system in Guangzhou. To make up for the lack of information, related collages, and pictorial information are used as a substitute, aiming to show the historical changes of the green space system. Besides, for the more detailed design, the project focuses on more critical and problematical regions. Other regions within the Landscape-nature network also have the potential for future exploration.

Reflect on methodology

The methodology of the project is based on original theories. Design research and research through design are applied to the project. This method gives a more solid knowledge base for the design and also uses design as a means of research. The literature review provides basic information for the research and design. Mapping helps with understanding the site and changes. Case study inspires design strategies and principles. The design uses different methods to experiment with the spatial application of the Landscape-nature network. The project uses a landscape approach. It helps with understanding the system and reading the site through scales and time. It provides a deeper understanding of the problems and the site. This approach helps to create a more systematic design intervention and provides a more sustainable environment.

The methods in this project are relatively qualitative in both analysis and design parts. For potential future exploration, a more quantitative evaluation system for the effect of the design would be a complement to the project.

Reflect on the economic value of green infrastructure

Green infrastructure has economic value for its an effective way to deal with the negative effects of climate change. Climate change has cost loss to many cities worldwide. From 2015-2020, insured losses in Canada exceeded CAD 1 billion per year, with payouts in 2018 close to CAD 2 billion (Pilz, 2020). In the short term, green infrastructure needs investment and time to take effect. However, this short-term cost could bring more long-term benefits. Taking flooding as an example, annual floods cause economic loss repeatedly. The aftermath of urban flood disasters takes up a lot of manpower, material and financial resources. This long-lasting negative could continue or even become severer if no action is taken under the background of climate change.

Green infrastructure also could do good for the economy by increasing employment, providing a coherent social environment and better living conditions for citizens. Green infrastructure could help with increasing the region's image. With a better city image, it's easier to attract higher-value industrial investment and tourists (The Economic Value of Green Infrastructure, 2008). Besides, it's also more helpful for the productivity of the workers to work in a better environment. These are all long-term economic benefits of green infrastructure.

Compared with the short-term costs, green infrastructure has more long-term economic benefits. Thus, investment in green infrastructure is necessary and profitable in the long term.

Reference

1. Alpak, E. M., Özkan, D. G., & Düzenli, T. (2018). Systems approach in landscape design: a studio work. *International Journal of Technology and Design Education*, 28(2), 593–611. <https://doi.org/10.1007/s10798-017-9402-7>
2. Blue/Green Network Strategy. (n.d.). Whangarei District Council. <https://www.wdc.govt.nz/Council/Council-documents/Strategies/Blue-Green-Network-Strategy>
3. Booreiland. (n.d.). What are nature-based solutions? — Nature Based Solutions | PBL Netherlands Environmental Assessment Agency. <https://themasites.pbl.nl/nature-based-solutions/nature-based-solutions>
4. Green infrastructure. (n.d.). Environment. https://environment.ec.europa.eu/topics/nature-and-biodiversity/green-infrastructure_en
5. Kaur, R., & Gupta, K. (2022). Blue-Green Infrastructure (BGI) network in urban areas for sustainable storm water management: A geospatial approach. *City and Environment Interactions*, 16, 100087. <https://doi.org/10.1016/j.cacint.2022.100087>
6. Liu, G., Li, J., & Wang, Y. (2021). Tracking the history of urban expansion in Guangzhou (China) during 1665–2017: Evidence from historical maps and remote sensing images. *Land Use Policy*, 112, 105773. <https://doi.org/10.1016/j.landusepol.2021.105773>
7. Metropolitan Park System of Greater Boston (U.S. National Park Service). (n.d.). <https://www.nps.gov/places/metropolitan-park-system-of-greater-boston.htm>
8. Moga, S. T. (2009). Marginal Lands and Suburban Nature: Open Space Planning and the Case of the 1893 Boston Metropolitan Parks Plan. *Journal of Planning History*, 8(4), 308–329. <https://doi.org/10.1177/1538513209351782>
9. Ramyar, R. (2017). GREEN INFRASTRUCTURE CONTRIBUTION FOR CLIMATE CHANGE ADAPTATION IN URBAN LANDSCAPE CONTEXT. *Applied Ecology and Environmental Research*, 15(3), 1193–1209. https://doi.org/10.15666/aeer/1503_11931209
10. Resilient Design. (2023, February 13). <https://www.resilientdesign.org/resilient-design/>
11. Russo, A., & Cirella, G. T. (2021). Urban Ecosystem Services: New Findings for Landscape Architects, Urban Planners, and Policymakers. *Land*, 10(1), 88. <https://doi.org/10.3390/land10010088>
12. The Board of Metropolitan Park Commissioners. (1893). Report of the Board of Metropolitan Park commissioners. WRIGHT&POTTERPRINTINGCO.,STATEPRINTERS,. Retrieved May 12, 2023, from <https://archives.lib.state.ma.us>
13. Veerkamp, C. J., Schipper, A. M., Hedlund, K., Lazarova, T., Nordin, A., & Hanson, H. I. (2021). A review of studies assessing ecosystem services provided by urban green and blue infrastructure. *Ecosystem Services*, 52, 101367. <https://doi.org/10.1016/j.ecoser.2021.101367>
14. 万方数据知识服务平台 . (n.d.). <https://d.wanfangdata.com.cn/conference/9100928>

15. 广州市气象局 . (n.d.). <http://gd.cma.gov.cn/gzsqxj/>
- 16.Data not processed / gegevens niet verwerkt. (n.d.). WUR. <https://www.wur.nl/formsession-expired-27.htm>
- 17.Ecosystem Services | Nature and Ecology. (n.d.). <https://ecology.fnal.gov/ecosystem-services/>
- 18.Green infrastructure. (n.d.). <https://biodiversity.europa.eu/green-infrastructure>
- 19.Green Infrastructure - Environment - European Commission. (n.d.). https://ec.europa.eu/environment/nature/ecosystems/index_en.htm
- 20.Just a moment. . . (n.d.). https://www.researchgate.net/publication/280831011_Landscape_as_a_System_and_Systems_Theory_as_an_Approach_to_Landscape_Design/citations
- 21.<https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201902&filename=1019904090.nh>
- 22.Ma, Y., & Xu, R. (2010). Remote sensing monitoring and driving force analysis of urban expansion in Guangzhou City, China. *Habitat International*, 34(2), 228–235. <https://doi.org/10.1016/j.habitatint.2009.09.007>
- 23.Meng, L., Sun, Y., & Zhao, S. (2020). Comparing the spatial and temporal dynamics of urban expansion in Guangzhou and Shenzhen from 1975 to 2015: A case study of pioneer cities in China’s rapid urbanization. *Land Use Policy*, 97, 104753. <https://doi.org/10.1016/j.landusepol.2020.104753>
- 24.Metropolitan Park System of Greater Boston | The Cultural Landscape Foundation. (n.d.). <https://www.tclf.org/metropolitan-park-system-greater-boston>
- 25.Metropolitan Park System of Greater Boston (U.S. National Park Service). (n.d.). <https://www.nps.gov/places/metropolitan-park-system-of-greater-boston.htm>
- 26.Resilient Design | asla.org. (n.d.). <https://www.asla.org/resilientdesign.aspx>
- 27.Road map of the Boston district showing the metropolitan park system - Norman B. Leventhal Map & Education Center. (n.d.). <https://collections.leventhalmap.org/search/commonwealth:wd3768116>
- 28.Steffen Nijhuis, & Daniel Jauslin. (2015). Urban landscape infrastructures. *Designing operative landscape structures for the built environment. Research in Urbanism Series*, 3 (1), 2015; *Flowscapes: Designing Infrastructure as Landscape*, 3(1), 13–34. <https://doi.org/10.7480/rius.3.874>
- 29.What are Ecosystem Services? (n.d.). <https://www.earthwiseaware.org/what-are-ecosystem-services/>
- 30.World Bank. 2021. A Catalogue of Nature-Based Solutions for Urban Resilience. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/36507> License: CC BY 3.0 IGO.
- 31.Guan, F. (2010). Study on Six Veins Drainage in Guangzhou City [MA thesis]. South China University of Technology.

- 32.Lan, S. (2018). A Historical Study of Urban Reconstruction in Guangzhou:From 1918 to 2015 [MA thesis]. South China University of Technology.
- 33.Liu, W. (2015). Study on the Relationship between Urban Canal-system of Ancient Guangzhou and City Development [PHD dissertation]. South China University of Technology.
- 34.Xie, N. (2019). The Rsearch on Dynamic Changes of Urban Green Space Pattern and Driving Forces——A Case Study of Guangzhou City [MA thesis]. Wuhan University.
35. 中国第一历史档案馆等 . (2003). 广州历史底图精粹 . 中国大百科全书出版社 .
- 36.Pilz, P. (2020). Investing in Green Infrastructure: A Win-Win for Economic Recovery. Delphi Group. <https://delphi.ca/2020/07/investing-in-green-infrastructure-a-win-win-for-economic-recovery/>
- 37.The Economic Value of Green Infrastructure. (2008). Retrieved May 14, 2023, from <http://greeninfrastructurenw.co.uk>

