

Changing Values on Water in Delta Cities

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DOI

[10.7480/abe.2018.20](https://doi.org/10.7480/abe.2018.20)

Publication date

2018

Document Version

Final published version

Citation (APA)

Tai, Y. (2018). *Changing Values on Water in Delta Cities*. [Dissertation (TU Delft), Delft University of Technology]. A+BE | Architecture and the Built Environment. <https://doi.org/10.7480/abe.2018.20>

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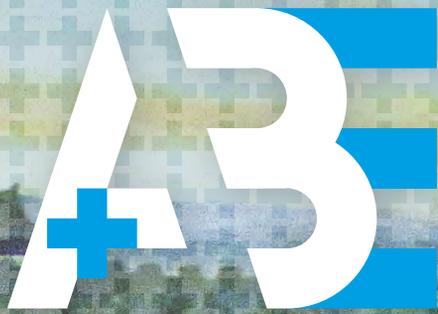
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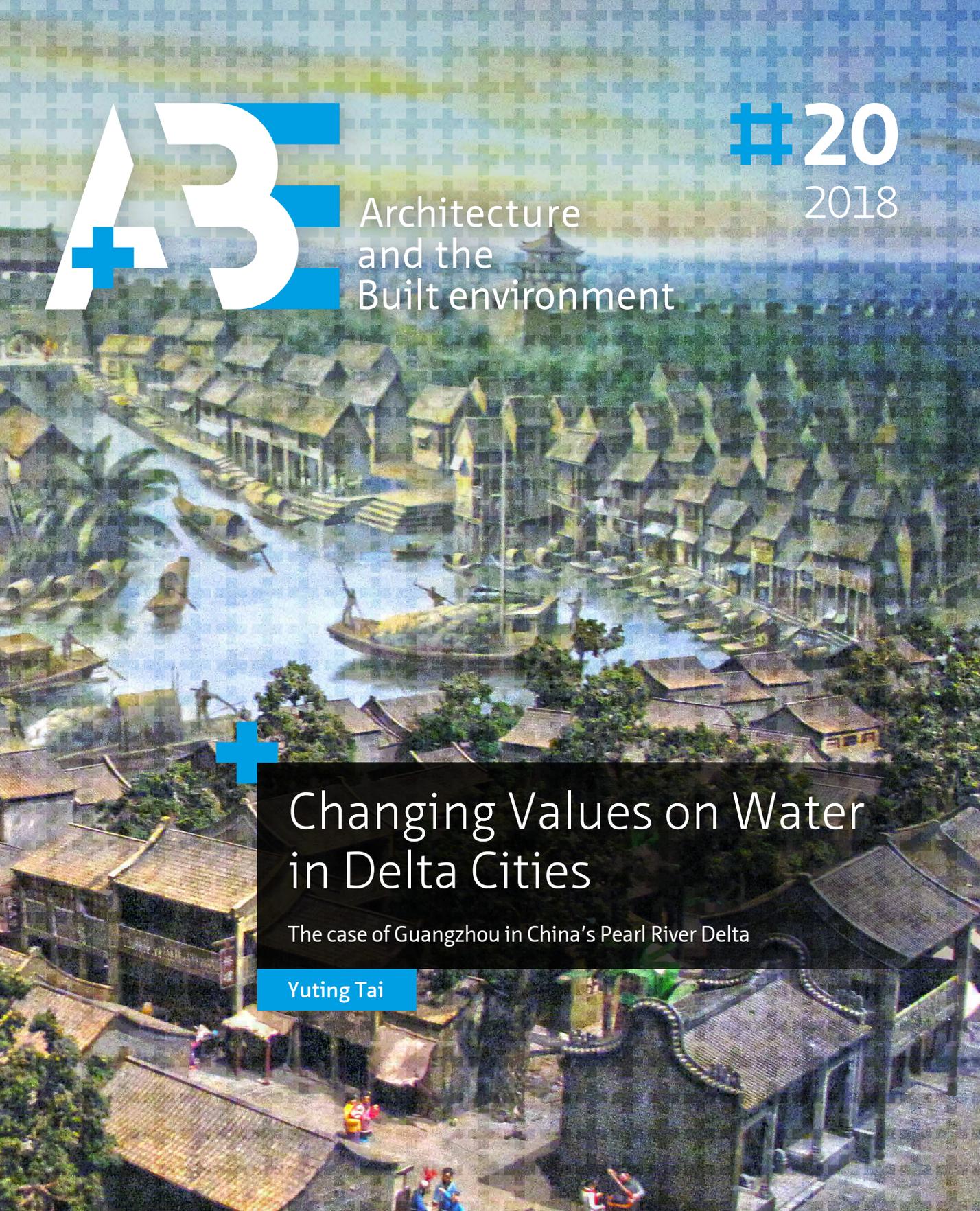
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2018



Changing Values on Water in Delta Cities

The case of Guangzhou in China's Pearl River Delta

Yuting Tai



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Yuting Tai

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Department of Urbanism*

Design: Sirene Ontwerpers, Rotterdam

Cover image: Exhibition at the East Moat Museum, Guangzhou (photo by author)

ISBN 978-94-6366-071-6

ISSN 2212-3202

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Changing Values on Water in Delta Cities

The case of Guangzhou in China's Pearl River Delta

Dissertation

for the purpose of obtaining the degree of doctor
at Delft University of Technology

By the authority of the Rector Magnificus Prof. dr.ir. T.H.J.J. van der Hagen

Chair of the Board for Doctorates

to be defended publicly on

Tuesday 11 September 2018 at 15:00 o'clock

by

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This research was funded by China Scholarship Council, which is thankfully acknowledged.

Preface

Pursuing a PhD in a foreign country is a lonely and tough journey with a lot of challenges and ups and downs. Looking back these years of effort and achievement, I cherish this invaluable experience that has greatly shaped and trained me to be an independent, strong and grateful person who appreciate every thing that I have and every tough moment that I've been through. Above all, I'm very thankful to many people who accompany, support and help me through those difficult periods, and share memorable moments with joys and tears.

Firstly my gratitude goes to my promoter - Prof. Han Meyer, who brought me into this amazing "delta" world where multi-disciplinary and worldwide experiences and knowledge are shared. Thank you for influencing me through your inspirational guidance, wisdom and patience. Your profound knowledge and expertise in the Dutch method of delta management has inspired me to shape my research ideas, methods and empirical studies. I am sincerely grateful to my daily supervisor - Dr. Lei Qu, who is always so kind to talk with. You have constantly guided me with patience, sharp perception and inspiring ideas and more importantly, encouraged me to overcome those difficult moments.

I am also very grateful to the committee members, Prof. Shifu Wang, Prof. Wil Zonneveld, Prof. Carola Hein, Prof. Luuk Boelens, and Prof. Martin de Jong, who spared time during the summer holiday to read the manuscript and brought up sharp and constructive comments that helped to improve the academic quality of my thesis.

I have received generous support from many people in the department of Urbanism. I would like to thank Vincent for your kind advice on my research and Machiel for your support and encouragement when I lost motivation. I'm very grateful to be part of the multi-disciplinary research group of "Delta Urbanism". Thank my research peers: Chenkun, Liang, Veronica, Taneha, Peter, Nikki, Fransje, Steffen, Diego, Inge, who enriched my understanding and knowledge on this interesting topic by sharing their work. I am very thankful to my colleagues from the chair of urban design, especially Els and Teake for inspiring me with the fine Dutch tradition of morphological analysis and mapping skills.

I am greatly thankful to my colleagues and PhD buddies at Urbanism: Sitong, Meltem, Jiaxiu, Luiz, Daniele, Ana Maria, Marcin, Mei, Yan, Azadeh, Cinco, Nurul, Bardia, Rachel, Birgit, Alex, Claudiu, Dominic, Akkie and Victor. It's great to have a community and receive all kinds of support in this journey. I also want to thank our lovely secretaries

at Urbanism: Linda, Amber, Danielle, Karin, Margo, Annemieke and Astrid for all the kind help and support over the years. Thank Véro for helping with the final layout and printing of the book, as well as Neil and Amanda for the English editing.

I would like to thank some people from my former university - SCUT for sharing their expertise and insights on urban issues of Guangzhou and the Pearl River Delta: Prof. Ye Liu, Prof. Yinsheng Tian, Prof. Yimin Sun, Prof. Jing Wang and Prof. Jianyun Zhou. Besides, my research can not be done without support from my friends in China: Xiaoye, Xiaofang, Qing, Xiaodong, and Chenghui, who helped to collect data and search for important documents and books for my case studies.

Life in a foreign country is not so easy. I'm lucky to have met many friends who are always cheering and sharing the same "values": Lijie, Xialu, Desirée, James, Chingwen, Leilei, Hoho, Yaya, Doreen, Astor, Yu, Jinghuan, Aura, Peiwen, Jing, Stefania, Pia and many others. Our friendship will never fade through distance and time.

Finally, I would like to extend my ultimate gratitude to my wonderful parents, who are always kind, supportive, encouraging and caring. My mum is my role model who teaches me the value of being a kind-hearted, optimistic, grateful and independent person. Thank both of you for shaping my personality and giving me freedom to live my life, even this life takes me so far away from you. Sorry for spending so little time with you these years.

Thank you all for every bit of help and encouragement, and I will pass on this positive energy to the future. I sincerely value the days and moments that we spend together.

Yuting Tai
July 2018, Delft

Contents

Summary 13
Samenvatting 15

PART I The concept of water values and research methodology

1 Introduction 19

1.1 Research subject and problem statement 19

1.1.1 Flooding issues in urbanising deltas 19

1.1.2 Other water related urban issues in delta cities 20

1.1.3 Complexity of urbanising deltas 21

1.1.4 “Water values” as a connecting point 23

1.1.5 The role of urban planning and design in shaping values 26

1.2 Introduction to the case of Guangzhou in the Pearl River Delta, China 28

1.2.1 The urban water environment of Guangzhou 28

1.2.2 Impact of urbanisation processes on the water-city interrelationship 32

1.2.3 Changing development ideologies and the way forward 35

1.3 Research questions and the structure 37

1.3.1 Research questions 37

1.3.2 Research structure 38

2 Water Values in Theory and Practice 41

2.1 Introduction 41

2.2	The value concept	42
2.2.1	Basic values	42
2.2.2	Values in planning	43
2.3	Value transitions from the 1960s	45
2.3.1	Value transitions in spatial development	46
2.3.2	Value transitions in water management	48
2.4	Underlying water values in urban planning and design practices	51
2.4.1	“Water sensitive urban design” and “low impact design”	52
2.4.2	The Dutch delta management	54
2.4.3	China’s “Sponge City” Programme (SCP)	55
2.5	Water values as a conceptual framework	56
2.5.1	Flood safety	59
2.5.2	Economic values	61
2.5.3	Environmental values	61
2.5.4	Social values	62
2.5.5	The main aspects of water values in this research	64
2.6	Conclusion	66
3	Analytical Framework and Research Methodology	69
3.1	Introduction	69
3.2	Analytical framework	70
3.2.1	Existing analytical tools	70
3.2.2	Morphological study and the Dutch “layer approach”	71
3.2.3	Analytical framework	78
3.3	Research methods	81

3.3.1	Literature review	81
3.3.2	Historical review	81
3.3.3	Case study of Guangzhou	83
3.3.4	Data acquisition	84
3.4	Methodological challenges and limitations	87

PART II Empirical studies of Guangzhou

4	The Waterways City (before the 1920s)	91
4.1	The delta landscape	91
4.2	Morphological analysis of water and the city	95
4.2.1	City site planning in the water environment	95
4.2.2	Inner city development and the canal system	97
4.2.3	Urban expansion in Xiguan	99
4.3	The changing values of water	110
4.3.1	Flood safety – flood-stricken delta city	110
4.3.2	Economy – prosperous treaty port	113
4.3.3	Environment – beauty of the delta landscape	114
4.3.4	Society – social diversity and vitality	115
4.4	Conclusion and discussion	117
4.4.1	Transitions of water values	117
4.4.2	Underlying forces of the transitions	119
5	The Functional City (1920s-1970s)	121

5.1	Urban development background	121
.....		
5.1.1	Political and socio-economic background	121
5.1.2	Urban planning sectors and spatial strategies	122
5.1.3	Water management sectors and spatial strategies	125
5.2	Morphological analysis of water and the city	127
.....		
5.2.1	Spatial structure and transport guided urban expansion	127
5.2.2	Land use change	129
5.2.3	Urban fabric of the dike road and the central axis	131
5.3	The changing values of water	136
.....		
5.3.1	Flood safety – regional engineered defence	136
5.3.2	Economy – industry-driven economy	137
5.3.3	Environment – conquering nature	138
5.3.4	Society – from diversity to uniformity	139
5.4	Conclusion and discussion	141
.....		
5.4.1	Transitions of water values	141
5.4.2	Underlying forces of the transitions	144
6	The Pluralistic City (after the 1970s)	147
.....		
6.1	Urban development background	147
.....		
6.1.1	Context of rapid urbanisation	147
6.1.2	Urban planning sectors and spatial strategies	149
6.1.3	Water management sectors and spatial strategies	151
6.2	Morphological analysis of water and the city	153
.....		
6.2.1	Current spatial structure of Guangzhou	153
6.2.2	Port-oriented urban expansion	156
6.2.3	Waterfront (re)development	157
6.3	Pilot water projects	160
.....		

6.3.1	Canal revitalisation as a catalyst for urban regeneration	161
6.3.2	Artificial lake creation	163
6.4	The changing values of water	166
6.4.1	Flood safety – increasing pluvial flooding	166
6.4.2	Economy – land finance	168
6.4.3	Environment – environmental alert	169
6.4.4	Society – social polarisation	171
6.5	Conclusion and discussion	175
6.5.1	Transitions of water values	175
6.5.2	Underlying forces of the transitions	177

PART III Conclusions and implications

7	Conclusions and implications	181
7.1	Introduction	181
7.2	Transitions of water values and underlying forces	182
7.2.1	Flood safety	183
7.2.2	Economic values	184
7.2.3	Environmental values	185
7.2.4	Social values	186
7.2.5	Underlying forces of value transitions	188
7.3	Interrelationships between water values	191
7.4	Reflections and implications for planning and design across scales	194
7.4.1	The changing roles of urban planning and design	194
7.4.2	Regional integration on the delta scale	195
7.4.3	Planning and design principles on the city scale	196

- 7.4.4 Value-based spatial patterns on the district scale 198
- 7.5 Theoretical and methodological implications 200
 - 7.5.1 Transferability of knowledge - the “value” concept 200
 - 7.5.2 Methodological development 203
 - 7.5.3 Future research 204

- References 206

- Appendix 1 Urban Planning and Water Management Documents 220
- Appendix 2 Interview 221
- Appendix 3 Timeline of Key Events, Policies and Sectors in Guangzhou 222

- Biography 223

Summary

Delta cities worldwide are confronted with great challenges concerning flood risks, environmental pressures and other water related urban issues. The complexity in both physical and social dimensions lies in diverse (and in many cases conflicting) values held by a wide variety of actors in spatial development. These values are shaped by the long-term impacts of natural forces, political powers, development ideologies, economic models, social structures, and local cultures. Defining the central role of “water” in structuring delta cities, this research applies the value concept as a particular lens to study how water is valued in each society through history. It argues that the recognition of diverse water values can help bridge the interplay between physical and societal systems within the delta, which can play a central role in developing urban planning and design strategies towards sustainable and liveable urban water environments.

The thesis develops an empirically tested analytical framework which links value theory with planning and design practices to investigate context-specific spatial transformations as a result of individual and collective value judgements. Four key aspects of water values including flood safety, as well as economic, social and environmental values are studied, and their interrelationships are discussed. Morphological analyses and value assessments are conducted to explore in what sense spatial changes can be considered an expression of the changing values and what we can learn from it to deal with complex spatial situations. The empirical studies are based on the long-term spatial development of Guangzhou as representative of a historical and rapidly growing delta city in China. Three development stages are illustrated to show different patterns of water-city interactions, the waterways city (before the 1920s) that was mainly structured by natural forces including natural waterways, the functional city (1920s-1970s) that was managed in a highly centralised approach such as functional zoning and large-scale flood defence, and the pluralistic city (after the 1970s) with the tendency towards accommodating plural values of water such as environmental sustainability, social equity and cultural identity.

Based on value theory and the empirical studies of Guangzhou, three main characteristics of value transitions can be suggested. First, values change through time in response to the changing conditions of natural dynamics, societal needs, and emerging risks. It is important to recognise the process of transition and its underlying forces to enable a comprehensive understanding of the mechanisms that influence spatial development and policy-making. Second, value conflicts act as a motivating force for changes in both spatial and social dimensions. Understanding the

interrelations between values, either synergic or conflicting, is important to evaluate spatial policies and define future development orientations. Third, the persistence of traditional values within a society over time indicates the core cultures and common interests intrinsic to each society with an adaptive capacity to cope with changing contexts.

Samenvatting

Over de hele wereld worden deltasteden geconfronteerd met grote uitdagingen met betrekking tot overstromingsgevaar, milieueffecten en andere watergerelateerde stedelijke problematiek. De complexiteit van zowel de fysieke als de maatschappelijke dimensies is te wijten aan de uiteenlopende (en in veel gevallen tegenstrijdige) waarden van een breed spectrum aan actoren op het gebied van ruimtelijke ontwikkeling. Die waarden zijn gevormd door de impact op de lange termijn van natuurkrachten, politieke macht, ontwikkelingsideologieën, economische profielen, maatschappelijke structuren en lokale culturen. Om de centrale rol van 'water' bij de vormgeving van deltasteden te definiëren is bij dit onderzoek het waardeconcept gebruikt als 'lens' om te onderzoeken hoe water in de loop van de geschiedenis in samenlevingen is gewaardeerd. Wij betogen dat erkenning voor de uiteenlopende waarden met betrekking tot water kan helpen om de wisselwerking te overbruggen tussen fysieke en maatschappelijke systemen binnen de delta, wat een centrale rol kan spelen bij de ontwikkeling van strategieën voor stadsplanning en -ontwerp gericht op duurzame en leefbare stedelijke wateromgevingen.

In dit proefschrift wordt een empirisch getest analytisch kader ontwikkeld dat waardetheorie koppelt aan planning en ontwerp in de praktijk, om onderzoek te kunnen doen naar contextspecifieke ruimtelijke transformaties die het gevolg zijn van individuele en collectieve waardeoordelen. Er zijn vier belangrijke waarden met betrekking tot water onderzocht, waaronder bescherming tegen overstromingen, naast economische, maatschappelijke en milieugerelateerde waarden. Ook de relaties daartussen worden besproken. Er zijn morfologische analyses en waardebeoordelingen uitgevoerd om te bepalen op welke manier ruimtelijke veranderingen kunnen worden beschouwd als een uitdrukking van veranderende waarden, en wat we daarvan kunnen leren voor de omgang met complexe ruimtelijke situaties. Het empirische hoofdonderzoek is gebaseerd op de langdurige ruimtelijke ontwikkeling van Guangzhou als typisch voorbeeld van een historische en snel groeiende deltastad in China. Er worden drie ontwikkelingsfasen geïllustreerd met verschillende interactiepatronen tussen water en stad: de waterwegenstad (vóór de jaren 1920) die voornamelijk was gevormd door natuurkrachten zoals natuurlijke waterwegen; de functionele stad (jaren 1920-1970) die sterk gecentraliseerd werd beheerd door middel van bijvoorbeeld functionele zones en grootschalige bescherming tegen overstromingen; en de pluralistische stad (na de jaren 1970), die de neiging heeft om verschillende waarden met betrekking tot water te accommoderen, zoals milieutechnische duurzaamheid, sociale rechtvaardigheid en culturele identiteit.

Op basis van waardetheorie en het empirische onderzoek naar Guangzhou kunnen drie belangrijke kenmerken van waardetransities worden aangeduid. Ten eerste veranderen waarden in de loop van de tijd als reactie op veranderende omstandigheden met betrekking tot natuurlijke dynamiek, maatschappelijke behoeften en nieuwe risico's. Het is belangrijk om het transitieproces en de drijvende krachten daarachter te onderkennen voor een volledig inzicht in de mechanismen die van invloed zijn op ruimtelijke ontwikkeling en beleidsvorming. Ten tweede functioneren waardeconflicten als motivatie voor de verandering van zowel ruimtelijke als maatschappelijke dimensies. Een goed begrip van de wisselwerking tussen waarden – synergetisch dan wel conflicterend – is belangrijk voor de beoordeling van ruimtelijk beleid en het bepalen van de richting van ontwikkeling in de toekomst. Ten derde wijst de langdurige doorwerking van waarden binnen een samenleving in de loop van de tijd op de intrinsieke kernculturen en gemeenschappelijke belangen van elke samenleving die in staat is zich aan te passen aan veranderende contexten.

PART I **The concept of water values
and research methodology**

1 Introduction

§ 1.1 Research subject and problem statement

§ 1.1.1 Flooding issues in urbanising deltas

Deltas are historically developed as hot spots for human settlements, where population and assets are densely distributed. At the same time, urbanising deltas - many of which are located in Asia (Seto, 2011) - are more likely to be affected by natural hazards such as flooding and land subsidence, and their ecosystems are highly sensitive to the changing natural environment and climate (World Bank, 2010).

Flood risk is one of the biggest challenges in urbanising deltas due to the inherent geographic features of low-lying floodplains and dense watercourses. “Delta” is originally a geographic term for low alluvial ground at the junction of rivers and sea, formed by young products of sedimentation (Galloway, 1975). Prior to human interventions, flooding was not a danger but acted as the driving force for the processes forming delta-landscapes as well as maintaining coastal and riverine ecosystems (WMO/GWP, 2007a). However, this process has been disturbed since mankind began to cultivate and urbanise the deltas. Drainage, reclamations, dams, dikes, and dredging activities frustrate the natural land making process and decrease the capacity of delta areas to cope with floods. Water systems and the deltaic landscape have been greatly altered by the increase of impervious areas, occupancy and the conversion of water bodies into other urban land uses. For centuries, rivers have been narrowed and channelised while ditches have been filled, areas with an impermeable surface are also increasing (Walsh, 2000).

Highly concentrated socio-economic activities in delta cities further amplify the possible consequences of future floods. According to C40 Cities, around the 2050s the majority of the world’s population will live in cities in or near deltas, estuaries, or coastal zones. The risk of flooding increases as more people live in urban delta areas and higher investments are allocated in ports, industries and financial centres in

flood-prone areas (Rosenzweig et al., 2011). Given the increasing threat of climate change such as sea level rise, more frequent storms and urban rain island effect, future challenges are likely to be even greater.

§ 1.1.2 Other water related urban issues in delta cities

From a historical perspective, water has played a multifaceted role in delta regions, such as water supply, irrigation, navigation, recreation, ecosystems as well as the cultural and economic carrier. Deltas and their estuaries hold both ecological and economic functions and are major centres of population and agriculture (Syvitski & Saito, 2007). Being the earliest areas of settlement, deltas also have a great socio-cultural significance. From the Nile to the Ganges, deltas serve as cradles of human civilization. The presence of water brings vitality to urban space and structures urban fabric (Wong & Brown, 2009).

The urbanisation process within the delta brings great challenges to nature and liveability as a vulnerable territory with sensitive ecosystems and high flood risks. The change of spatial patterns (especially the land use change) and land reclamation activities can exert negative impacts on the natural environment and the quality of life for the local residents (Calder, 1993), such as land subsidence, saltwater intrusion, and water pollution. The introduction of the modern street system for example, was unresponsive to the natural landscape and topography, as it replaced the original network of streams and creeks and created large areas of impermeable surfaces that hindered rainwater retention. Moreover, it impaired the environmental and social values of the delta landscape, resulting in uniform and unattractive urban form (Register, 2006; Farr, 2011). In addition, there is a growing worldwide trend of problems such as waterfront decline or gentrification, environmental changes, and the loss of water-featured cultural identity (Aerts et al., 2009; Howe & Mitchell, 2012). Although these issues are universal, the impacts are more dramatic in densely populated Chinese delta cities where rapid urbanisation has taken place and economic development has been prioritised, at the cost of social and environmental benefits (Zhang & Zhang, 1995; Lin, 1997).

Within the deltaic landscape, waterfronts are focal areas where dynamic spatial transformations take place in relation to socio-economic development and flood protection (Wood & Handley, 1999; Goodwin, 1999). In the current context, waterfront redevelopment is usually led by urban regeneration, focusing on regenerating and restructuring spatial functions, adapting to changing environments,

while preserving or enhancing certain economic, environmental, social and cultural values (Zhang et al., 2001; Gospodini, 2001). Complex and multifaceted, the trend of current waterfront redevelopment is associated with many factors such as industrial restructuring, historic preservation, environmental awareness, as well as urban expansion and renewal (Breen & Rigby, 1996; Sairinen & Kumpulainen, 2006).

Although economic development has been a major driving force in waterfront (re) development through history, increasing studies and practices have focused on multi-dimensional aspects and the design of waterfronts, covering a broad range of disciplines such as geography, environmental sciences, urban design, spatial planning, hydraulic engineering and politics (Hall, 1993; Meyer, 1999). A noticeable trend is that cities have lost their tradition of integrating public spaces and city life with large infrastructures like ports and have been attempting to return to that legacy (Hein, 2016). For the last decade, cultural tourism and eco-tourism have been the new focus of waterfront redevelopment and stress the importance of the socio-cultural and environmental values of waterfronts (Smith, 2009).

§ 1.1.3 Complexity of urbanising deltas

In general, deltas can be perceived as complex systems characterised by many elements and variables (sub-systems) with complex interrelationships. An urbanising delta is considered as a complex and dynamic system that consists of various social, ecological, and physical components with constant changes and interactions (Giacomoni et al., 2013). The complexity lies in great uncertainties about the dynamics of the elements, the values of the variables, and the characters of the relationships (Dammers et al., 2014). Delta regions contain complex ecosystems shaped by highly variable rivers and the sea. They are also characterised by the diversity of land uses, as well as the relations with the economy, culture, and society (Meyer et al., 2010).

Apart from hydrological dynamics and spatial characteristics, urbanising deltas are also confronted with great social complexity. First, diverse actors are involved in the development of delta regions and the divergence of individual interests, cultural backgrounds, social status and political positions causes the complexity in policy-making. Second, the institutional structure is complex as multi-level and cross-sectoral authorities (spatial planning, water management, port development, and environmental protection etc.) at different levels (local, regional, national and international) have interdependent relationships (van Leeuwen & van Buuren, 2013). In practice, water related urban issues are tackled by multiple and often disconnected

professions, particularly urban planning/design and water management. Different specialties and priorities result in different spatial interventions. Problems may occur when these two professions are not well coordinated. On the one hand, spatial planning and design is implemented to create more urban land so as to accommodate increasing populations and economic activities on the low-lying floodplain, leading to a higher exposure to flood risks. On the other hand, water management (flood risk management in particular) is required to deal with flooding with engineered solutions, neglecting other important functions of water in the city.

The above-mentioned water related urban issues (including flooding, declining waterfronts, and vulnerable ecosystems) are threats but can also represent new opportunities for future urban development. Spatial strategies can turn threats into opportunities by means of reorganising land uses and spatial functions. To cope with the development challenges of delta cities, some concepts such as “sustainability”, “liveability”, “spatial quality”, “adaptation” and “resilience” are often mentioned; and water-related development models like “water sensitive urban design” and “low impact development” have become popular worldwide. However, these concepts are mostly developed in Western contexts and their feasibility and applicability in different cultural, social, political and economic contexts remains a challenge. For instance, the latest “sponge city” movement in China has adopted the concept of “low impact development”, which was originally developed in North America. The experiment in the Chinese context still has a long way to go.

In order to make delta areas more sustainable and liveable, there is an increasing need to find a proper balance between the processes of the formation of delta landscapes by natural forces, and the processes of urbanisation and flood protection. The complexity of the delta system and the difficulty of taking effective actions are reflected in the lack of mechanisms that incorporate scientific knowledge and social complexity. The importance of the science-policy interface is being gradually recognised (Baker, 2007; Dunn et al., 2017). Science searches for objective facts, rational methods, measurements, and incremental progress, contributing to the understanding of physical systems and transformation dynamics. By contrast, the policy-making process involves subjective values, beliefs, perceptions, and political concerns (Bernabo, 1995). In terms of flood risk, scientific research on geographic and hydrological features of deltas as well as climate change scenarios play an important role in indicating the levels of flood risks and the locations of flood-prone zones. It also suggests that the uncertainties of climate change will make future flood risks more complex and unpredictable. In this regard, transformative policy agendas are crucial to increase the adaptive capacity of delta cities to deal with future uncertainties based on scientific knowledge (Dunn et al., 2017).

§ 1.1.4 “Water values” as a connecting point

Most research on the current state of urbanising deltas focuses on connecting water problems with deficiencies in aspects like technological development, governance and interdisciplinary collaboration as a result of different ambitions and separate divisions of tasks and responsibilities, which challenges planners and other actors to reach consensus in making spatial policies (Pahl-Wostl, 2002; Edelenbos, 2005; Dammers et al., 2014). For example, the “CAS (complex adaptive systems) approach” advocates the synchronisation of sectors and mobilisation of actors (Teisman et al., 2009). However, The real complexity is that there are many values regarding water, struggling and competing with each other, which creates conflicts in spatial development. Little research pays attention to the underlying reasons of fragmented governance - the lack of shared values on water as common ground and general knowledge for mutual understanding and collaboration that contributes to organising collective actions.

When we talk about different opinions, ideas, beliefs and interests among actors, the fundamental mechanism that determines their attitudes and actions are values in essence (Rescher, 1982; Schwartz, 1992). An important feature of urban development is that of value creation (Franzen et al., 2011). Urban development is the result of people attributing (new) meanings to their living environment, especially for socio-economic development (Strang, 2004). As for delta cities, water is regarded as crucial for shaping landscapes, facilitating economic development, structuring urban fabrics, and influencing the daily life of the people living there. At the same time, water is considered a threat due to high flood risks in low-lying delta areas.

The value concept provides a new way to understand the complexity of physical and social systems in delta cities. In view of future development challenges concerning social and urban complexity, consensus building in the process of planning and design is essential for the development of spatial strategies that involve a wide variety of public interests. This thesis argues that, consensus can only be reached with the recognition of diverse and in many cases conflicting values. The value conflicts drive the negotiation among actors in society.

In light of overlooked values in both theory and practice in the management of complex delta system and the essential role of water in delta cities, we need a comprehensive perspective to help understand the dynamics and underlying forces that drive changes and actions in spatial development. The concept of “water values”, in such a case, is put forward as a lens and a connecting point to provide a comprehensive perspective from which to understand the hidden mechanisms that drive the spatial development of delta cities in both physical and societal dimensions. Water values here are defined

as *the perceptions and attitudes of actors toward the functions and roles of water in the natural environment and human society based on individual and public interests*. Various participating actors all have their own perspectives on the values of the urban water environment, including public authorities that commission and evaluate it, private sectors who initiate and execute it, and communities who experience and judge it.

In modern society, public authorities are responsible for implementing public policies and spatial strategies to achieve or maintain certain values. Both urban planning/ design and flood risk management interventions can facilitate spatial development and the outcome is a selection of water values in order to optimise some spatial quality or to achieve certain development goals. This research focuses on the values associated with surface water systems in delta cities that structure spatial patterns. Therefore, some other important values of water are not discussed, such as safe drinking water and sanitation.

Creating the synergy between diverse water values is the key for the development of integrated and effective spatial strategies that can achieve multiple goals in spatial development. The question is, how to gain an optimal and synergic set of values in terms of sustainability, liveability, and spatial quality in a water sensitive context? It is essential to develop adaptive strategies that can not only integrate different values for a robust economy, a vital society, and a safe and liveable environment but can also deal with changing contexts and great uncertainties. Synergy doesn't mean all values should be assigned equal importance in policy-making. In fact, some fundamental societal needs require a higher priority, such as flood safety. The key principle is that the achievement of some values should avoid negative effects on others.

A troublesome issue in planning is to find appropriate techniques to evaluate alternative plans and indicate underlying values in policy-making. Some technical tools have been developed to relate value to the monetary worth of subjects (Debreu, 1987). For example, politicians often rely on the cost-benefit assessment results presented by economists to make spatial policies and prioritise investments in development (Dasgupta, 1974). To offset the political bias towards the economic value, Green GDP index is used to calculate the environmental consequences of GDP growth, such as the loss of biodiversity and costs caused by climate change (Talberth & Bohara, 2006). However, criticism is raised against the neutral grounds in the process of plan evaluation without appraising the values in a social context (Davidoff, 1965). In view of that, some qualitative research focuses on developing analytical tools to evaluate values and organise societal supports, such as multi-criteria analysis, where a group of actors (often experts or decision makers) are invited to grade each policy option based on a set of criteria (Voogd, 1988). Contingent valuation on the other hand is based on survey questionnaires to address an individual's willingness to pay for a good or to

accept damage (Cummings et al., 1986; Carson et al., 2001). However, these methods can create biases due to subjective opinions and individual differences. To overcome the inadequacies of the traditional financial-based performance measurement tools, the Balanced Scorecard (BSC) was developed to measure and integrate intangible assets into performance measurement (Kaplan & Norton, 1992), but its limitation was recognised in implementation due to diffused accountability and lack of inter-organisational innovation (Awadallah & Allam, 2015). Although some social scientists and policy researchers have developed the value-based policy analysis approach, using the concept of values as an analytical tool to review the processes of public policy-making (Thacher & Rein, 2004; Stewart, 2009), the analysis is mainly focused on institutional structures and policy-making processes, while the spatial relevance and the involvement of a broader range of actors (e.g. citizens, communities, NGOs) are missing. And this kind of argument is built upon a modern social structure based on formal institutions.

In spite of widespread applications, these evaluation methods are not able to bridge the gap between theory and practice. The challenge is to develop an evaluation framework in policy-making that is 'responsive to complexity, transparent for communication, and enable effective interaction' (Alexander, 2006: P274). This evaluation framework needs to be developed with a value-based approach, which helps to 'articulate values, identify decision opportunities and create alternatives' (Keeney, 1992).

From a historical perspective, spatial development is influenced by complex relationships between political, economic, social and environmental goals, the values associated with these goals, and the rules that determine the costs and benefits for the actors involved (Smits et al., 2006). Complementary to the existing value-related approaches, this thesis argues that the spatial indication of values in a transformative setting provides a more objective and comprehensive lens for understanding the mechanisms and dynamics of spatial development. It is noted that, the value concept bridges the interplay between the physical urban system and the urban society. On the one hand, the physical urban system supports social activities and processes. On the other hand, the social system generates control over the physical system in changing conditions by means of value selection and prioritisation (Klaasen, 2003) (Figure 1.1). In terms of delta management, the continuous interplay between geographic physical dimensions (urban morphology) and diverse values carried by actors within metropolitan deltas is highlighted (Wang et al., 2018).

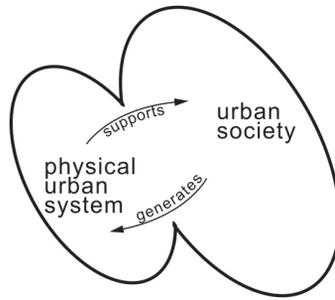


FIGURE 1.1 Interrelationship between the physical urban system and urban society

Source: Klaasen, 2003.P22

Concerning the analytical framework, this research focuses on three dimensions of water values: “form”, “scale” and “time”, and is aimed at exploring context-specific spatial development as a result of individual and collective value judgements at different development stages. First, it argues that the spatial form of a delta city is the outcome of the selection of water values in each society. Second, water values may differ across scales, as national, regional, and local interests can conflict with each other. Third, the criteria and indicators of water values could vary through time along with changes in common interests, societal needs, urgent risks, and development contexts. These three dimensions are adapted from urban morphological studies, which will be further explained in chapter 3 - analytical framework and methodology.

§ 1.1.5 The role of urban planning and design in shaping values

Due to the complex mix of multi-level interests involved in water related urban issues in delta cities, it is essential to develop policies which can mediate conflicts and create common interests in the society (Portugali et al., 2012). Given the fact that these public interests can conflict with each other, consensus building is important to maintain the order of a society by internalising shared norms and values (Kroeber & Parsons, 1958; Klosterman, 1980). This kind of consensus should be reached between different social groups, between different professions, and between authorities who hold power and the public.

The discourse of urban planning and design has been acknowledged as a tool for consensus building to address the plurality of public interests, as well as to deal with social and political fragmentation, uneven power and conflicting values (Innes, 1996).

Strong underlying narratives are crucial for striking a balance between different social groups, reflecting the value judgments made by individuals (Cronon, 1992; Hajer et al., 2010). Urban planning and design can play a role in enhancing the economic, social and environmental values of space through gathering actors' views (Carmona et al., 2002). The participatory process of planning and design is important for addressing diverse values and building consensus among actors. For example, the Dutch "polder model" came into fashion as an economic and social policy-making model based on consensus building among a variety of actors in the 1980s and 1990s (Schreuder, 2001).

This kind of consensus has an evolving nature and some level of consistency in a society. In the Chinese context, diverse cultural, political and economic forces shape urban planning ideologies. Initially, the ancient Chinese philosophical schools - Confucianism and Taoism for example - promoted the balance between humans and nature. During the socialist period, large-scale heavy industrial development was implemented under the guidance of a centrally planned economy and nature was regarded as a barrier that humans should conquer. Influenced by the open-door policy and the socialist market economy adopted in the 1980s, unprecedented urban growth has taken place at the cost of great environmental decline and social polarisation. Nowadays, the Chinese society is undergoing continuous social diversification and differentiation (Hui, 2013). Criticism is raised against the tendency that the overwhelming reformation of the socio-economic and political systems has threatened traditional Chinese norms and values (Wang, 2013). Although challenged by fast-changing economic and political forces as well as the trend of internationalisation, some traditional values can still be perceived in the existing urban context of Chinese cities. For instance, Fengshui culture has been developed further into the concept of "Shanshui City"¹ since the 1990s for the integration of the natural and artificial environment. The main idea of the "Shanshui City" is to improve the environmental quality of cities by incorporating the traditional Chinese cultural essence of "mountain-water" paintings, poetry, and gardening in urban planning (Bao & Gu, 1996). Facing great development challenges, urban planning has been playing a retrospective role to accommodate plural values in contemporary Chinese society, generally from prioritising economic development and urban growth towards more balanced development with increasing cultural, social, and environmental concerns.

1 "Shanshui City" literally means "mountain-water city" in Chinese. The concept was first mentioned by scientist Qian Xuesen in 1990, following the traditional Chinese philosophy of the "unity of humans and nature".

§ 1.2 Introduction to the case of Guangzhou in the Pearl River Delta, China

§ 1.2.1 The urban water environment of Guangzhou



FIGURE 1.2 Location of Guangzhou in China's Pearl River Delta

Among urbanising delta regions in the world, the Pearl River Delta (PRD) is one of the most densely populated. It covers a total area of 41,698km², accommodating a population of 60 million in 2016 (Figure 1.2). The PRD is also one of the most economically dynamic regions in the world. Influenced by the open door policy at the end of the 1970s, the PRD has become a pilot region and a test field in China's revolutionary transition from a centrally planned economy to a socialist market

economy² (Vogel, 1989; Shen et al., 2002). Driven by economic globalisation, China has established its prosperous export-oriented manufacturing sector and the PRD region has become the world's factory. Although the PRD occupies only 0.57% of the land area of China, it contributes to a large share of the national GDP. For instance in 2016, the GDP created in the PRD accounted for 9.1% of the total national GDP³. According to a World Bank report, China's Pearl River Delta has overtaken Tokyo as the world's largest megacity region in both size and population, due to a shift from agriculture to a manufacturing and service-based economy (World Bank, 2015).

Guangzhou (also known as Canton) is the central metropolis in the Pearl River Delta and the capital city of Guangdong Province, with a total metropolitan area of 7434km². It is a prosperous port city with a long history of more than 2200 years. Experiencing dynamic spatial transformations, the delta landscape is crucial to urban development. The geographic features of Guangzhou as a typical delta city can be traced through various levels of urban transformations. The city is located near the intersection of three main rivers in the delta - the North River, the West River and the East River. A dense water network characterises the landscape pattern, and the historical city centre was built on the floodplain between the mountains to the north and the sea (current Pearl River) to the south. Guangzhou occupies the central position in the PRD with respect to geographic location, administrative priority, socio-economic significance, as well as cultural identity, such that the urban development of Guangzhou has a strong impact on the development orientation of the whole PRD (Xu & Yeh, 2003).

Supporting basic functions such as navigation, irrigation, drinking water, military defence, and drainage, the water environment highly contributes to the economic profile of the city. Since ancient times, Guangzhou has always been an important trading port for China. The port activities began in the Han dynasty (204 BC – 220 AD) and made Guangzhou one of China's busiest ports during the Ming and Qing dynasties, serving as an important part of the "Silk Road on the Sea" (Qiu, 1998). The port development stimulated great prosperity during a period when the Qing government adopted the "Canton System" (1757-1842), also known as the "Single Port Commerce System" (一口通商) (Van Dyke, 2005). Figure 1.3 shows numerous foreign ships on the Pearl River, with merchants from Western countries in Guangzhou in the 1800s.

2 Between 1949 and 1978, China adopted a centrally planned economy. The state set production goals, allocated resources, controlled prices and a large share of China's economic output. The economic reforms since 1979 have led to relatively decentralised economic policy-making, with the introduction of market forces, known as the socialist market economy.

3 Hong Kong and Macau are not counted in national or provincial statistics because of different economic management systems.



FIGURE 1.3 Prosperous port and trade development of Guangzhou (Canton) in the 1800s
 Source: unknown artist, watercolor and gouache on paper © Peabody Essex Museum

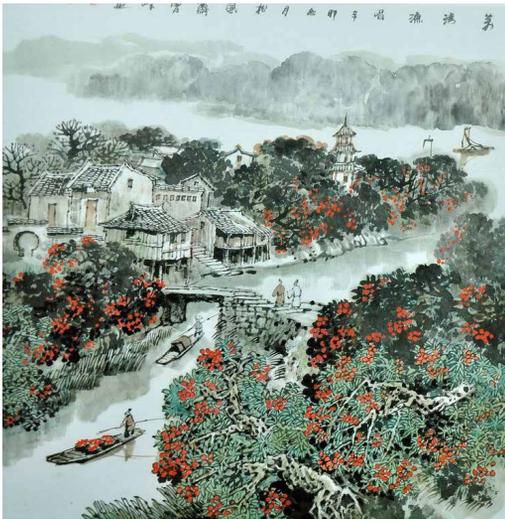


FIGURE 1.4 The Lychee Bay landscape in the Ming dynasty
 Source: painted by Zeng Rong



FIGURE 1.5 Shamian Canal in the 1930s
 Source: Ato Photographic Association © RGS-IBG

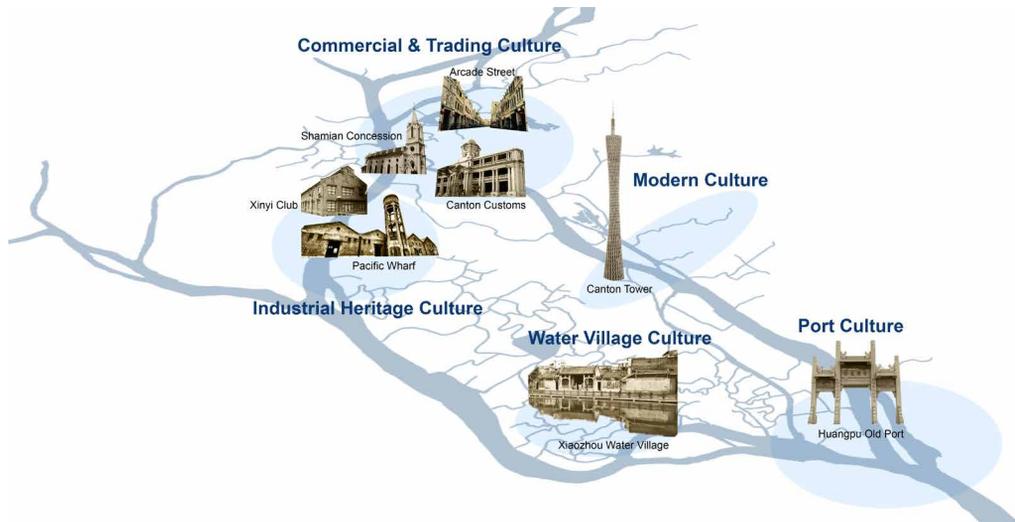


FIGURE 1.6 Coexistence of diverse water cultures in Guangzhou's existing spatial structure

The tradition of the port-oriented economy with international significance remains till today. In 2016, Guangzhou ranked seventh among the largest container ports in the world (World Shipping Council) and the port economy has a far-reaching influence over various aspects of urban development, social structures and water environments.

In addition to its economic significance, water also plays an important role in social life and cultural representation in Guangzhou. The water structured spatial form has distinctive characteristics that represent the Lingnan culture⁴. Not only the architectural style of an elegant garden setting, but also the daily scenes and the lifestyle of water villages have been demonstrated in poems and photos since ancient times (Figure 1.4, 1.5).

Water not only has had a great impact on the spatial form of Guangzhou, but also on the societal organisation of the city. Even now, a strong imprint of water cultures is reflected in the local dialect, religions, food, music, street names and socio-cultural activities, thus becoming a water-featured cultural identity and a strong collective memory for the local people. Established in 214 B.C., Guangzhou has developed over

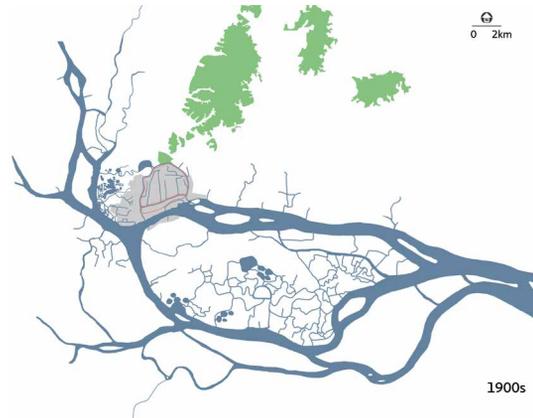
4 Lingnan culture refers to the culture developed in the Lingnan region in South China, including Guangdong, Guangxi and Hainan Provinces. Lingnan culture is characterised by rational pragmatism, innovation and general openness to new and foreign ideas owing to its commercial, trading and oceanic root that embodies the history of the region.

ten imperial dynasties, from an agriculture-based delta territory to a modern city driven by industrialisation and urbanisation, and now is a regional centre within the delta and a global city with a large number of national and international migrants (Li, 2014). Guangzhou is a historical delta city with diverse cultures, most of which are related to water. In the existing spatial structure, various spatial patterns are organised by water linking a diversity of water cultures developed during different periods of time, such as the commercial and trading culture, the industrial heritage culture, the modern culture, the port culture, and the water village culture (Guangzhou Water Affairs Bureau, 2011) (Figure 1.6).

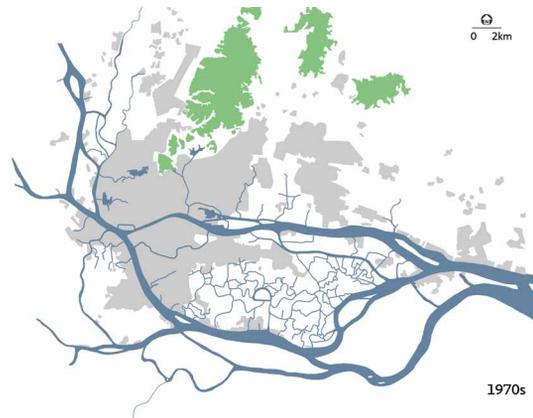
§ 1.2.2 Impact of urbanisation processes on the water-city interrelationship

In China, the rate of urbanisation swiftly increased from 21% in 1982 to 57% in 2016 (National Bureau of Statistics). Being the experimental field of the open-door policy, urbanisation has taken place in the Pearl River Delta at an extraordinary pace. As in Guangzhou, the population has increased sharply from 1.9 million in 1980 to 14.04 million in 2016, and the built-up area has witnessed enormous growth compared to that of the 1900s, expanding from the north bank of the Pearl River to the current metropolitan area (Figure 1.7). During such processes, the previously synergic interrelationship between water and the city has been changed. Guangzhou has problems common to other delta cities in the world, but the city is facing more crucial challenges when it comes to flood risk management, environmental protection, urban regeneration and cultural preservation due to rapid population growth and urban expansion (Wong & Tang, 2005; Carmona et al., 2014).

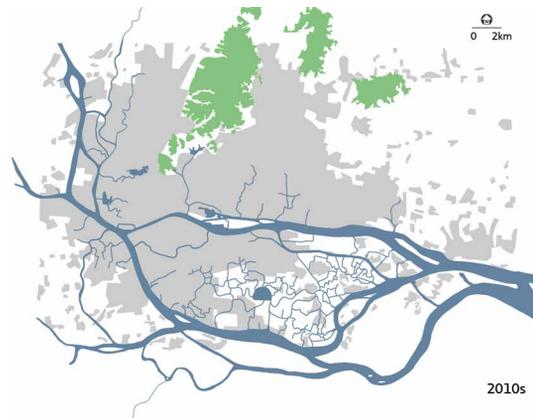
Above all, the unsustainable model of urban development increases flood risks. Originally, water shaped the city in a natural hydrological environment made up of ponds, rivers, streams, and wetlands. As the city expanded, the original low-lying floodplain was transformed into new urban areas, bringing considerable pressures to the natural system. The tradition and culture of water management has been altered, from local residents' self-management to hydraulic engineers' construction work. Inappropriate land use in flood prone areas has resulted in a significant reduction in the storage and retention capacity of river basins and has consequently increased flood risks. As most surface water has been covered over, the city's drainage is highly dependent on the artificial drainage system, which is often out dated and functions poorly compared to the pace of urban expansion.



1 *Guangzhou in the 1900s*



2 *Guangzhou in the 1970s*



3 *Guangzhou in the 2010s*

FIGURE 1.7 Urban growth and water systems of Guangzhou city centre in the 1900s, 1970s, and 2010s

The flooding issues of Guangzhou have changed along with the processes of urbanisation and industrialisation. Possessing a sub-tropical climate and located at the estuaries where rivers meet the South China Sea, Guangzhou is exposed to three types of flooding, from the north (upstream) to the south (downstream); fluvial, pluvial and coastal flooding. In particular, the city centre has been suffering from frequent pluvial flooding caused by extreme typhoons and storms. The current amount of waterlogging locations in Guangzhou has increased 16 times compared to that in the 1980s, these are mostly in the newly urbanised areas (Dong et al., 2015). The situation is exacerbated if we consider future socio-economic and climate uncertainties. Recent research predicts that Guangzhou will rank top amongst global cities with the highest flood risk due to a large exposure of the population and assets in 2050, with an estimated annual flood loss of \$13.2 billion (Hallegatte et al., 2013) (Figure 1.8). Both limited space and a changing climate call for more adaptive strategies for future urban development.

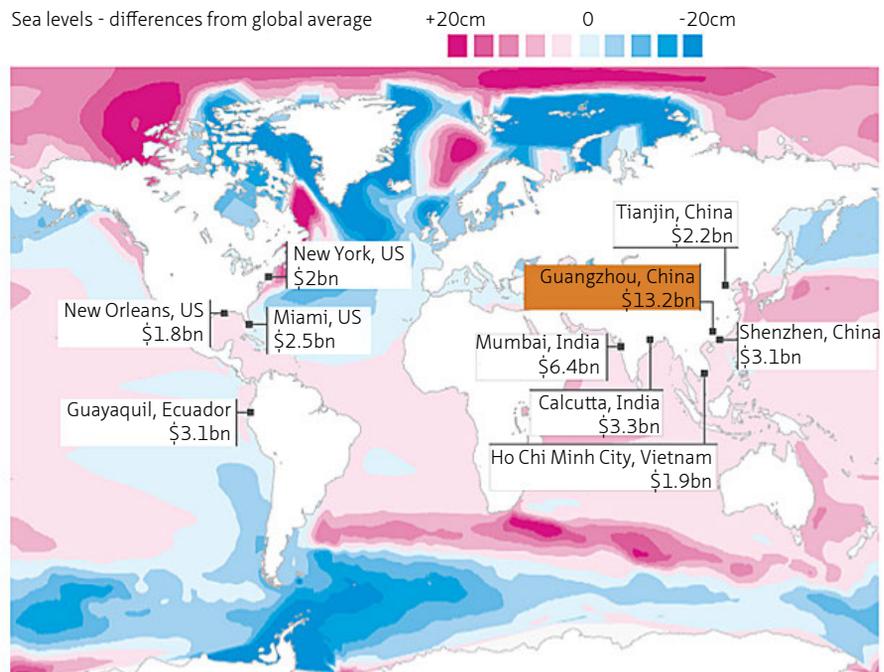


FIGURE 1.8 Top ten cities in the world with the highest annual flood costs in 2050
Scenarios with socio-economic change, subsidence, sea-level rise and adaptation to maintain flood probability (scenarios SLR-1, and adaptation option PD) (data source: Hallegatte et al., 2013)
Image from BBC News (<http://www.bbc.com/news/science-environment-26715589>)

Aside from growing flood risks, the unprecedented speed of urbanisation has brought enormous challenges such as environmental degradation, unbalanced social development, and a lack of a sustainable vision (World Bank, 2013). According to the economic assessment and prediction of Guangzhou (Guangzhou Development Academy), the city accommodated a population of over 14 million in 2016, which greatly surpassed the comprehensive carrying capacity of natural resources (the Overall Environmental Planning of Guangzhou 2014-2030). The city's strategic development plan even set a population target of about 18 million by 2020.

Since the 1990s, dynamic spatial transformations have taken place in waterfront areas driven by market forces, resulting in many environmental and social issues (Bao & Liu, 2005; Zhang et al., 2013). Since most surface water that used to structure the urban fabric and carry social life has been covered, the city has lost its identity as a famous water city in southern China. Water however, is introduced back into the city for city branding and beautification purposes, in the form of canals and artificial lakes. The traditional urban fabric and public centres at urban waterfronts have been altered due to rising land prices, causing social equity issues such as polarisation and gentrification. In the meantime, the city is seeking new land and opportunities for expansion at the regional level. Urban growth is led by regional infrastructures such as highways, high-speed railways, international ports and airports. Thus, industry and logistics-based new town development is another trend of urban development. More land is being reclaimed from the sea, resulting in the issues of increasing flood risks and declining ecosystems (Zhang, 2009). As new ports have been established at the estuaries of the Pearl River, old industries and ports in the historical centre are facing new transitions.

§ 1.2.3 **Changing development ideologies and the way forward**

Taking a retrospective view on urban development worldwide, contemporary cities are more structured by short-term individual interests and that long-term collective interests are often ignored (Venturi et al., 1972; Frey, 2003). This kind of unsustainable development model has seen increasingly social and environmental challenges. For example, Gehl (2013) addresses a low priority on human dimensions and public interests in dominant planning ideologies such as modernism. In addition, delta cities are facing more complex issues such as climate change, globalisation, environmental deterioration, and growing social inequality (IABR 2016).

These challenges have urged ideological changes over values in development policies and planning practices on a global scale. Following the debate over sustainable development, the “Urban Agenda 2030” discussed at the UN Habitat III conference in 2016 reinforced both social and environmental aspects of values in urban development. The agenda made a commitment to pay more attention to urban deltas, coastal regions and other areas with sensitive environments. In particular, their importance as ecosystem providers and a significant resource for transport, agriculture, ecosystem services and resilience is highlighted. All these challenges demand that an urgent transition to a new economic model should take place, in the direction of low-carbon, resource efficient, socially inclusive and spatially integrated (Pieterse, 2008). The same trend is also happening in Chinese cities towards a balanced relationship between economic development and socio-environmental values. Since the 1990s, China’s annual GDP growth rate has been accelerated by rapid urbanisation and industrialisation but recently reached its lowest point, 6.7% in 2016. To cope with increasing pressures from the deteriorating environment and socio-economic transitions, the national government has been searching for a more sustainable and stable way of development, in the name of “New Urbanisation⁵” (Niu, 2013).

At present, a great variety of societal forms and cultures that have developed through history coexist in large historical metropolises like Guangzhou and these need to adapt to environmental, socio-economic and political transitions. The key question is, how to understand these transitions and redesign synergies among different social groups, between humans and nature, between system and individual, and ultimately between sustainability and growth. Due to the complexity and dynamic transitions of spatial development and associated interests in delta cities, we need a systematic analytical tool to help understand the past and present situations as well as provide scientific guidance for future development.

5

To deal with future socio-economic and environmental challenges in urban development, the Chinese government released the “*National Plan of New Urbanization 2014-2020*” in March 2014 (State Council of China, 2014).

§ 1.3 Research questions and the structure

§ 1.3.1 Research questions

This research is concerned with diverse values attached to water in spatial development at different stages in history. The main objective is to better understand the processes of urban transformations and the interrelationship between water values and spatial development in delta cities. Based on the interpretation of the value concept in a water-sensitive delta context, the thesis develops an empirically tested analytical framework of the value concept with spatial implications. The main empirical study is based on the long-term spatial development of Guangzhou representing a historical delta city in China with dynamic value transitions. Reviewing the historical development of Guangzhou, the society has formed different dominant values on water at each stage and keeps adapting to emerging risks and opportunities.

The recognition of diverse water values can play a central role in developing planning and design strategies. This research aims at exploring in what sense can the spatial changes be considered as an expression of the changing values, and what can we learn from it to deal with complex spatial situations. The value concept is studied to provide an analytical framework in linking theory and practice for a better understanding of the dynamics of spatial development.

The main research question is: **What is the interrelationship between water values and spatial development in urbanising deltas?**

In order to achieve this goal, three sub research questions are formulated as follows in sequential order:

Q1. What transitions of water values are reflected in spatial transformations?

Q2. What are the interrelationships between water values?

Q3. What are the implications of value transitions for urban planning and design towards sustainable urban water environments?

§ 1.3.2 Research structure

The thesis is divided into 3 main parts including 7 chapters (Figure 1.9): Part I (Chapter 1, 2, 3) – Introduction, understanding value theory in spatial development, analytical framework and methodology; Part II (Chapter 4, 5, 6) – Empirical studies of Guangzhou; Part III (Chapter 7) – Conclusions and implications.

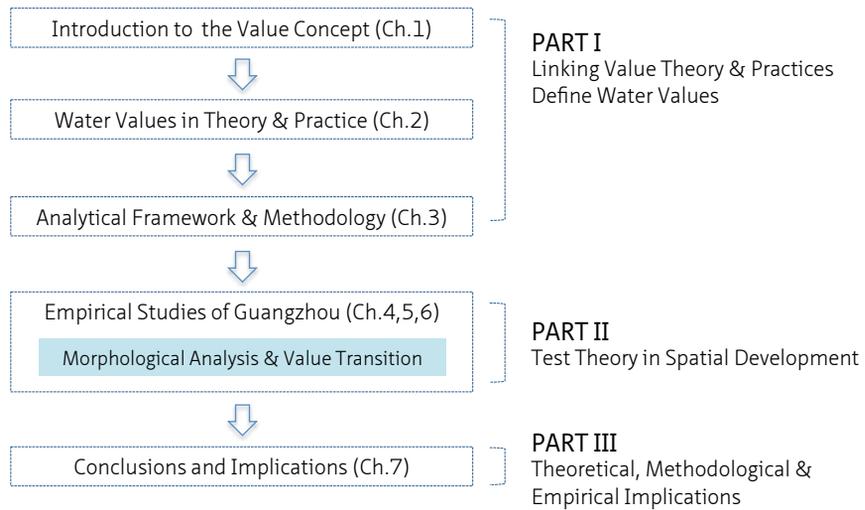


FIGURE 1.9 Research outline

Part I (Chapter 1, 2, 3) – Introduction, understanding value theory in spatial development, analytical framework & methodology

Chapter 1 introduces the problem statement regarding water related urban challenges in urbanising deltas worldwide and the case of Guangzhou as a dynamically developing delta city - flooding as well as the changing economic, environmental, social and cultural values of water. Recognising the gap between scientific research and planning practices, main research questions are proposed to develop an analytical framework that contributes to the understanding of spatial development from a value perspective. Chapter 2 gives an overview of value theory and its relation to public policy-making and spatial development from an interdisciplinary perspective. Based on extensive research and practices worldwide, the analytical framework and methodology on water values are explained in chapter 3.

Part II (Chapter 4, 5, 6) – Empirical studies of Guangzhou

The following three chapters (Chapter 4, 5, 6) use empirical studies to demonstrate the changing values of water at three main urban development stages of Guangzhou, reflecting different water-city interactions and values in spatial development: chapter 4 - the waterways city at the pre-industrial stage (before the 1920s); chapter 5 - the functional city at the industrial stage (1920s-1970s) and chapter 6 - the pluralistic city at the post-reform stage (after the 1970s). The phasing of the historical review will be explained in section 3.3.2.

Part III (Chapter 7) – Conclusions and implications

Chapter 7 answers research questions by summarising the transitions of four key aspects of water values in the analytical framework, analysing their interrelationships and concluding with three dimensions of values: form, scale, and time. Finally, the chapter addresses the implications of the value concept for the spatial development of Guangzhou based on value-related spatial patterns, and generalises theoretical and methodological implications for other delta cities in the world.

2 Water Values in Theory and Practice

§ 2.1 Introduction

Chapter 1 introduced the complexity of the delta system and water related urban challenges in Guangzhou as a representative case of delta cities: flooding as a main threat in dynamically changing socio-economic contexts. These challenges are associated with spatial development in regard to diverse interests and attitudes toward water. It argued that the main complexity of meeting multiple spatial development goals is concerned with complex and sometimes overlooked values. In this respect, the concept of “water values” was put forward to explain the hidden mechanism behind the spatial development of delta cities. To better understand how values influence spatial development and their characteristics, this chapter introduces value theory and its application on water values from an interdisciplinary perspective. First, the value concept is introduced at the theoretical and conceptual level with a discussion of values in society and the role of planning as an important public policy to promote public values. It argues that some values inevitably conflict with each other and that the synergy among values in spatial development is essential. This chapter further illustrates the main value transitions from the 1960s in spatial development and water management that both show the trend towards accommodating diverse values to cope with changing development needs and risks. Regarding the growing pressures from climate change and other water related urban challenges in delta cities, planning and design practices worldwide are introduced to gain practical insights on recognising diverse water values and coping with water related issues in spatial development. This chapter concludes with four main aspects of water values that shape the conceptual and analytical framework to be applied in following chapters including flood safety as well as economic, environmental and social values. Among which, the social aspect is often ill-defined but is nevertheless closely linked to the obligations of the planning profession.

All around the world, transitions of focal values in spatial development have taken place, influenced by changes in natural conditions, political priorities, social needs and perceived risks. In light of which, the Dutch experience of spatial development in a typical delta region indicates the tendency towards creating alternative spatial strategies and flexibility to achieve plural values throughout history. Some of the conceptual and empirical argument in this chapter is inspired by the Dutch method

of delta management composed of integrated concepts, initiatives and measures, particularly addressing the role of urban planning and design in consensus building among plural water values. Apart from the gradual shift of spatial policies that represent dominant values in society, the Dutch “layer approach” is introduced in chapter 3 under the framework of morphological analysis to help understand the dynamic and complex delta system with spatial and temporal implications.

§ 2.2 The value concept

§ 2.2.1 Basic values

The theory of value begins with the subject matter. Value theory is concerned with the understanding of how, why, and to what degree people value things (Rescher, 1982). The definition and scope of value varies in different fields, such as in psychology, economics, and sociology. In classical political economy, value is defined as ‘a measure of the worth of something to its owner or any other person who derives benefit from it, this being the amount at which it can be exchanged’ (Carmona et al., 2001). Reflecting economic principles (Bannock et al, 1998), two types of value can be distinguished - the exchange value that has tangible financial consequences and can be converted to monetary worth, and the use value that is more intangible and difficult to be measured financially (Marx & Mandel, 1894; Eccles, 1996). There is a growing tendency in theory towards addressing the ethical aspects of value (Stern & Dietz, 1994; Campbell, 1996), which extends the economic process to the underlying human motives. Moral or ethical value is thus discussed as ‘attaching to an act, motive or disposition, viewed in the light of a rule or principle, which in turn is designed to organize and harmonize interests’ (Perry, 1916).

In this thesis, water values are not simply concerned with the monetary, market worth of water or the objective functionality of water. Water values reflect the basic values of society or, in other words, how individuals and collectives attach value judgements to water. Therefore, it is essential to understand the concept of basic values and how it sheds light on the attitudes and behaviours of individuals as well as the functioning of organisations, institutions, and societies.

The concept of values has been discussed for several decades among anthropologists (Kluckhohn, 1951), philosophers (Morris, 1956), sociologists (Williams, 1968), and psychologists (Rokeach, 1973), and is defined as the ideological foundation of human interaction. Rokeach (1973) argues that 'the value concept, more than any other, should occupy a central position [...] able to unify the apparently diverse interests of all the sciences concerned with human behaviour'. Only since the 1990s has a systematic theory of the value system concerning individuals been proposed and empirically validated. Value theory defines values as 'desirable, trans-situational goals, varying in importance, that serve as guiding principles in people's lives' (Schwartz, 1992). Values are concerned with the selection or evaluation of actions, policies, people and events. Some basic values have been found across cultures regarding three universal requirements of the human condition: 'needs of individuals as biological organisms, requisites of coordinated social interaction, and survival and welfare needs of groups' (Ibid).

Value theory recognises value priorities and hierarchies, indicating the coexistence and dynamic interactions among a set of basic values. This provides the theoretical backbone for value transition. Maslow's well-known "hierarchy of needs" argues that people intend to acquire higher-level values such as self-actualisation when their basic needs are met (Maslow, 1943). According to Jorgensen and Bozeman (2007), values are not equally important and their interrelationships can be categorised into three main dimensions: proximity, hierarchy, and causality, which indicate their closeness and relative primacy. The relationships between values are either contradicting or compatible (Schwartz, 1996). For example, some empirical studies (Schultz et al., 2005) indicate that values for power and achievement are associated with viewing humans as consumers of nature, rather than part of it. And people who value individualism would stand in opposition to collectivism. It is important to acknowledge the dynamic interactions between diverse values, especially identifying the conflicts. Referring to cities worldwide, conflicts are highly concentrated in places with high cultural, social, and environmental values, and in the meantime influenced by economic pressures and interests (Girard, 2010). For instance, in the process of urban regeneration, conflicts are raised between real estate development and the preservation of cultural heritage in the historical city centre.

§ 2.2.2 Values in planning

Acknowledging that values are diverse and sometimes conflicting, consensus building based on shared values among actors is crucial for every society to function and develop in a stable condition. Contemporary societies are characterised by a plurality

of values shaped by political forces, societal ideologies, historical experiences, cultural backgrounds, territorial features, as well as shared beliefs and interests. Shared values can be regarded as the totality of the beliefs, attitudes, and political orientations expressed by the members of a particular society concerning current issues in their political and social environments (Anderson, 1997; Obo et al., 2014).

In practice, the outcome of spatial development is influenced by public policies. Davidoff (1965) defines values as 'inescapable elements of any rational decision-making process'. In the field of public administration, public value is widely discussed as an appraisal of what is created by public organisations (government for instance) as a result of evaluations about the basic needs of individuals, groups and the society as a whole (Moore, 1995; Meynhardt, 2009; Bozeman, 2007). In terms of inevitably conflicting values, policy actors often search for "trade-off" strategies to prioritise certain values (Bozeman, 2007) by applying some evaluation tools such as the cost-benefit analysis. It has been argued that values are hardly commensurable in political practices. It is not plausible to weigh values rationally and decide their relative importance (Thacher & Rein, 2004; Stewart, 2006). In reality, policy makers "cycle" between conflicting values over time or they assign primary responsibility for pursuing each value to a separate institution, which is normally the case in a modern society. As a result, the policy responses to value conflicts are often short-term and the underlying dilemma is rarely resolved (Thacher & Rein, 2004).

As an important public policy, an ideological transition has taken place since the 1960s-70s in the planning of Western countries, from focusing on the physical and functional aspects of the city to addressing plural public values in spatial development that the expected role of planners has also changed (see section 2.3). Davidoff (1965) argues that planners should act as advocates articulating the interests of diverse social groups, especially the poor and powerless. Contemporary urban planning is recognised as essential for consensus building among actors, which is concerned with 'a community of common interests' (Harvey, 2000). In practice, consensus building is difficult in that diverse groups represent divergent interests. Campbell (1996) illustrates three main conflicts in a triangle of planning goals: a property conflict between social justice and economic growth (efficiency), a developmental conflict between social justice and environmental protection, and a resource conflict between economic and environmental goals. At the conceptual level for example, economists and environmentalists speak different languages. Dialogue needs to be created to exchange the economic vocabulary of global cities, market forces, and regional restructuring etc. with ecological terms such as carrying capacity and biodiversity. Planners need to act as "translators" to communicate the priorities and reasoning among diverse groups (Campbell, 1996).

Values are regarded as path dependent (Inglehart & Maker, 2000). Although the modernisation process worldwide has an impact on local traditional values, the fact that a society is historically shaped shows the persistence of traditional values with enduring effects. Therefore, the judgment of planning alternatives requires an understanding of universal values and the particularities of place. As values are characterised by contextual factors and dynamic interactions, planning should not be restricted to fixed values and singular notions, but rather a process of valuation and evaluation (Campbell, 2002), and the process of strategy development requires an integrated perspective of values (Friedmann, 1987). In-depth and comprehensive recognition and understanding of values can help policy makers identify development opportunities and create alternative solutions (Cerreta, 2010). This requires value-based thinking from a multi-dimensional perspective, which considers tangible and intangible values, use and non-use values, intrinsic and extrinsic values as well as their complex relations, either synergic or conflicting. Insights across boundaries are also needed in order to formulate a “situated strategy” (Liew & Sundaram, 2009).

§ 2.3 Value transitions from the 1960s

Values change through time in line with changing political agendas, societal needs and cultures, as well as the emergence of previously unknown risks. Modernisation for example, brought economic security to society, which also led to a shift in values from authority, hierarchy, and conformity to autonomy and diversity (Inglehart, 1997). In the process of spatial development, the transition of development ideology reflects the orientation of dominant values at different stages. In order to better understand the transitional nature of dominant values that influence the perception of water and its management through history, this section illustrates value transitions in both spatial development and water management from the 1960s when environmental crises and socio-economic restructuring required a shift of dominant values. In such a context some new development concepts such as sustainability, liveability, spatial quality, adaptation and resilience took shape and had a strong impact on spatial policies.

§ 2.3.1 Value transitions in spatial development

In the 1960s-1970s, a global trend of value transition in spatial development took place, when levels of environmental awareness generally increased in Western society. Environmental degradation was recognised as a result of industrialisation and economic growth, as indicated in the “Club of Rome” report entitled “The Limits to Growth” (Meadows et al., 1972). The concept of value implicit in the calculation of GDP was criticised as reflecting ideological prejudices towards economy. This was followed by discussion of the quest for sustainable development that might deliver an equilibrium between the economy and environment (IUCN, 1980).

A broad consensus concerning sustainability emerged in 1987 in the report of “Our Common Future”, also known as the “Brundtland Report”, namely that ‘Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ (WCED, 1987, P8). In 1992, the United Nations Conference – “Earth Summit” in Rio de Janeiro - further addressed this concept on the global agenda. There are three main pillars of sustainable development: social, environmental and economic conditions. It is also represented in the well-known Triple P (People, Planet, Profit) concept (Figure 2.1). Sustainable development is about finding a balance between these three aspects (UNGA, 2005).

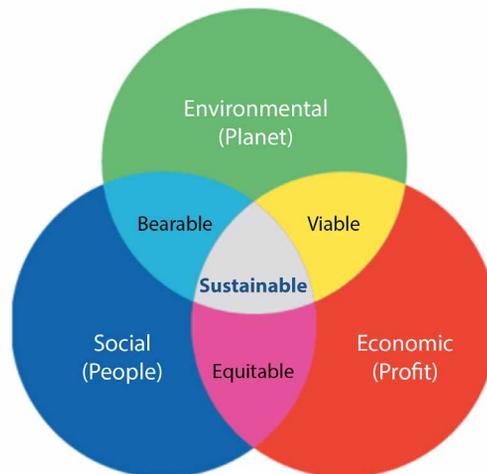


FIGURE 2.1 Venn diagram of sustainable development
Source: adapted from Tanguay et al., 2010

The three pillars of sustainable development reflect three main aspects of water values: namely social, environmental and economic values. The key principle to maintaining a proper balance between these three aspects is to understand and harmonise their relations. There are three aspects to sustainable development: economic viability, social benefit and environmental support. Economic viability means that development should be economically feasible and viable in the long term. Social benefit suggests that development should be responsible and beneficial to broad social needs while environmental support indicates that the development model should be environmentally friendly, energy efficient, ecologically supportive and incur minimal negative environmental impacts. In terms of sustainable water management, plans and strategies should be socially and environmentally bearable, therefore not exceeding the carrying capacity of the society and the natural environment. They should also be equitable in terms of socio-economic relationships between people and profit making. Finally, to deal with environmental and economic conflicts, a viable strategy should be both environmentally friendly and financially feasible (Tanguay et al., 2010; Giddings et al., 2002).

In the meantime, the need to change urban development models became more urgent as many big cities in Western countries were confronted with urban sprawl and a decline of attractiveness in the city centre. A growing concern over the quality of life, urban vitality and social diversity triggered criticism on rationalist and modernist planning and further propelled retrospective planning and design practices worldwide in the 1960s (Lynch, 1960; Jacobs, 1961; Alexander, 1965). Some concepts concerning living quality such as liveability and spatial quality came into fashion in both societal and political debates.

Liveability is a reflection of “quality of life” and the satisfaction of societal needs (de Haan et al., 2014). Lynch (1981) discusses the form of a good city or a “good settlement” and suggests that ‘for a city to be liveable, it must be responsive to the human situation and further determines the connection between human values, their actions and the physical form of cities’. Vuchic (1999) describes the elements of liveability including safety, economic opportunities, welfare, health, convenience, mobility and recreation at all scales. Van Dorst (2011) defines liveability as an indicator for a sustainable environment that provides healthy and safe living conditions, and supports control over interactions with the human society and nature. These ideas on liveability have addressed diverse needs concerning human values. In order to stress the importance of “space” in the urban context, the term “spatial quality” is highlighted to address the process of value creation that results from spatial interventions. Spatial quality is defined by three values: “user value”, “experiential value”, and “future value”, referring to the dimensions of function, form and time. According to Heurkens (2001), spatial quality is ‘the degree to which the development

project satisfies user, experience and future values of multiple actors involved'. These three values are ultimately based on Vitruvius' well-known trio of "utilitas", "firmitas" and "venustas", indicating buildings should meet functional, stable and aesthetic criteria (Franzen et al., 2011). The Fifth National Policy Document on Spatial Planning in the Netherlands (VROM, 2001) defines the criteria of spatial quality as follows: 'spatial diversity, economic and social functionalities, cultural diversity, social equality, sustainability, attractiveness and human scale'. Spatial quality cannot be discussed without reference to social, cultural, and psychological factors involved in the interaction between man and environment (Rapoport, 1970).

Water is essential for achieving sustainability, liveability and spatial quality in delta cities, this is reflected in dynamic water-human interrelationships. For example, waterfronts have become focal areas that can provide certain living quality to bring attractiveness and vitality to cities (Hoyle & Pinder, 1981; McCarthy 1996). Although these concepts are often intertwined and have seen an increasing influence in political discourse, an evolving nature of focal values can be perceived along with changing contexts. Sustainability is concerned with the maintenance of natural resources and long-term environmental impacts of development, while liveability focuses more on the benefits gained by individuals or society, thereby the social dimension is strengthened. Additionally, spatial quality connects the quality of life and living environment with the organisation of space, so that spatial diversity, functionality and experience are associated with public values. These concepts all have value related spatial indicators, such as ecological environment, economic performance, human environment and social development. As water plays an important role in people's daily lives regarding safety, wellbeing and interaction etc., the indicators of liveability with a water dimension have been widely recognised (Johnstone et al., 2012). The social needs of water in relation to sustainability, liveability, and spatial quality will be further illustrated.

§ 2.3.2 Value transitions in water management

Also since the 1960s value transitions have taken place in urban water management, from the single value of flood mitigation towards combining flood mitigation with other water values regarding the opportunities of economic, social and environmental development, such as recreation, aesthetics, ecology and resilience (Fletcher et al., 2015) (Figure 2.2).

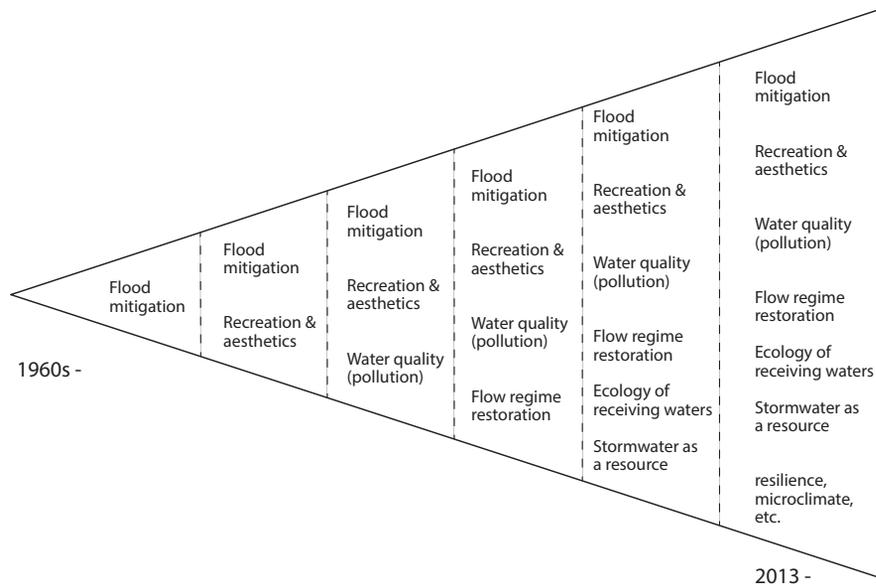


FIGURE 2.2 Increasing water values recognised by urban drainage management over time
 Source: Fletcher et al., 2015, adapted from Whelans et al., 1994

This transition reflects the changing perception of water in society driven by the required functions of water and socio-political forces (Figure 2.3). The origin of many cities relied upon a dependable water supply, navigable waterways, and water powered industries. Urbanisation disturbs the natural processes of infiltration and drainage due to increased impermeable surfaces, leading to the construction of separate sewerage and drainage systems. Over the recent decades, growing environmental and socio-economic pressures have triggered a (re)appreciation of the multi-functional role of water, that the concept of the “water sensitive city” has been put forward to create a resilient, liveable, productive and sustainable living environment.

As shown in Figure 2.3, from a water supply and sewered city to a water sensitive city, the transition demonstrates significant changes in water values, from a mono-functional facilitator to a multi-functional and valuable resource. For example, some key values including ecological health, amenity and equity are added to the framework of the water sensitive city. This kind of transition not only reflects technological innovations, but also shows a comprehensive development of societal and institutional arrangements. Meanwhile, the awareness of future uncertainties such as urbanisation and climate change is also considered in this framework.

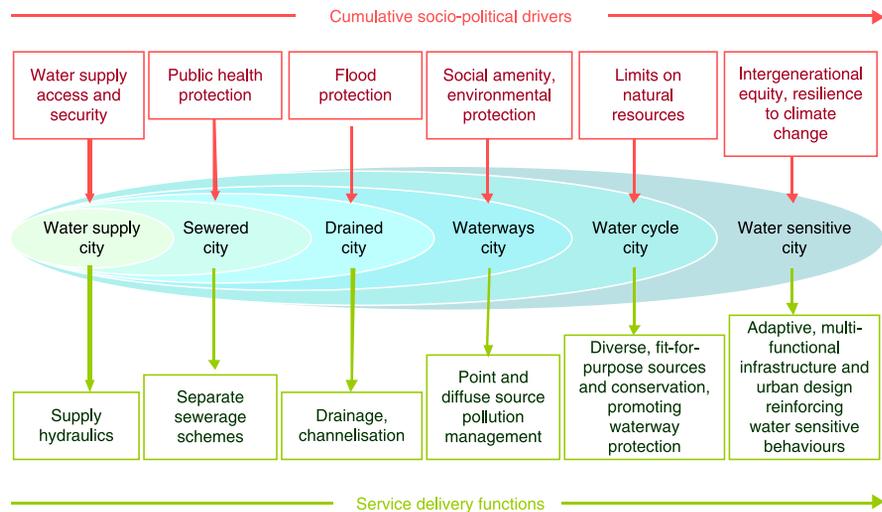


FIGURE 2.3 Urban water management transitions framework of Australian cities
 Source: Brown, Keath & Wong, 2009

Since the 1990s, a growing concern has arisen across the globe over the urgency to deal with the uncertain consequences of climate change (Hallegatte et al., 2013). Situated in low-lying floodplains with complex water systems, delta cities are particularly vulnerable to the consequences of climate change related floods that are aggravated by sea level rise and extreme climate events such as storms, typhoons, tsunamis, and intense precipitation (Aerts et al., 2012). The traditional prevention-focused approach of water management has been recognised as unsustainable and lacks the flexibility to deal with increasing peak discharges of rivers and intensifying rainstorms. Some new concepts such as adaptation and resilience emerged in response to unpredictable risks like climate change. Resilience is defined as the capacity of a system to buffer or cope with natural variations, recover from disturbances and return to its previous state (Klein et al., 2004; Folke, 2006). The scope of resilience is broadly discussed in relation to engineering, ecological and social dimensions (Davoudi, 2012). The concept of resilience is important to places with high environmental risks and social complexity such as urbanising deltas, where spatial patterns and the society are expected to withstand disturbances with an adaptive capacity and transform the system to stay functional. This idea has been applied in water management practices such as the Dutch multi-layered safety approach. It recognises that flood management is not only the responsibility of engineers, but also land use planning, early warning and evacuation should be integrated (Walker & Salt, 2012; Folke et al., 2010; Lu & Stead, 2013). Regarding the complexity of both physical and social systems in delta cities, the transition to climate-adaptive or resilient spatial development shows a shift in water management from centralised flood defence approaches led by the state to

more involvement of society that can endure temporary disturbance and contribute to the repair afterwards. It is a major challenge in values that urban planners, hydraulic engineers and policy-makers need to address (Meyer et al., 2010; Carter et al., 2015).

The concern over climate change and its uncertain impact, together with the growing societal needs of better spatial quality, has driven policy transitions in water management. In the Netherlands for example, the scope of water management has extended beyond traditional technological measures to the consideration of a wide range of water values including flood safety, economic prosperity, nature conservation, and spatial quality (V&W, 1998). An increasing awareness of environmental sustainability and adaptation to climate change has led to discussions on innovative and adaptive planning and design measures (van Veelen, 2016; Pahl-Wostl, 2002; Jacobs & Buijs, 2011).

§ 2.4 Underlying water values in urban planning and design practices

Value transitions not only take place at the conceptual level, but also are rooted in planning and design practices worldwide. This section introduces some of these concepts and local design practices, with an indication to the transitions of focal water values by means of planning and design approaches. China has the tradition of learning through international experiences in order to tackle urban development issues, especially since the 21st century when environmental challenges and diverse social needs have required a more adaptive and sustainable development model. To deal with growing flood risks, best practices worldwide were promptly applied in small-scale pilot projects in China. Innovative ideas and advanced technologies were learned in an effort to build flood-proof cities, including the concepts of “water sensitive urban design” and “low impact design/development”, as well as some pilot projects such as the “Chicago tunnel and reservoir plan” and the “Cheonggyecheon Stream restoration project”. However, due to different political, economic, social, cultural, and geographical contexts and development pressures, successful practices in other countries may not be optimal solutions for Chinese cities. In relation to which, the “sponge city” programme in China is mentioned to show the trend towards integrated water management approaches and associated challenges.

§ 2.4.1 “Water sensitive urban design” and “low impact design”

Applying the water sensitive principle, recent decades have seen emerging initiatives to deal with the opportunities provided by urban development and flood mitigation from an integrated perspective, such as “water sensitive urban design (WSUD)” in Australia, “low impact design (LID)” in New Zealand and “low impact development (LID)” in USA and Canada, “urban flood management (UFM)” in Europe, and “sustainable urban drainage systems (SUDS)” in UK. These concepts have been widely applied in water management, urban design and planning practices, with a focus on developing strategies and principles to solve water related urban issues.

Water sensitive urban design (WSUD) is an urban design initiative practiced in Australia. It is targeted at urban design professionals to integrate land and water planning and to develop best practices regarding water conservation and reuse, stormwater and environmental management based on a “best fit” principle for various urban patterns. As such, WSUD aims to combine multiple water values through design. Firstly, it protects and enhances the intrinsic value of the natural water cycle and environmental quality by minimising disturbance to existing ecological conditions and the natural hydrologic processes of catchments and riparian zones (Wong & Brown, 2008). Secondly, it aims to reduce downstream flooding by managing stormwater runoff. Thirdly, it provides water-related environmental and recreational opportunities. WSUD represents a significant shift in the way water resources and water infrastructures are considered in planning and design, so that opportunities for land use planning, urban design, ecology, and stormwater management are intrinsically linked (Wong, 2006). WSUD combines economic, environmental and social benefits of water with urban design opportunities to achieve ecologically sustainable development (Hoban & Wong, 2006). Some best planning practices (BPPs) are mentioned, such as land use planning, multifunctional public open spaces, street layouts and streetscapes (Water by Design, 2009).

Similar to WSUD, low impact design (LID) is a site design approach in New Zealand that incorporates natural features into stormwater management plans. Water is considered a key natural resource that should be managed in a sustainable way (Dietz, 2007). Some basic principles of LID are identified as follows, ‘adapt environmental systems to account for urban constraints; plan for urban frameworks, patterns of infrastructure, and natural systems at appropriate scales to achieve “the right thing in the right place”’ (ARC TP124 Low Impact Design Manual for the Auckland Region, ARC 2000). A toolkit was developed within a technical report prepared by the Auckland Regional Council to combine opportunities of LID and urban design at multiple scales and across urban and environmental gradients (Figure 2.4). Urban and environmental transitions

are referred to as “transects” in the toolkit that focuses on three main scales: urban density and land use change at the regional or municipal scale, different flood control measures according to topographic and hydrological features at the catchment scale, and local stormwater management measures at the site scale (such as bio-retention systems, green roofs and swales) that are located at, or near, the source of runoff (Lewis et al., 2010). Among these, a “living street” concept is highlighted in the guidelines so that the objectives of LID and urban design can be highly integrated in the design of streets as the main public spaces for social life and the main locations of stormwater treatment facilities.

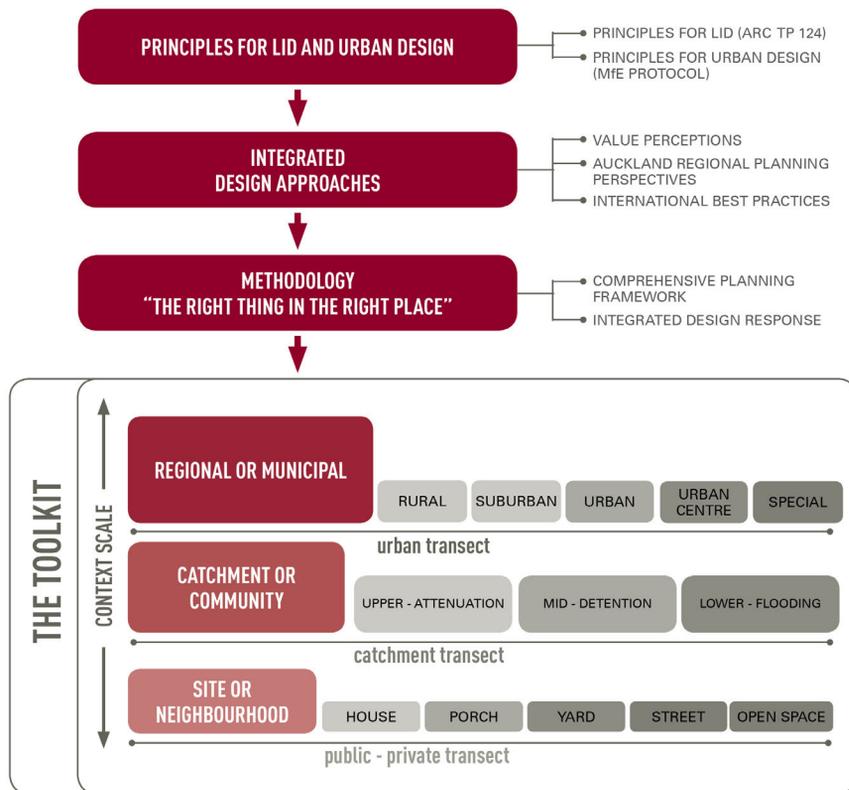


FIGURE 2.4 Low Impact Design Toolkit in New Zealand
Source: Lewis et al., 2010

§ 2.4.2 The Dutch delta management

Located in the Rhine-Meuse-Scheldt Delta (RMSD), the Netherlands has a long history and abundant experience in integrating water management in spatial development. Throughout the centuries, the Dutch have had to defend themselves against flooding by building dikes and dams, canalising rivers and reclaiming land for socio-economic activities (van de Ven, 1996; Vossesstein, 2014). Catastrophic flooding events in history led to large-scale engineering approaches to coastal flood defence. The resistance-centred approach during the 19th and 20th centuries tuned the river system, the drainage systems in the polders, and the coastline into machines (Meyer, 2016). Many environmental problems emerged as a result of the “dredge, drain and reclaim” approach of land development: this included land subsidence, coastal erosion, salinisation and a decrease of the discharge capacity of rivers (van Veen, 1950). Therefore in the 1970s, the Dutch government was confronted with public resistance against coastal engineering flood defence for its ignoring of important values other than flood safety, such as ecological, economic and social consequences, leading to a transition of paradigms from “fighting against water” to “involving nature” (Correljé & Broekmans, 2015; Keessen et al., 2013; Disco, 2002). Flood risks have been tackled in combination with environmental needs, land uses, and water-related functions such as port development and recreation (van der Brugge et al., 2005; Meyer et al., 2012).

Facing increasing pressures from climate change and environmental decline, a shift of dominant values in the spatial development of the Dutch delta took place in the 1990s, from the focus of flood defence to the integration with multiple values concerning socio-economic development and environmental quality. Meanwhile, a transition has taken place in Dutch policies to promote decentralisation and liberalisation, combining both centralised (national) steering and decentralised (local) decision-making processes (Zevenbergen et al., 2015). The national “Room for the River Plan (RvR Plan)” is one of such initiatives to increase the discharge capacity of main rivers in the delta and improve spatial quality (Ministry of Transport, Public Works and Water Management, 2006). Rather than following previous defensive approaches, alternative water management measures were applied to accommodate water in the river system with more space, such as widening the rivers, removing obstacles, creating ancillary channels, and increasing retention areas.

Situated at the bottleneck of the River Waal with great flood risks, the project in Nijmegen demonstrates the achievement of synergy among diverse water values and a balance between the national goal of flood safety and local development needs by adaptive design (Nijssen & Schouten, 2012). The initial design proposed by the national infrastructure-planning agency merely focused on flood safety and showed

little concern for other interests in this area. To increase the river discharge capacity, an ancillary channel was proposed in an area that had been previously designated for a large housing project, which could hinder the city's expansion plan. As a result, the announcement of the plan resulted in strong protests from the local inhabitants and the municipal executive (Heeres et al., 2017). With the municipality in the lead, a vision was formulated to explore how different interests can be integrated with opportunities for water management, urban development, economy and leisure, as well as local and regional road infrastructures in the area. As a result, alternative design solutions were carried out to resolve the conflicts between flood safety advocated by the national government and other values regarding socio-economic development at the local level (RvR, 2013; Zevenbergen et al., 2015). The project has also brought added value to the environmental, social and cultural development of the city while meeting its economic development plan (Reimerink, 2015).

§ 2.4.3 China's "Sponge City" Programme (SCP)

With existing urban drainage systems insufficiently dealing with pluvial flooding in China, the central government has been searching for alternatives of flood management approaches that can be combined with urban development needs. In such a context, the "sponge city" programme (SCP) was initiated in 2014 by the national government, guided by several national sectors including the Ministry of Housing and Rural-Urban Development (MOHURD), the Ministry of Finance (MF) and the Ministry of Water Resources (MWR). Municipalities are responsible for the planning and construction of sponge city projects at the city level. Thirty pilot cities across China were approved in 2015-2016 and allocated substantial financial support by the central government.

Adapted from the concepts of WSUD and LID etc., researchers and practitioners have been exploring the application of such concepts in the Chinese context (Yu et al., 2015; Qiu, 2015). As distinct from past flood control measures, SCP stresses the role of urban planners and designers in urban flood management. It is expected to experiment with the ways cities can collect, store, drain, purify and reuse rainwater like sponges, through green-blue infrastructures, including natural water systems, wetlands, permeable pavements, rain gardens, and green spaces. These indicated measures however, are still restricted to the technical level with quantifiable control and make a limited contribution to spatial quality. According to the "National Technical Guideline for Sponge City Development (2014)", SCP aims at maximising water retention and minimising the effects of urban flooding. The overall objective is to absorb and reuse around 70% of

rainwater in urban areas. From 2015, all types of new urban districts, industrial parks, development zones and communities should be designed and built according to the new standard (Guidelines for Promoting Sponge City Development, 2015).

Although armed with innovative ideas, China's sponge city programme is facing many challenges and the effectiveness of flood mitigation requires a long-term investigation. First, the sponge city concept is still at the experimental phase and focuses on small-scale pilot projects, the scaling up of which remains a challenge. Second, the selection of the pilot projects for the implementation of the sponge city concept mainly depends on their feasibility and development potential. All these 30 cases are either located in small cities or new districts of big cities. While suffering a high flood risk, Guangzhou however, is not yet on the list. One practical reason is that the construction of new water retention facilities or the replacement of surface materials is much more complicated in densely built urban areas than in new districts. Third, instead of a repetition of conventional technical flood management measures, how to integrate the programme in the current urban development agenda is essential for the planning practice. Along with flood mitigation, SCP can be integrated with urban development opportunities to bring added value to the city, such as recreational public spaces, healthier environments, increased biodiversity, and cooler temperatures. It is therefore a challenge but also an opportunity for urban planners and designers to play a role based on local issues and development demands. The possibility and feasibility of integrated strategies for Guangzhou with the sponge city concept will be further discussed in chapter 7.

§ 2.5 Water values as a conceptual framework

As discussed in chapter 1, water values can be regarded as a lens to help understand the mechanisms influencing the spatial development of delta cities. This section is focused on defining water values and the key aspects for delta cities. Water values are associated with the benefits which society derives from water, either directly or indirectly, via the market or via other mechanisms (Burril, 1997). A number of studies have focused on how indigenous societies attribute meaning to water and the role of water in social organisations (Strang, 2004; Mooney & Tan, 2012). A contextual principle for urban water management has been developed based on the aspect theory of Dooyeweerd (1953) and applied to disclose present or potential values of water to actors (Figure 2.5). Each aspect is a perspective that human beings can attribute meaning to the urban area, such as health (biotic aspect), perception (sensitive aspect),

coherence (analytical aspect), history (formative aspect), symbol (lingual aspect), quality of life (social aspect), efficiency (economic aspect), beauty (aesthetic aspect), regulation (juridical aspect), and care (ethical aspect), commitment (pistic aspect). It is suggested that a balance should be maintained in water management to combine both the technical norms (functioning of water) and the societal norms (safety, logic, effectiveness, etc.) (Lems, 2008).

Although the religious view is not a focus of this research, it plays an important role in influencing people's beliefs and values, especially the traditional ones. The above-mentioned aspect theory of Dooyeweerd is based on his belief in Calvinistic (dogmatic-protestant) principles, which is regarded very controversial for those who have a more liberal idea of religions.

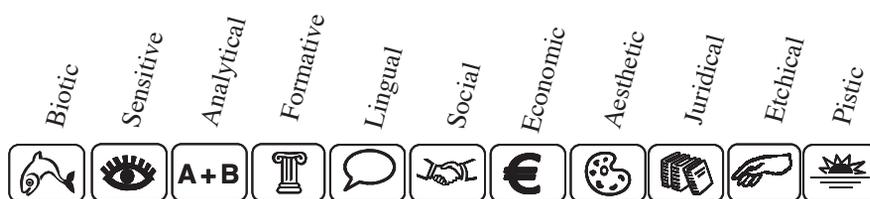


FIGURE 2.5 Values of water
Source: Lems, 2008, P4

Some other research focuses on a broad sense of water as related to societal needs and liveability. According to Syme and Nancarrow (2008), the social aspects of water can be conceptualised in the sphere of needs (SON) including health, wealth, prestige and social identity, social cohesion, recreation, aesthetics, moral and cultural, and spiritual needs. In addition, categories of societal needs in urban water systems are developed, as shown in Table 2.1 (de Haan et al., 2011), that are based on Maslow's "hierarchy of needs" (Maslow, 1943) and Alderfer's "E.R.G. Theory (Existence, Relatedness and Growth needs categories)" (Alderfer, 1969). Existence needs include material and physiological desires, such as safety. Relatedness needs refer to relationships and interactions between people and nature, which is associated with the aesthetic and recreational role of water. Growth needs are related to one's opportunities, including identity and social equity etc.

TABLE 2.1 Societal needs in urban water systems (de Haan et al., 2011)

NEEDS CATEGORY		Urban Water Societal Needs	Description
Existence	Physical and material needs	Drinking water	Safe, secure and accessible supply of water for direct human consumption
		Non-drinking water	Safe, secure and accessible supply of water available for other uses
		Public health	Protection from polluted wastewater and stormwater; tolerable microclimates; public places that promote physical and mental health
		Public safety	Protection of people from the hazards of water, e.g. during floods or storm events
		Property protection	Protection of property and infrastructure from water, e.g. during floods or storm events
		Economic activity	Industries and jobs that rely on water and/or water systems and services
Relatedness	Social interaction and inter-personal relationships	Recreation	Places for play, sport and leisure
		Social cohesion	Safe and secure places for social interaction and human connectedness with people and nature
	Societal-environmental inter-relationships	Beauty	Aesthetic urban environments
		Comfort	A pleasant micro-climate and landscape for human thermal comfort
		Ecological health	Clean and healthy ecosystems with no negative impact on other ecosystems
Growth	Societal self-esteem and self-actualisation	Identity	Harmony with culture and tradition, to feel belong. Proud association with urban water systems and environments
		Purpose and ambition	Progress towards a shared vision of a water sensitive future
		Control and independence	Choice and influence on decision-making about water infrastructure and services
		Equity and social justice	Equal opportunity to access the benefits of the urban water system
		Intergenerational equity	Preserve the ability of future generations to meet their water-related needs

In China, water has played a multifunctional role in structuring the built environment and social life. In ancient times, water facilitated the military defence, drainage, storage, recreational space and trading route (Wu, 1995). In the process of industrialisation and urbanisation, some important values disappeared, and water was once the main facilitator for industry and economic activities. The missing socio-cultural and environmental values of water have been addressed by researchers, practitioners and even at the governmental level (Zhang, 1998; Zuo, 2013). In 2013, the National Ministry of Water Resources put forward the “Advice for Accelerating the

Construction of Water Ecological Civilization (关于加快推进水生态文明建设的意见)”, which highlighted seven key values for sustainable urban water management: water safety, water resources, water quality, water ecology, water aesthetics, water culture, and water economy. These key values show the reflections and main considerations of water as an opportunity for enhancing the social, environmental and economic performance of cities in contemporary Chinese society.

Water is crucial for spatial development, which in turn is greatly influenced by human interventions based on people’s perceptions of water. Water is generally valued in multiple ways: the economic value that is utilised with pricing mechanisms for economic benefits, the environmental value representing water system services for nature and ecosystems, and the social value indicating the cultural and emotional meaning of water in human society (Van der Brugge et al., 2005; Smith, 2013). Based on the contexts and challenges of water related spatial development in delta cities and in response to climate change, four key aspects of water values are defined, namely, flood safety, economic, environmental, and social values.

§ 2.5.1 Flood safety

The value of flood safety here refers to the level of protection against flood hazards. As mentioned in chapter 1, flood safety is of crucial importance to the quality of life and socio-economic development of delta cities. In particular, facing the uncertainties of climate change, a growing number of flood events have been reported worldwide since the 1950s (Jha et al., 2012). In general, delta cities are highly exposed to three main types of flooding: fluvial flooding (flooding from the river), coastal flooding (flooding from the sea), and pluvial flooding (flooding from heavy rainfall before the runoff enters drainage).

Flood risk is defined by two important factors, probability (the chance of flood events) and consequences (the level of damages and losses) (Hall et al., 2003). Urban development patterns are closely related to the level of flooding consequences. Abundant studies have demonstrated that increased flood risks worldwide are associated with a high rate and intensity of urban development and population growth (Crichton, 1999; Nirupama & Simonovic, 2007; Wheater & Evans, 2009). Flood risk is related to hydrological, social, economic and political uncertainties. As urban areas grow, both geographically and demographically, flood risk increases due to higher exposure of population and assets. Throughout the centuries, continuous land reclamation and development activities in low-lying coastal areas have greatly

intensified the risk of coastal flooding. Watercourse channelisation and regulation for navigation and industrial functions have narrowed riverbeds and increased vulnerability to river flooding in case of dike failure. The process of urbanisation has greatly intensified pluvial flooding by altering hydrologic characteristics, such as the decrease of surface water and pervious area (wetlands, natural ponds and streams) and the increase of the surface runoff process (Montz, 2000). Figure 2.6 shows that while the natural water cycle normally features by high evaporation and infiltration rates and low surface runoff. However, urbanisation processes disrupt natural drainage patterns and watercourses by turning pervious natural surfaces into less (or non) pervious artificial surfaces. Consequently, the capacity of surface water bodies, plants and soil to naturally retain stormwater runoff declines, leading to an increased risk of urban flooding (WMO/GWP, 2007b).

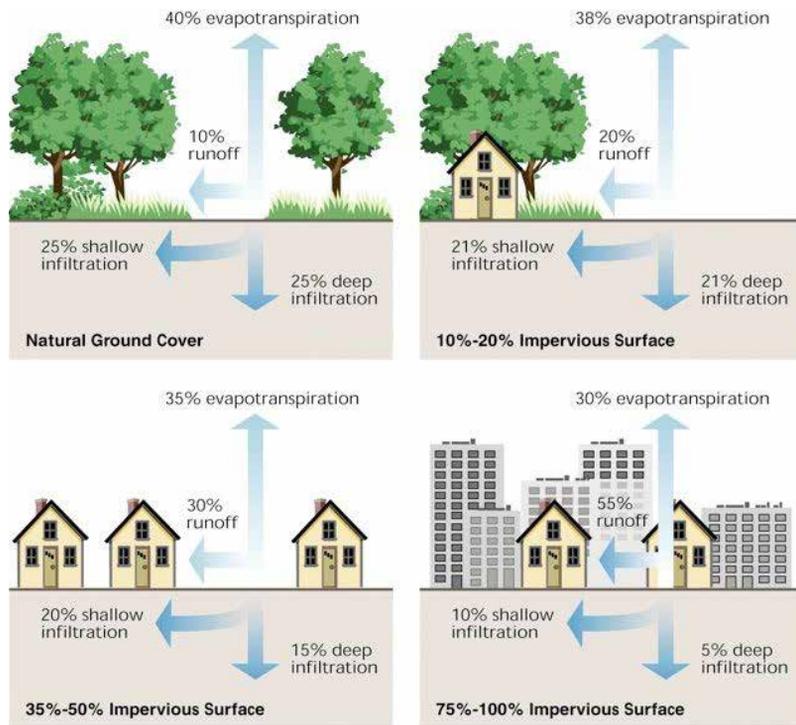


FIGURE 2.6 Degrees of imperviousness and its effects on stormwater runoff
 Source: *Stream Corridor Restoration: Principles, Processes, and Practices* (10/1998) pp. 3-23
 By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

§ 2.5.2 Economic values

Water is the fuel of the economy. The United Nations Conference on Environment and Development (UNCED, 1992) concludes that: 'Water should be regarded as a finite resource having an economic value with significant social and economic implications regarding the importance of meeting basic needs.' Likewise, the Dublin Statement on Water and Sustainable Development (1992) indicates that, 'water has an economic value in all its competing uses and should be recognised as an economic good.'

Water facilitates core economic activities in the delta, such as agriculture, fisheries, cargo traffic and goods processing (Meyer et al., 2015a). The role of water and the ways in which water is utilised to boost economic profits differ. In rural areas, water is a valuable resource for agriculture, aquaculture and fisheries. Before the industrial stage, major rivers were regarded as engines for economic development as they provided vital transport routes. Therefore, the most prosperous cities, such as Rotterdam, Shanghai, and Guangzhou, etc., were originally developed along major rivers that enabled their trading, port and commercial activities. To facilitate navigation and as a convenient link with inner cities, canals were dug and connected to rivers. In the industrial era, these rivers functioned as principal water supply resource and transport routes for industries and ports. Influenced by the global market, water today contributes to multiple aspects of the economy. In China for example, economic growth has been highly prioritised in the last three decades that the ideology of "planning for growth" has greatly influenced the urban water environment (Wu, 2015a). Water is considered a catalyst for city branding and attracting investments and tourists. Urban waterfronts have been undergoing transitional functionalities such as real estate development due to increasing land prices.

§ 2.5.3 Environmental values

Water is the most important natural resource in deltas, taking the form of rivers, lagoons, ponds and wetlands. Water is of vital importance to the natural environment via its support of the wellbeing of human and aquatic habitats. Areas of gradual transitions between land and water and between salt and fresh water are the biotopes for many species that are crucial for the ecological balance. Deltas possess rich ecosystems, including both freshwater ecosystems of rivers and saltwater ecosystems from seas and oceans, such as beach and dune systems, salt marsh systems, coastal coral reefs and mangrove forest systems. Wetlands also have great environmental values such as water

storage, climate adjustment, water purification and biodiversity conservation (Woodward & Wui, 2001). The undervaluing of ecosystems leads to its lack of priority in decision-making concerning land use plans (Emerton & Bos, 2004). To emphasise the economic and social benefits of ecosystems, some studies focus on quantifying the environmental values of water, such as ecosystem services (Costanza et al., 1997; Daily, 1997).

Apart from the ecological role of water, environmental quality is often mentioned as an essential value to the satisfaction of people in physical, social, and symbolic senses (Lansing & Marans, 1969; Porteous, 1971). In terms of sustainability, the environmental values of water are highly associated with the living quality and wellbeing of people. One of the main reasons for delta regions being hot spots for human settlements is their attractive environment composed of a natural water landscape. However, the urbanisation process has exerted negative impacts on the natural environment. Unsustainable urban development usually results in a decline of the water environment, such as via water pollution or a loss of biodiversity.

§ 2.5.4 Social values

The social values of water are concerned with the role of water in shaping the society and facilitating the relationships between different social groups, as well as between humans and nature. The social values of water are associated with the unique culture of each society, which influences the ways that water is valued, used and managed by the majority (Johnston et al., 2011). In the third World Water Forum (Kyoto, 2003), UNESCO defined water as ‘the only natural resource to touch all aspects of human civilization - from agricultural and industrial development to the cultural and religious values embedded in society. The ways in which water is conceived and valued, understood and managed, used or abused, worshipped or desecrated, are influenced by the cultures of which we are a part.’

The cultural meaning of water plays an essential role in Chinese society. In ancient China, water was considered as an important natural resource and that a balance should be maintained between humans and water (Wang, 2002; Ball, 2016). For instance, in Taoist philosophy, water is regarded as the essence of nature and a model for human conduct: ‘be still like a mountain and flow like a great river’. Cultures change through modernisation and globalisation. To accommodate a rapidly changing economy and urbanisation, the essence of Chinese philosophy has been inherited and adapted with new meanings at present. To specify the complex social values of water, three main dimensions are discussed.

The first dimension is cultural diversity, as highlighted by UNESCO, 'Culture takes diverse forms across time and space. Diversity is embodied in the uniqueness and plurality of the identities of the groups and societies...It is the common heritage of humanity and should be recognized and affirmed for the benefit of present and future generations' (UNESCO Universal Declaration on Cultural Diversity, 2002, Article I). The characteristics of cultural diversity are not only shown across nations or places, but also can be observed through time within one society. Cultural differences therefore, are particularly important when exporting knowledge and practice from one place to another.

The second dimension of social values is the interrelationship between diverse cultures in society. It is essential to maintain and enhance cultural diversity by promoting harmonious interactions among people and groups with plural, varied and dynamic cultural identities. It has been acknowledged that historically, water can facilitate social interaction for both interpersonal relationships and societal-environmental inter-relationships (Syme et al., 2008). The former aspect refers to the central role that water has played in the location and organisation of communities around water resources since ancient times (Priscoli, 1998). And the societal-environmental inter-relationships are reflected in the recreational use of water, such as nature appreciation and aesthetic enjoyment activities (Heathcote, 1998).

The third dimension of social values is about the balance of benefits associated with water. Although water is a natural resource and public good, it has been viewed as a source of political power that should be controlled. As Castells (2013) points out, value is an expression of power indicating the beliefs and ambitions of those who hold power. The history of water management worldwide shows the conflicts and struggles of the forces between decision makers and public interests (Donahue, 1997). For example, in ancient times the Egyptians and Romans were masters of irrigation and the creation of major infrastructures that controlled waterways. Nowadays, it is common practice to canalise large rivers for navigation and construct large-scale dams for water storage and hydropower. These hydraulic interventions come at the cost of large displacement of local communities and diminishing ecosystems (Schelwald-van der Kley & Reijerkerk, 2009). Therefore, the dominant water values are reflections of complex political structures and institutional arrangements.

In Chinese society, water management has a long-standing tradition of environmental manipulation and exploitation, which has created a political language (Ball, 2016). For example, the building of the Three Gorges Dam caused a strong public dispute. Despite the benefits of the dam for agriculture and industries with hydropower electricity, as well as flood control, river navigation, reservoir fisheries and recreational activities, a huge displacement of local residents should not be ignored. In recent decades,

waterfront development has witnessed dynamic transformations due to a transition of economic forces, from an industry and port based economy to a service based economy. Debates have been raised over waterfront gentrification and social equity issues such as the negative impact on society and local culture when urban villages are demolished for real estate development (Bao & Liu, 2005; Song et al., 2010).

This kind of power-led phenomenon has drawn attentions at the international level. The second World Water Forum (The Hague, 2000) added a social equity issue to the declaration, 'to manage water in a way that reflects its economic, social, environmental and cultural values for all its users... This approach should take account of social equity concerning the basic needs of the poor and the vulnerable.' Later in 2002, water was declared a human right by the former UN Secretary Kofi Annan.

§ 2.5.5 The main aspects of water values in this research

This research reveals changing water values attached to the process of spatial development, focusing on the quality of life within flood-prone delta cities and incorporating urban development and natural dynamics. Sustainability, liveability and spatial quality in general, as well as water sensitivity in particular, are the main criteria for evaluating spatial development regarding economic, social, cultural, and environmental impacts (Munier, 2005; Basiago, 1999) and flood safety as well as future uncertainties at different development stages. Above all, considering the specific geographic and hydrologic conditions of delta regions, flood safety is considered a basic requirement for achieving liveable environments and sustainable socio-economic systems. Based on relevant theories and research (Strang, 2004; Lems, 2008; de Haan et al., 2011; Johnston et al., 2011; Johnstone et al., 2012) while referring to water related urban challenges in delta cities, the focal points of the four key aspects of water values are defined as follows. As discussed earlier, the social aspect of water values is multifaceted and difficult to convert into monetary worth. Compared with the other three, the social aspect of values is more often addressed by urban planners and designers. This thesis discusses the interrelationship between these four aspects of water values, with the social aspect being highlighted and elaborated from three sub-dimensions: cultural diversity, social interaction and social equity.

- **Flood safety** - the protection level of people and property against fluvial, pluvial and coastal flooding
 - **Economic values** - economic benefits that are derived from water facilitated economic activities
 - **Environmental values** - the quality of the water environment for the wellbeing of humans and aquatic habitats, biodiversity and ecological processes within catchments
 - **Social values** - the social needs related to water and concerned with the organisation of society and the interrelations between diverse social groups
- 1 *Cultural diversity* - uniqueness and plurality of the identities of groups and societies, where multiple water-featured cultures coexist with harmonious interrelations
 - 2 *Social interaction* - dynamic and changing sequences of social actions and connectedness between individuals or groups, between humans and nature
 - 3 *Social equity* - equal opportunity to access the benefits of the urban water environment, especially concerning the basic needs of the poor and the vulnerable

Given the broad discussion of values, concepts and theories are mainly developed in Western countries, little application and discussion in public policy can be found in the Chinese context (de Jong, 2012; Mu et al., 2015). Moreover, values change over time within each society. Value theory indicates that values have specific meanings to diverse actors and vary at different development stages so values cannot be illustrated with consistent definitions and criteria. The cultural aspect for example is influenced by the local history, climate, beliefs, religions, social structures, and external influences, and it changes along with the restructuring of the social environment. Thus, it is very difficult, perhaps impossible, to judge certain historical values from the perspective of current values. On the other hand, the persistence of values in each society can be perceived in the adaptation to new social environments. It is essential to refer to specific socio-economic contexts and spatial conditions when discussing the meanings of values in history. Although some of these focal values may not be regarded as important in the past, the reflections on these aspects show changes in spatial development and impacts on the current city and society. Not only are the meanings of these four main aspects of values changing, but also their interrelationships vary at different stages, which increase the complexity in developing spatial strategies. Therefore, it is important to develop an analytical framework from a historical perspective to help understand these dynamic transitions and their interactions. The transitions and reflections are expected to provide guidance and implications for urban planning and design that a synergy among these values can be maintained.

§ 2.6 Conclusion

The research develops the concept of values based on theoretical research and practices worldwide that promote a better understanding of water values in spatial development. Value theory is researched based on various disciplines, from the economic meaning of monetary worth to the social perspective of human motives and interests. Value theory indicates that values are either compatible or conflicting. The synergy between values creates a certain level of persistence through time while the conflict provides a dynamic motive for transition. This thesis does not intend to study the track of basic values or public values themselves, but rather to reveal a hint of these values reflected in the perception and judgement of the functions and roles of water over time. The value concept is crucial for the understanding of conflicting goals and opinions among different social groups. As an important public policy, urban planning is expected to reconcile conflicts by indicating diverse values and building societal consensus with value-based thinking.

An overview of the global trend of value transition in general, and the perception of water values in particular, reveals its multi-dimensional nature. A multi-disciplinary perspective offers such opportunities through the engagement of a broad range of professions, such as hydraulic engineering, urban planning and design, landscape architecture, ecology, and social science. Among which, two major orientations are shown in terms of urban planning/design and water management practices. First, an increasing involvement of planning and design professions in urban water management has been identified. Second, water management has shown the trend towards combining more environmental and social values as well as coping with uncertainties in response to climate change. The Dutch experience shows the graduate transition from the traditional defensive approach towards the “new” Dutch approach of delta management addressing plural values. The lengthy process of value transition is influenced by many factors such as growing societal involvement with public protests and debates as well as the rise of new knowledge in science and engineering and its reflection in planning and design. Although worldwide practices indicate the intent of value-based thinking in spatial polices, the application of these concepts in a different context needs to be elaborated in addition to technology transfer. For example, China’s sponge city programme has encountered many challenges regarding its effectiveness of flood mitigation, divergent interests, great development pressures, institutional segregations, conflicts between short-term political visions and long-term environmental impacts, as well as its combination with other urban development goals.

With reference to relevant theories and practices, four key aspects of water values are defined in the context of delta cities: flood safety as well as the economic, environmental and social values of water. A synergy among these four key aspects is essential for developing integrated spatial strategies such that multiple goals can be achieved in spatial development. Acknowledging the complex nature of values and their dynamic transitions, it is essential to understand the transition processes, and engage planning and design in influencing spatial development with a comprehensive indication of both universal values and local particularities. In this regard, analytical tools and instruments need to be developed to identify these values and their interrelationships based on a comprehensive framework, which leads to the discussion in chapter 3. The conceptual and methodological implications of the value concept will be illustrated in chapter 7.

3 Analytical Framework and Research Methodology

§ 3.1 Introduction

Chapter 2 outlined value theory as well as the definition and components of water values in both generic studies, and within the context of the Chinese society. It further investigated integrated approaches to urban planning and design worldwide where water values are essential to reach consensus and balance diverse goals in spatial development. However, the challenge is how to understand spatial development processes that are influenced by diverse values, and how planning and design can play a role in shaping the spatial form of delta cities.

Firstly, values change over time as a result of the changing interests and perceptions of multi-level actors. Spatial development is the reflection of dominant values in society within a certain period of time. Secondly, spatial transformations are driven by value conflicts resulting from different dynamics and uncertainties of systems, as well as diverse interests involved over institutions, actors and scales. Thirdly, values are influenced by the forces of political, economic and social structures, the vulnerability and sensitivity of natural systems, as well as the uncertainties of socio-economic development and climate change. Therefore, values need to be understood within specific contexts.

Furthermore, it is difficult to apply a certain method to the assessment because some values are vague and difficult to quantify, such as the social aspect of values. Based on which, it is essential to develop a systematic analytical framework with analytical tools and methods for a better understanding of the role of water values in spatial development and to link value theory with planning and design practices for delta cities. This chapter introduces the analytical framework that an interdisciplinary research methodology is illustrated with two main aspects for the organisation of the following empirical studies and discussions: morphological analysis and value assessment.

§ 3.2 Analytical framework

§ 3.2.1 Existing analytical tools

In general, two main approaches are often used to address the comprehensive values reflected in spatial development, namely the quantitative approach and the qualitative approach. The quantitative approach argues how to convert costs and benefits of spatial strategies into monetary values, the distribution of costs and benefits amongst actors, and how these accrue over time (Vandell & Lane, 1989; Eppli & Tu, 1999). The most common quantitative approach is the cost-benefit analysis (CBA), which offers a framework to assist rational investment decisions (Lichfield, 1960). Applying the CBA concept, some evaluation tools have been developed to help practitioners estimate the benefits of water management measures, such as BeST - "Benefits of SuDS (Sustainable Urban Drainage Systems) Tool". The tool focuses on quantifying and monetising the benefits of a SuDS scheme for a specific location and time period. Benefits such as flood safety, economic growth, ecology, recreation, and tourism, etc., are categorised and calculated based on ecosystem services and triple bottom line (social, financial and environmental) frameworks (Ashley et al., 2015).

The qualitative approach focuses on how various actors perceive values and how spatial strategies influence the interests of different actors (Verhage & Needham, 1997; Loe, 1999). Among others, the multi-criteria analysis (MCA) is considered a complementary tool next to CBA that intangible values and multiple dimensions are included (Raaijmakers et al., 2008; Voogd, 1988). Instead of assigning monetary values to non-quantifiable aspects, such as social, cultural and ecological values, MCA organises the assessment of multiple options based on a rating system against a set of criteria. A panel of experts or groups is invited to rate the options on multiple criteria, thus the assessment is flexible and can incorporate a diverse range of information (UN, 2011).

In planning practices, MCA is often applied to assess the quality of space. In the Netherlands, a spatial quality assessment framework - Ruimtelijke Kwaliteits Toets (RKT) was developed in the "Room for the River" programme (Bos et al., 2004). A "quality team" with experts from different professions was formed to evaluate the impact of spatial strategies on spatial quality, using a set of criteria based on three dimensions of spatial quality, namely utility, attractiveness and robustness (Klijn et al., 2013). As the RKT framework is geared towards relatively rural areas along rivers in a regional landscape, the set of criteria has been adjusted to fit in the urban context

(Nillesen, 2013). Similar to the rating scale, signs like “++”, “+”, “0”, “-” or “--” are shown to indicate if the proposed intervention has positive or negative effects on the aspects concerning spatial quality.

In the case of the Southwestern Delta region in the Netherlands, three key values are defined – safety, economy and nature, and a triangle scheme is applied to compare the changing values between 1950 and 2020 to assess if current projects and strategies are multi-functional with a synergy on these three values (de Vlieger, 2016). First, with high flood risks and a growing threat from climate change, the safety level against flooding is given high priority in the spatial development of the Dutch delta. Second, as an economic hub with diverse economic activities, the economic value is measured with the scale of employment and contribution to national income in major industries such as port, energy, trade, and care. Finally, the value of nature such as the estuarine ecological value of tidal marshes and flats is highlighted as an important criterion for spatial quality.

Although the above-mentioned methods can provide guidance and suggest alternatives to policy making, their weaknesses have been recognised. CBA assesses whether the benefits of a policy outweigh its costs, but it fails when comes to the conversion of multiple dimensions of value to the single metric of money. It is difficult to compare and balance non-quantifiable costs and benefits against quantifiable ones. MCA on the other hand contributes to the qualitative evaluation of space, but the result is inevitably subjective. Biases occur in scoring and ranking, and it is not easy to reach an agreement on rating (UN, 2011).

§ 3.2.2 Morphological study and the Dutch "layer approach"

Much of the evidence in this research is qualitative, and does not lend itself to easy reduction based on a simple set of criteria. Considering the strengths and weaknesses of both CBA and MCA, especially when the value transition needs to be understood from a historical point of view, this research puts forward an analytical framework for the understanding of the dynamic transitions and interactions of the key water values. Water values can be interpreted by the recognition of diverse water-related spatial patterns in spatial development so that spatial form is important for the understanding of the value concept. As discussed in chapter 1, water values are closely related to the dynamics of the complex delta system incorporating natural landscapes, water infrastructures and urban patterns. It is essential to develop a systematic framework to reveal and visualise these dynamics. Regarding the spatial evidences and indications

of water values, urban morphological studies and the layer approach provide analytical tools for understanding spatial dynamics and transformations.

Urban morphology is the study of the form of human settlements and the process of their formation and transformation. Morphological research can provide both descriptive and prescriptive information by investigating how and why cities are built and how cities should be built. It investigates the radical transformations of urban form incorporating spatial structures, land use types, infrastructures and urban fabrics, as well as the main driving forces for transformations (Whitehand, 2001; Whitehand & Gu, 2006). Traditionally, three main schools of morphological studies are acknowledged in the European context – British, Italian, and French schools. The common ground of these different schools can be summarised with three main principles: '1) Urban form is defined by three fundamental physical elements: buildings and their related open spaces, plots or lots, and streets; 2) Urban form can be understood at different levels of resolution: the building/lot, the street/block, the city, and the region; 3) Urban form can only be understood historically since the elements of which it is comprised undergo continuous transformation and replacement (Moudon, 1997).' Therefore, "form", "scale (resolution)" and "time" constitute three fundamental components of urban morphological research.

Regarding the application of the traditional approach of morphological analysis in urban studies, its limitation to the research of historical cities and a lack of cross-scale perspective of spatial relationships is pointed out (Pinzon Cortes, 2009). In view of which, the Dutch school of morphological study is mentioned as a complementary approach to investigate the relationship between multi-scale urban patterns and delta landscapes based on a so-called "layer approach" (Chung, 2014). The idea of the layer analysis was initially brought up by McHarg in his book "Design with Nature" (McHarg, 1969), that an overlay method for site analysis was developed from an ecological perspective (Figure 3.1). Design principles were suggested based on overlaying analyses of both socio-economic indicators and landscape features such as soil, climate and hydrology.

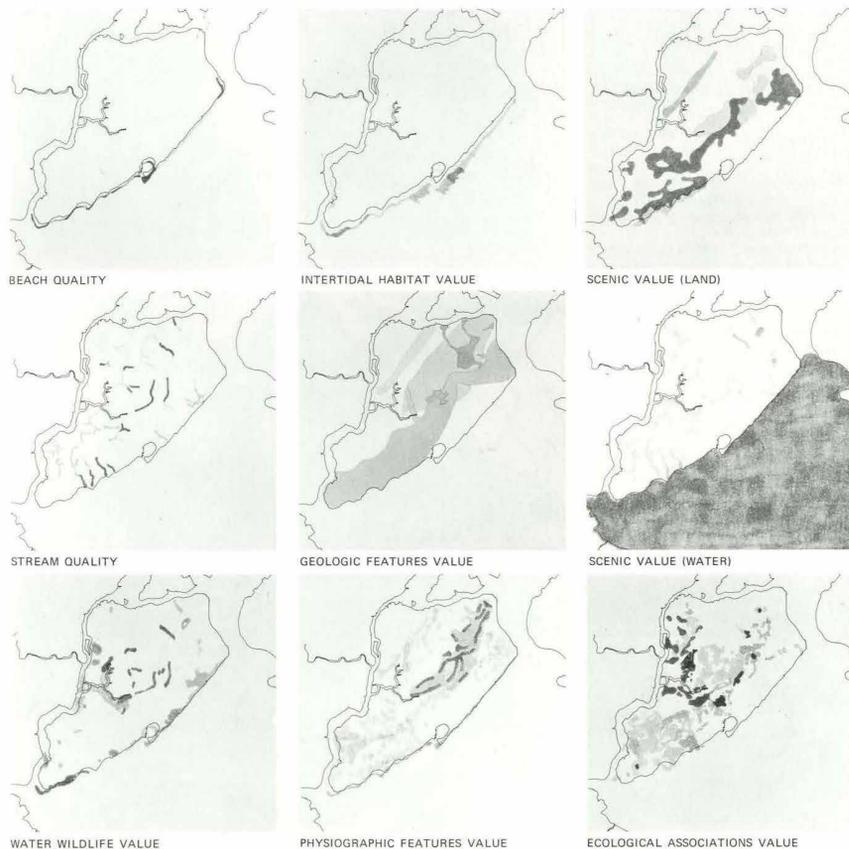


FIGURE 3.1 Layer analysis of the landscape value of the Staten Island
 Source: McHarg, 1969

The “layer approach” was introduced in the national debate on spatial planning in the Netherlands in 1998, along with a paradigm shift concerning water values in spatial strategies and the rising need to create a scientific base for practices. A layer model that distinguished the three layers of spatial planning tasks was developed on the basis of different planning horizons. The “base layer”, or the “substratum”, contains the systems of water, soil and ecology; the “network layer” encompasses main physical infrastructures, including water, energy and transport infrastructures; and the “occupation layer” refers to different spatial patterns that accommodate port, industry, recreation, agriculture and other human activities (Sijmons, 1991; Tjallingii, 1996; de Hoog et al., 1998). All these layers are subject to changes with different dynamics (Figure 3.2). The speed of change varies from 10-25 years in the occupation layer to 25-100 years in the networks layer. The speed of change in the base layer is identified as the slowest, that significant changes only take place every 50-500 years.

The differences of layer dynamics provide practical implications for the development of spatial strategies. The landscape layer for example, changes more slowly compared with urban dynamics. Thus, a long-term view in design based on natural conditions is important.

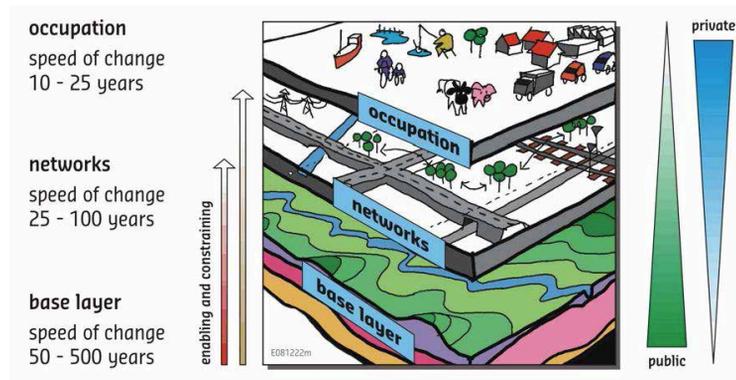


FIGURE 3.2 The layer model with an indication of different dynamics
 Source: Peter Dauvellier, 2004 & 2006, www.ruimtexmilieu.nl/lagenbenadering

The layer approach has been extensively applied in the analysis of Dutch delta cities and reflected in some planning and design documents in the Netherlands since 1998 (van Schaick & Klaasen, 2011). At the analytical level, the layer approach contributes to the recognition of diverse water values through analysing different spatial patterns and layer dynamics. It provides a scientific basis for the understanding of how the complex delta system works and the cross-scale relation between layers (Meyer, 2017). On the regional/city scale, the integration of water management and land use plans is essential as some measures such as the designation of floodwater storage areas and primary flood defence structures have to consider the impact on local environmental quality and socio-economic development. On the city/district scale, multifunctional public spaces create opportunities to combine the city's climate adaptation goals with local development needs. The inter-relationship between layers is essential for making spatial policies that promote the cohesion of the complex delta system, such as to balance development needs and the capacity of natural systems. The analysis of the dynamics between natural and urbanised landscape layers can help to understand the main characteristics of the natural landscape and the inevitable limits for future development (Palmboom, 1987) (Figure 3.3). The layer analysis of the historical landscapes shows how the existing spatial patterns are structured and differentiated by different water systems and landscape patterns, and provides scientific basis for developing site-specific solutions.

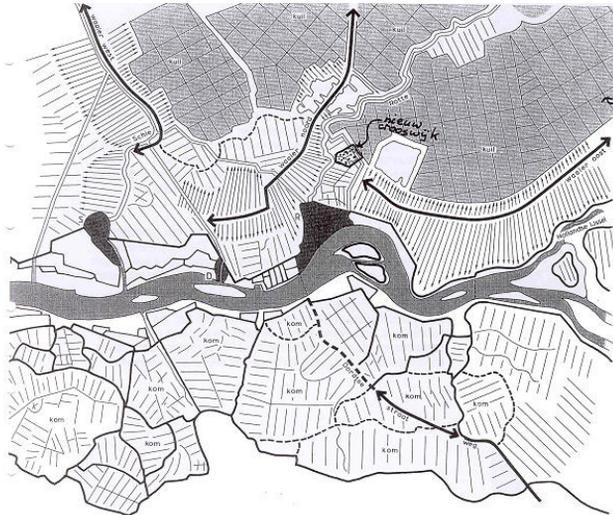


FIGURE 3.3 Analysis of the Rotterdam landscape in 1850
 Source: Palmboom, 1987

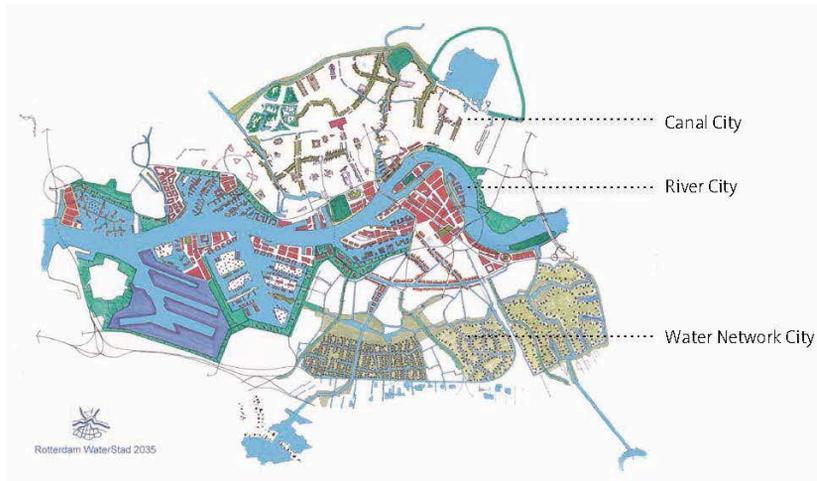


FIGURE 3.4 Vision of the Rotterdam Water City 2035
 Source: Rotterdam Waterstad 2035

These ideas are reflected in urban design practices and water policies such as the “Rotterdam Water City 2035” and “Rotterdam Waterplan 2”. Innovative design options such as green roofs, multifunctional waterfronts, floating buildings and alternative forms of water storage, are suggested to cope with the uncertainties of climate change

as well as the economic, environmental, and aesthetic values of water (Molenaar et al., 2010; Dunn et al., 2017). The “Rotterdam Water City 2035” for example, provides a vision to combine the opportunities of urban development and water management, so as to enhance the competitiveness and attractiveness of the city with a guarantee of both water safety and spatial quality. Integrated and site-appropriate design was put forward based on specific water systems, flood risks, nature, culture, and urban development potentials (de Greef, 2005). In the Rotterdam North, the “Canal City” concept aims to improve existing water channels, combined with water retention strategies such as water squares and green roofs. In the city centre, the “River City” concept strengthens the river as a strong identity and economic engine for urban renewal, and the historical port area is regarded as a vital place that embraces new recreational and economic functions. Innovative climate adaptation strategies such as floating houses are expected to offer development opportunities, especially in unembanked areas. In the Rotterdam South, the concept of a “Water Network City” focuses on connecting the waterways for an attractive living environment in a natural setting, while preserving the water-structured identity and urban fabric (de Graaf & van der Brugge, 2010) (Figure 3.4).

On the delta scale, a recent research project - Integrated Planning and Design in the Delta (IPDD) has applied the layer model in combination with the system theory to investigate the adaptive capacity of the Southwest Delta region in the Netherlands. Figure 3.5 shows the conceptual model of the research to indicate the subsystems in the delta and the interrelationships between them. Some key sub-systems in the Southwest Delta are pre-defined in the research representing multiple values such as safety, nature, economy, urban development and energy transition. This project suggests that, the complex delta system and its subsystems are continuously adapting to internal and external forces including natural forces, risks and development needs. Spatial planning and design can play a role in keeping a sustainable balance of the system by enhancing its adaptive capacity in coping with pressures and facilitating dynamic interactions between different subsystems. In addition, the relationship between design, knowledge and governance is important to establish a “Robust Adaptive Framework (RAF)”, which addresses the issues of time, uncertainties and shifting responsibilities for spatial planning and design (Meyer et al., 2015b).

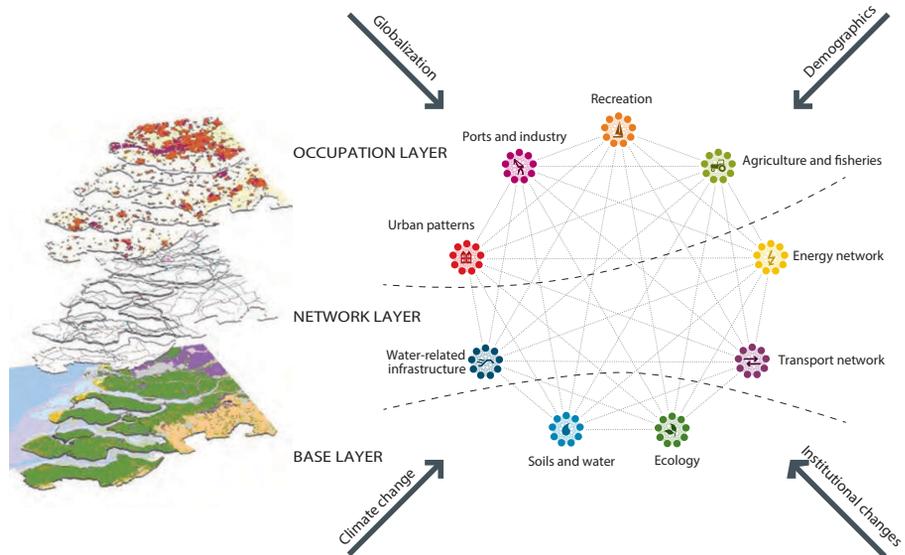


FIGURE 3.5 The Southwest Delta as a complex system with subsystems in a layer model
 Source: Meyer, Bregt, Dammers, & Edelenbos, (Eds.), 2015. P52

The layer approach provides important implications for the development of contemporary delta cities. Problems may occur if the relationships between layers are not well organised. Compared with others, the importance of the base layer is usually neglected in planning and design. The layer approach indicates the importance of the natural landscape in shaping the initial spatial structure of delta cities. Topographic features and natural water systems define the settlement location and the formation of the original urban form. In this regard, water system is considered the most dynamic element in the base layer that influences spatial transformations. With the development of hydraulic engineering, modern water infrastructures such as dikes and dams have become common practice in flood protection. Thus, the original link between water and the spatial structure is gradually lost.

Although the Dutch layer approach has contributed to connecting the dynamics of spatial development with water related spatial policies, the social layer is usually ill illustrated. The social layer refers to the varying factors of creation and the utilisation of space based on different political systems, social structures, institutional arrangements, and cultural characteristics. The social layer represents diverse water values that are held by multiple actors and interacts with physical structures within the delta system. In this regard, the analytical framework in this research will use “water values” as a lens to address the link between physical layers (spatial conditions) and

the social layer (values held by actors), and further explore how planning and design can play a role in connecting these two parts.

§ 3.2.3 Analytical framework

The analytical framework of this research is underlined by the first two research questions raised in chapter 1. Based on which, the implications of the value concept for planning and design practices can be drawn with theoretical, methodological and empirical contributions.

Q1. What transitions of water values are reflected in spatial transformations?

Q2. What are the interrelationships between water values?

The first question is concerned with the analytical methods on values. In this research, the morphological analysis is applied as an analytical method to establish the link between different spatial patterns and water values. In relation to the three fundamental components of urban morphological research - form, scale and time, it is essential to develop integrated strategies with a comprehensive framework addressing these three aspects. As for the case of Guangzhou, strategies should be developed based on an overall consideration of both quantifiable and non-quantifiable values, which is reflected not only in form and quantity, but also in function and quality. First, spatial form demonstrates water values. Adapted from the system analysis in a layer model, this research focuses on three major systems in the morphological framework - the water system, flood management system and urban system. The assessment of the four key aspects of water values is based on the interactions between these three systems. Respectively, form analyses will focus on the geographic distribution and connection of surface water (natural and artificial) for the water system, engineering and nature-based structures for the flood management system, as well as spatial structures, land uses, street patterns and public spaces for the urban system. Second, a multi-scale perspective is necessary to understand the impact of large-scale (national / regional) spatial policies on local-scale (municipal / district) development. Spatial patterns are analysed to address the interrelationship between water values on three main scales: delta, city and district (Figure 3.6). On the delta scale, the dynamics of the natural landscapes and water systems shape the unique urban pattern of Guangzhou in the Pearl River Delta. On the city scale, urban expansion and land use change indicate the focus of development and the impact on water and natural systems. On the district scale, more detailed spatial analyses of water systems, water infrastructures and urban

fabrics are conducted. The relations between water and urban form including street structures, public spaces, blocks, plots and important buildings are analysed. Third, the empirical study from a historical perspective helps to develop a retrospective view on how historical values influence existing spatial form and what kind of implications can be drawn from value transitions so as to guide future development. The method of the value analysis over time is explained in section 3.3.2 - historical review.

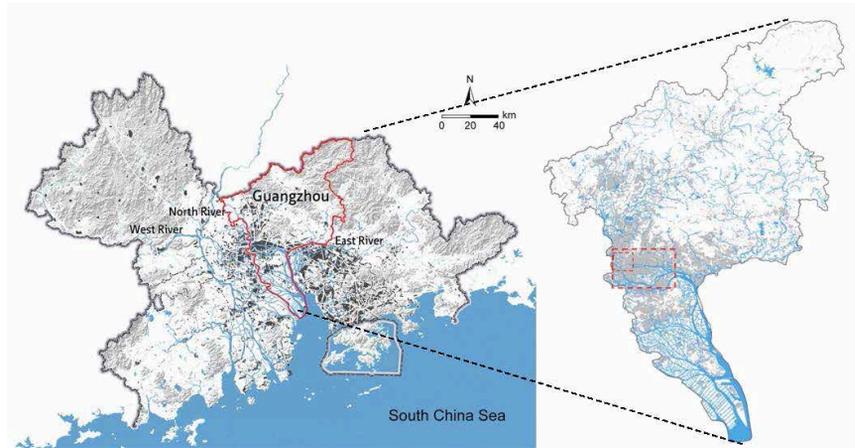


FIGURE 3.6 Three scales (delta, city and district) of the morphological analysis

To better indicate different values, the following colours are applied to morphological analyses on the district scale in particular: blue – water system; grey – built-up area; yellow – main streets; green – green space; red – buildings with significant cultural values.

The second question explores the assessment tool that helps to understand the changing interrelationships between the key aspects concerning flood safety and economic, environmental and social values. It is important to clarify that each aspect has different components and meanings for each development stage due to the changing contexts. Value theory discussed in chapter 2 suggests the complex relations between different values, either synergic or conflicting. Synergies indicate the coexistence of values that enables the system to develop in a stable and sustainable way while conflicts bring risks and drive innovations of spatial policies to create shared values in the society. Based on the four key aspects of water values defined earlier, a triangular pyramid structure is designed as an assessment tool in the empirical studies of Guangzhou comparing three main development stages. For each stage

spatial characteristics of these four values are analysed and their interrelationships are indicated at four levels: synergy (orange line); synergy+ (thicker orange line); conflict (blue line); and conflict+ (thicker blue line) (Figure 3.7). These levels suggest whether multiple water values coexist at a certain stage or the achievement of some values is at the cost of other values in the process of spatial development. Based on which, underlying forces are discussed to better understand why synergies and conflicts occur during a particular period of time, and what kind of spatial strategies concerning urban planning/design and water management affect value transitions. These analyses are expected to provide empirical evidences and implications for spatial development, that urban planning and design can play a role in maintaining a synergy among these key values of water.

This analytical framework will be applied to the empirical studies of Guangzhou that include the spatial analysis of water and city as well as selected cases on the district scale. It is expected to build the connection between form and values across scales. To achieve this goal, the following research methods are applied in the analysis.

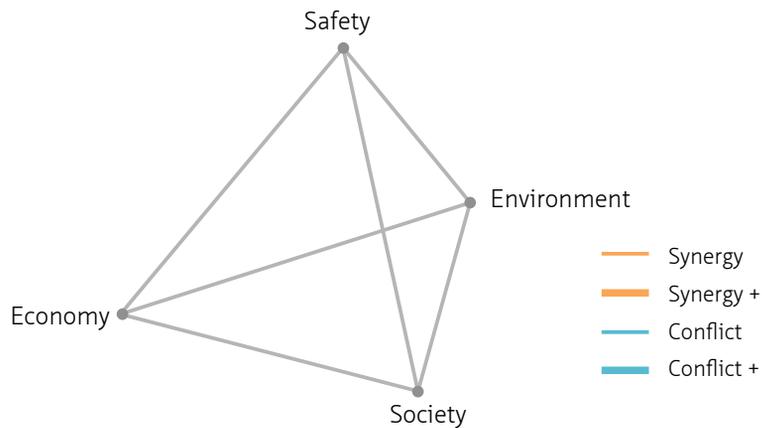


FIGURE 3.7 Assessment tool for analysing the interrelationships between the four key water values

§ 3.3 Research methods

§ 3.3.1 Literature review

Literature review provides international and local research backgrounds concerning the cross-disciplinary knowledge of spatial development in a delta context and its relation with water values. Extensive literature was studied in terms of theoretical, methodological and empirical aspects. First, theories on the value concept are reviewed to build up the conceptual framework. In particular, water values and their relevance with spatial development are studied based on the main research questions. An overview of the integrated concepts and best practices of combining water management in urban planning and design practices is organised to link theory with practice. Based on which, four key aspects of water values are defined as the focal components to address the multi-dimensional role and challenges of water in the context of urbanising deltas. Second, multiple research methods and analytical tools are compared to structure the main research methodology that combines morphological analysis and value assessment. The Dutch method of delta management provides the knowledge concerning the approaches of interpreting diverse values in spatial development based on some analytical tools such as the layer approach. Third, the main body of the research is conducted based on the empirical studies of Guangzhou from a historical perspective. Knowledge is acquired from multiple disciplines ranging from geography to sociology, culture, hydrology, water management as well as urban planning and design. Literature review can provide evidences complementary to morphological studies when values are intangible and difficult to be visualised. For example, the social values of water in the past are based on the illustration in city archives and history books.

§ 3.3.2 Historical review

The evolutionary feature of a complex system requires a retrospective perspective to help understand the dynamics and characteristics of the system and shed light on future development. The chapters of the empirical study are organised according to the urban development stages of Guangzhou, with different driving forces and their impact on the urban water environment. The structure is inspired by some related work that

connects the traditions of water management to urban development. Among which, two main types of phasing are recognised with different contexts.

1. Phasing with water management contexts (Table 3.1)

Some researchers focus on the changing driving forces of water management along with technological and conceptual development. Brown et al. (2009) proposed a typological framework showing the transitions of cities towards sustainable urban water management with temporal, ideological and technological contexts (see also Figure 2.3). Van der Ham (2002) illustrated a phasing according to the development of water management approaches and the impacts on Dutch delta landscapes. Three main stages were recognised from the 1500s - nature & defence, offensive, and manipulative. Based on which, Hooimeijer (2011) elaborated a more detailed phasing that the manipulative stage was further divided into three stages from the 1800s on – offensive, manipulative and adaptive manipulative.

2. Phasing with water-city interaction contexts (Table 3.2)

Delta cities and their waterfronts have similar development paths all over the world. The relations between water and city have experienced transitions covering three main stages (Hoyle, 2000; Porfyriou & Sepe, 2016). The first stage is the pre-industrial era (before the 1920s), that water usually determined the locations for city settlement. Many cities were originally developed from the waterfronts by large rivers, or adjacent to the sea-land interface for good conditions of navigation, irrigation and water supply. At this stage, waterfronts were mostly developed into commercial centres and trading hubs, mixed with port and urban functions. The second stage is the industrial era (1920s-1970s) that water mainly functioned as the facilitator for navigation and industrial water supply. Industries and ports occupied the waterfronts, causing serious environmental problems such as water pollution and ecosystem decline. The synergy between water and city was thus undermined. The third stage is the post-industrial era (from the 1970s). Along with the global trend towards industrial restructuring, urban waterfronts have experienced de-industrialisation with the land use change from industries and harbours to new urban centres. Along with the rise of middle-class communities and the quest for liveability, waterfronts have been developed with multiple values incorporating ecological, tourist, leisure and cultural functions.

In the Chinese context, the processes of industrialisation and urbanisation are closely related to political transitions. Both urban development and flood risk management are influenced by the dominant development ideology of that certain political stage. The organisation of the empirical chapters is based on three main urban development stages of Guangzhou. These three stages represent different patterns of water-city

interactions, driven by both urban development and water management forces. These driving forces have fundamental impacts on the key transitions of the delta system, through influencing how water is valued and managed in the urban context. The first stage describes the situation before the industrial era (before the 1920s) when the city was mainly structured by natural forces such as waterways and topography. The second stage (1920s-1970s) illustrates radical spatial transformations due to the ideological change from a commercial city to an industrial city. Management approaches such as functional zoning and large-scale flood defence were adopted to create a centrally controlled system. The third stage (after the 1970s) shows a transition from a functional city that promoted efficiency and human power to the needs of accommodating plural water values such as environmental sustainability, social equity and cultural identity.

TABLE 3.1 Phasing with water management contexts

	-1500S	1500S-1800S	1800S-1890S	1890S-1990S	1990S-NOW
Brown et al. (Australia)			Water Supply City	Sewered City Drained City Waterways City	Water Cycle City Water Sensitive City
Van der Ham (Netherlands)	Nature & Defence	Offensive	Manipulative		
Hooimeijer (Netherlands)	Nature & Defence	Anticipative	Offensive	Manipulative	Adaptive Manipulative

TABLE 3.2 Phasing with water-city interaction contexts

	-1920S	1920S-1970S	1970S-NOW
Waterfront development	Pre-industrial Era	Industrial Era	Post-industrial Era
Author (Guangzhou)	The waterways city (Ch4)	The functional city (Ch5)	The pluralistic city (Ch6)

§ 3.3.3 Case study of Guangzhou

Case study is a common research method when a holistic, in-depth investigation is needed. According to Yin (1994), some applications for a case study model are presented, such as explaining the casual links in real-life interventions, describing an intervention and the real-life context, and exploring the situations in which the intervention being evaluated has no clear and single set of outcomes. This research is mainly based on the empirical studies of Guangzhou in China's Pearl River Delta. The

main storyline is organised by depicting the historical transformations of water-city interactions with a focus on spatial changes and water values for each development stage.

There are four main types of water systems influencing the spatial transformations of Guangzhou, namely the Pearl River, streams and canals, lakes and wetlands, and the sea. Regarding the water-city interaction, three spatial patterns are discussed - the historical city centre structured by the canal system, the waterfronts along the Pearl River, and the coastal new town. For each stage, I focus on the areas with new developments or dynamic spatial transformations which reflect the changing relations between water and the city, as well as spatial strategies, and how these spatial transformations demonstrate water value transitions.

To elaborate the transformations of spatial patterns from the value perspective, some specific water related cases in Guangzhou are selected and analysed for each stage based on four main objectives: 1) showing the diversity of spatial patterns and the distinction between different social groups in valuing water; 2) demonstrating the interactions between water systems and spatial patterns which reflect specific water values; 3) indicating the interrelationships (synergy or conflict) between values across scales; 4) exploring the transitions of focal water values while referring to multiple levels of actors.

§ 3.3.4 Data acquisition

Multiple sources of evidences are analysed to support the reasoning of value transitions. Data is collected for case studies, including spatial elements such as natural landscapes, urban patterns, land uses, water systems and flood defence infrastructures. In addition, socio-economic data is used to reflect the facts about spatial development and water-related activities.

1. Historical data collection

As for the historical analysis, historical maps, facts and figures, photos and paintings are important sources for understanding past situations. Various data is collected from local chronicles and statistical yearbooks on water management and urban development. The historical maps of the Pearl River Delta and Guangzhou are mainly derived from the following sources. The book "Selected Historical Maps of Guangzhou (广州历史地图精粹)" (Zhou & Xiao, 2003) collects abundant historical maps including

the landscape, water system, urban form, and planning visions of Guangzhou for almost 300 years from the Qing dynasty (1685) to the People's Republic of China (1949). The book "History and Geography of Guangzhou (广州历史地理)" (Zeng, 1991) provides comprehensive knowledge of the evolution of Guangzhou with an introduction to its geological and hydraulic conditions, city and infrastructural developments, and cultural significances. On the street/plot level, the earliest complete survey was carried out by Guangzhou Land Bureau between 1926 and 1935. The survey outcome was recorded in the "Map of land divisions and boundaries of Guangzhou in the Republican Period (广州民国经界图)", showing detailed street layouts, plots and building arrangements at the scale of 1:600. For the second stage of development, aerial maps of 1955 and 1978 are the basis for drawing analytical maps with essential land uses, infrastructures, public spaces and buildings. The current situation is based on Google map and Baidu map, as well as various urban planning and design documents.

In fact, tracing the urban transformations of Guangzhou is far more difficult than some Western cities due to the lack of a systematic record of the historical data. Information from different map sources is not always precise and complete. Some maps reveal more detailed information on streets and public buildings but with abstract information on rivers and canals. Some of the earliest maps illustrate the city in a symbolic way, with hardly any information on plots and buildings. Map reading is very important for the selection of the most reliable base maps. In this regard, historical maps from a range of 10-20 years are compared and adjusted according to literature and current aerial maps. Key form elements are highlighted and overlapped based on a comprehensive understanding of the city's history, development focuses and values.

Besides maps, photos and paintings are also important visual references presenting the actual situations of a certain period back in time. They can also show vivid images of how activities and daily lives were organised in relation to water. Many valuable visual references have been found from the collections of university libraries, museums and magazines. Next to visual references, facts and figures are collected from local archives and statistical yearbooks to provide the grounds of argument in history, such as the economic data of trade, industrial output and GDP growth, and the environmental data such as ecosystem services and the change of ecological land uses.

2. Review of urban planning and water management documents (Appendix 1)

The findings based on the historical analyses of urban transformations are expected to reflect on current urban planning and water management. Therefore, plans and designs on national/delta, city and district scales are reviewed to discuss the dominant development approaches and value priorities across multi-level institutions. At the national/delta level, plans such as the *New Urbanisation Plan*, *the Sponge City*

Programme, and the *PRD Flood Control Plan* are upper-level guidelines for the city-level and district-level planning and water management. On the city scale, the main references include master plans and land use plans such as *Guangzhou Master Plan 2011-2020* and *Guangzhou Land Use Plan 2006-2020*. On the district scale, district plans and urban design projects are studied to explore the main development objectives. These three levels of plans reflect value synergies and conflicts across scales, especially between the state and the local government. For instance, Nansha New District has been a focal area with a high development potential since 2000, when the previous coastal county-level city became a new district of Guangzhou. At the same time, due to dense water networks at the estuaries of the Pearl River Delta, environmental sensitivity and water resources are two major challenges for future development facing great uncertainties of climate change. In addition, historical plans are also mentioned as important documents to indicate the main development ideologies and political interest in history that influenced spatial patterns and water values.

3. Interview (Appendix 2)

As values are carried and perceived by people, it is important to get multi-faced and in-depth insights from different actors involved based on their views, experiences and priorities. Due to the interdisciplinary subject and the gap between research and practice, interviews are organised for a better understanding of how plans and projects are developed and implemented; what synergies and conflicts have occurred in development; as well as to what extent water values have been achieved in terms of costs and benefits. Interview is not a main research method in this research. It is organised for the empirical study of recently implemented projects where literature is not yet available and the achievement of values requires more time to unveil. The main interviewees are professionals and practitioners from urban planning and hydraulic engineering institutes of Guangzhou. The research methodology and content is also discussed with relevant academic experts. Interviewees can only tell part of the story that biases are noticed across disciplines and sectors due to differences in prioritised values. Besides face-to-face interviews with experts and project leaders, some local voices and reflections are mainly collected by in-depth interviews organised by local social media such as online platforms and news reports. In the reports, more up-to-date information of the on-going projects and feedbacks from the local residents is reviewed as complementary to the research.

§ 3.4 Methodological challenges and limitations

This research mainly adopts morphological studies to justify water values with complementary literature and plan review as well as expert interview. Same as many other qualitative approaches, this research methodology bears limitation of inconsistent and subjective assessment of values, especially towards the intangible values. Rather than measuring and comparing values, the triangular pyramid intends to provide an approach to identify the changing interrelationship between values and suggest the general trend of value transitions. Although morphological analyses can provide relatively objective evidences to support the assessment, it is difficult to apply the same criteria and form indicators to the assessment due to the multi-dimensional characteristic of values. And it is impossible to judge historical values with current values. The long-term spatial development with a division of three main stages can only address the most representative characteristics of water values and their interrelationships based on selected cases at each stage. Furthermore, the approach combining morphological analysis and value assessment still needs to be tested and adjusted when applying to other cases with different contexts and challenges.

Data acquisition is of great importance to the analysis. However, some historical data and maps are difficult to acquire for a certain period of time or on a certain scale. For instance, the flood risk map at the second development stage is missing and the information of natural landscape and geographic conditions is not generally accessible. Moreover, it is a challenge to apply the morphological approach in historical research when some historical plans are only described in words. Aside from visual references, interviews also provide crucial evidences to assess the achievement of water values as indicated in planning and design projects. However, interviewees may carry some professional biases, especially when multiple values conflict with each other across sectors. Furthermore, there is a lack of support that the interests of all actors can be addressed for current projects, let alone the past ones.

PART II Empirical studies of Guangzhou

Introduction

Part I brought forward the conceptual framework and methodology for a better understanding of diverse and sometimes conflicting values in spatial development based on the problem statement regarding water related urban challenges of Guangzhou representing fast developing delta cities: flooding issues as well as the changing economic, environmental, and social values of water. Part II (Ch4, 5, 6) uses empirical studies to demonstrate the changing values of water during three main urban development stages of Guangzhou - the waterways city (before the 1920s), the functional city (1920s-1970s), and the pluralistic city (after the 1970s).

This part follows the same structure for the illustration of historical spatial development of Guangzhou. First, a broader context of the long-term evolution of the Pearl River Delta by means of natural dynamics and land reclamation facilitated by diking (section 4.1), socio-economic and political backgrounds, as well as institutional arrangements (section 5.1 & 6.1) are introduced. Second, morphological analyses (section 4.2, 5.2 & 6.2) are organised focusing on several levels of water-city interactions and transformations within the morphological framework: spatial structure, land use and urban fabric, indicating dynamic changes of surface water and the relation with urban form in the process of spatial development. The analyses focus on development features of three urban patterns (the inner city, waterfronts and new urban areas), in relation to four water systems (the Pearl River, canals and streams, wetlands, and the sea). Morphological analyses and literature review provide scientific evidence for understanding diverse water values in spatial development. Based on value transitions, I further discuss the main underlying forces for these (radical) changes to explore why some certain water values are reinforced while others are ignored (section 4.3, 5.3 & 6.4). It is expected that the understanding of historical development processes and the interpretation of embedded water values can provide important lessons to deal with current and future challenges and opportunities in urban planning and design practices.

4 The Waterways City (before the 1920s)

§ 4.1 The delta landscape

The Pearl River Delta (PRD) has gradually taken shape over the last 40 thousand years, driven by long-term sedimentation brought by river discharge. The delta consists of three major rivers, namely the West River (Xijiang), the North River (Beijiang) and the East River (Dongjiang) (Tan, 1993). The historical centre of Guangzhou is situated on the north bank of the Pearl River. Rivers flow from the north (upstream) to the south (downstream) of the delta through Guangzhou, generating large amounts of sediment (Huang et al., 1982) (Figure 4.1). The water levels in these branches are influenced by the tides from the estuaries of the South China Sea and, owing to the subtropical climate, the average annual precipitation ranges from 1600-2300mm. The annual flood season in the Pearl River Delta lasts almost half a year, generally from early April to late September. During the flood season, typhoons and storms bring intense rainfall, which accounts for 80% of the annual precipitation.

With a large amount of low-lying land prone to flooding, the Pearl River Delta has witnessed continuous dike construction and land reclamation since the Tang dynasty (618-907) (Zeng & Huang, 1987). Originally, local people developed farmland on fertile and relatively high ground. The southward migration from the western areas of China to Canton increased the population density of the Pearl River Delta by the end of the Tang dynasty. Therefore, the low-lying delta had to be cultivated for the required food production, which led to the necessity of dike construction in order to protect the land against flooding (Weng, 2000). The Pearl River Delta experienced rapid land reclamation and dike construction in the Ming and Qing dynasties (1368-1912) (Figure 4.1). Land was reclaimed from the sea or wetlands for agricultural development, which was protected by small-scale self-managed dikes built by local farmers. However, flood defence structures channelled the silt away from the former floodplains and directed it further downstream to the estuaries of the Pearl River (Marks, 1998). Dike construction also sped up the silting process and as more dikes were built, rivers were channelized and easily silted up, resulting in higher water levels (Weng, 2007).

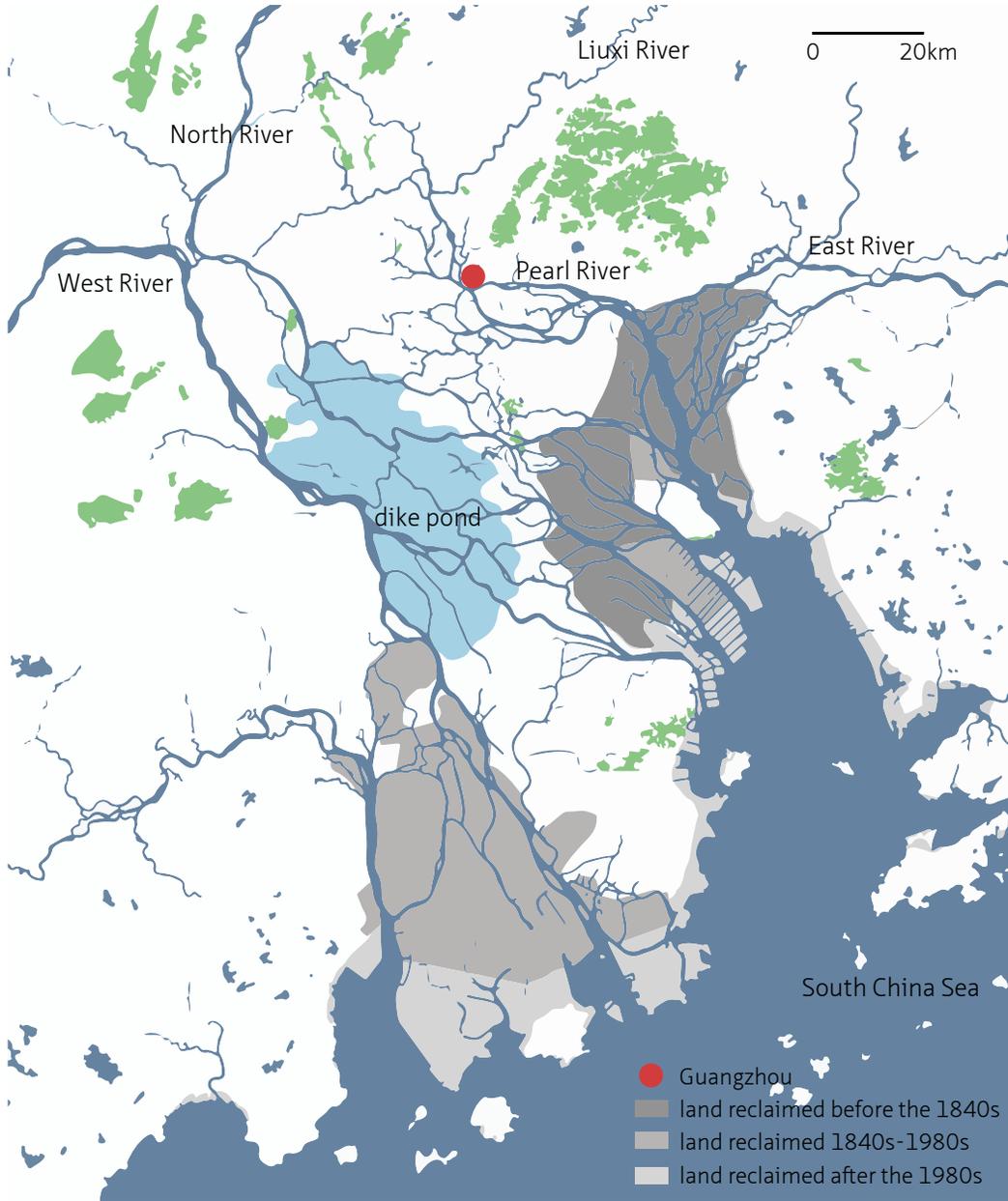


FIGURE 4.1 Landscape and land reclamation of the Pearl River Delta

Within the delta landscape, the dike-pond system (Figure 4.2) is a unique artificial ecosystem developed on the reclaimed land in the Pearl River Delta (Xu, 2009). Nine centuries ago the delta was a vast expanse of waterlogged land that was frequently flooded. Local people turned the low-lying, waterlogged land into fishponds by using the excavated mud to construct dikes around ponds. Farmers planted fruit and mulberry trees on dikes while developing fish farming in the ponds (Figure 4.3). The dike-pond system could mitigate flooding to a large extent. It is estimated that every 1m² of fishponds could contain the runoff for about 14m² of the urban area (Ruddle et al., 1983). The dike-pond ecosystem not only contributed substantially to flood mitigation, it also functioned as a self-sustaining circular ecosystem with both ecological and economic values (Ruddle & Zhong, 1988). However, this type of adaptive economic-ecological landscape has sharply decreased in the Pearl River Delta due to industrial development and urban expansion since the 1930s (Guo & Situ, 2010) (Figure 4.4).



FIGURE 4.2 The dike-pond system in the Pearl River Delta
source: www.southcn.com

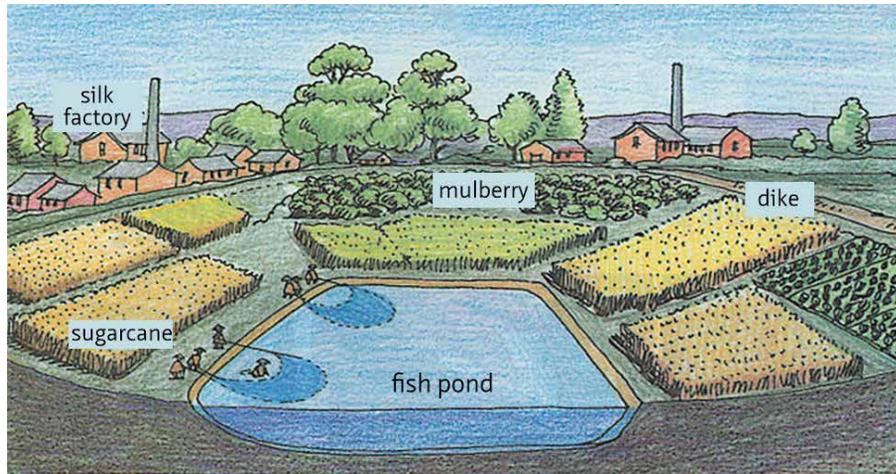


FIGURE 4.3 The mulberry – dike – fish pond model
 source: www.wapbaike.baidu.com

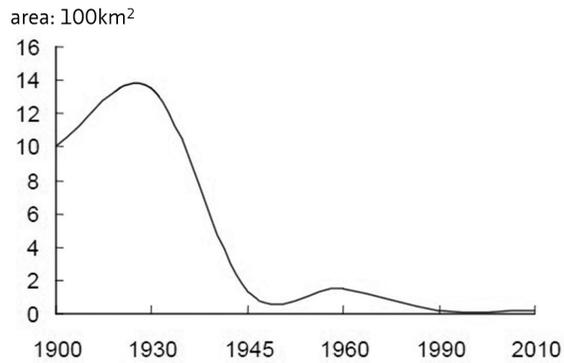


FIGURE 4.4 Decreasing of the dike-pond system in the Pearl River Delta
 Source: Guo & Situ, 2010, P455

§ 4.2 Morphological analysis of water and the city

§ 4.2.1 City site planning in the water environment

For centuries, Chinese people have developed harmonious ways of interacting with the natural environment in order to survive and develop. For example, Feng Shui (literally means “wind” and “water”) is a traditional Chinese philosophy and technology for city site selection. By observing and adapting to nature, Feng Shui simultaneously considers both the natural and cultural values of water to pursue harmony and balance between people and nature as well as among people (Hu, 1994; Han, 2001). The basic principle of Feng Shui is straightforward – people benefit when the landscape is rich and healthy and they suffer when the landscape deteriorates (Bruun & Kalland, 2014). Connecting to Feng Shui, an important theory of the site selection for cities was propounded by a philosopher - Master Guan (管子) in ancient China (26 BC). His main idea was ‘to select a site for a capital, either at the foot of great mountains, or on broad plains; neither too high to get water supply, nor too low to avoid extra drainage works.’

Guangzhou is the political, economic, and cultural centre of the Pearl River Delta. It is also the transportation hub and an important historical port city in southern China. The stable and prosperous development can be traced back to the initial landscape and site selection of the city more than 2200 years ago. Following Feng Shui thought and the ancient planning culture, Guangzhou is located near the intersection of the three major rivers (East, West and North River) of the Pearl River Basin (Situ & Li, 1998). The historical city centre (the walled city) was established on the vast floodplain between mountains to the north and the sea (current Pearl River) to the south due to good conditions of water supply and drainage, shaping an ecological spatial pattern of “mountain-city-river” (Figure 4.5).

The Pearl River (Guangzhou part) has experienced great transformations through history, which was extremely obvious in the period of the Ming and Qing dynasties (1368-1912). The transformation trend was: the north bank of the Pearl River continued moving towards the south due to urban expansion and sedimentation, while the south bank stayed relatively stable. The Pearl River has narrowed considerably, from a width of 1500m in the 400s, to 1400m in the 900s, 900m in 1209, 700m in 1369, 500m in 1850, 400m in 1910, and the narrowest part of the Pearl River today is only 180m near the Haizhu Bridge (Li, 1990). Both the natural process of sedimentation along the north bank and land reclamation activities promoted urban expansion

towards the south bank across the Pearl River. The shrinking Pearl River enabled the city to gradually overcome this natural boundary and to develop on the south bank of the river. Due to diverse landscapes and water systems, urban developments of Guangzhou in the 1900s differed between the inner city and suburban areas. Generally, urban areas expanded from the higher ground within the city wall (higher than 4m above the Pearl River) to the low-lying floodplain to the west of the city wall (2-4m above the Pearl River) (Figure 4.6).



FIGURE 4.5 Site planning of Guangzhou in natural surroundings in the 17th Century
Source: *Selected Historical Maps of Guangzhou*, 2003



FIGURE 4.6 Spatial form of Guangzhou with ground elevation in the 1900s

§ 4.2.2 Inner city development and the canal system

The initial urban development within the city wall was closely related to the canal system, that was constructed according to the topography. In ancient China, Master Guan put forward a theory on the construction of the urban canal system, 'In a sage's work on his capital planning, the city should stand on flat and steady land, fertile and rich, backed up by mountains and served by rivers and lakes; a well-formed drainage system is needed inside the city, ensuring a smooth drainage into rivers'; and 'to ditch on the highlands and dike on the lowlands'. These ideas represent the wisdom of adaptation to the constraints of the natural landscape in ancient city planning (Wu, 1995).

Since the 1100s, Guangzhou has established an artificial water system for the functions of navigation, military defence, drainage and water supply. Crowned as the “blood circulation of the city”, the water system had a standardised form based on a ring of moats around the outside of the city wall and a network of canals running inside (Figure 4.7). Six main canals were constructed within the city wall to conform to the landscape features, mainly in the north-south direction. Rain and wastewater was drained through the ditches to these six canals, was then diverted to the East Moat, West Moat, and Yudai Moat in the south, and was finally discharged into the Pearl River. It was estimated that the overall water storage capacity in the six canals was about 100,000m³ (Huang, 1994a). The whole water system contributed to flood mitigation within the walled city so the government (both provincial and county levels) launched constant dredging activities to maintain the network. Meanwhile, local businessmen collected public funding for the maintenance of the canals outside the city wall. In 1810, a public association for canal dredging (*qinghaogongsuo* 清濠公所) was established by the local businessmen from foreign firms (Liang, 1911).

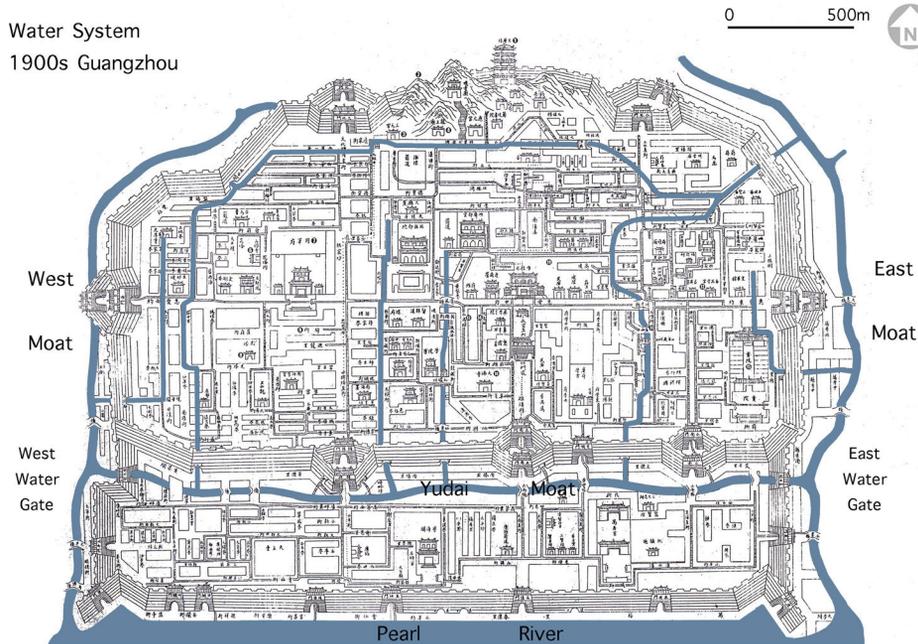


FIGURE 4.7 The water system in Guangzhou walled city in the 1900s
 Source: Guangzhou Urban Planning Bureau & Guangzhou Urban Development Archives, 2010

The three-level water system (canal-moat-Pearl River) had a strong impact on urban development in the walled city. The significance of the water system can be concluded in several aspects concerning flood safety as well as environmental, economic and social values. As a historical port city, canals and moats were open to boats for navigation, especially before the 1920s when cars became prevalent in Guangzhou. The convenience of navigation stimulated commercial development and foreign trade along the canals, moats and the Pearl River.

§ 4.2.3 Urban expansion in Xiguan

Besides the walled city, water also played an essential role in structuring spatial patterns in the suburb of Guangzhou. During the Ming and Qing dynasties, the walled city was not able to meet the needs for socio-economic development due to rapid population growth. Thus, the suburban area to the west of the city wall - Xiguan - became an ideal location for textile factories and settlements. Xiguan (literally meaning “the west gate”) refers to the area outside the west gate of Guangzhou, situated on the flat plain to the north of the Pearl River. The Xiguan area has superior geographical conditions for agriculture with a fertile plain, Xiguan Plain. It is located in the centre of waterways within the delta with vast wetlands and a dense network of streams connecting to the Pearl River. Local residents used to build dikes around the wetlands for flood protection and, similar to the dike-pond system, they planted lychee trees on the dikes and developed fish farming in the ponds. It was not until the Song dynasty (960-1279) that the Xiguan area was developed from the swamp plain into urban land (Figure 4.8).

During this period, the Xiguan area could be divided into five districts according to different land uses: the textile industry district in the northeast, the residential district in the northwest, the commercial district along the water system in the middle, the foreign trade district along the Pearl River in the southeast, and the Shamian Concession island (Figure 4.9).



FIGURE 4.8 Urban expansion of Guangzhou before the 1920s
 Source: drawn by author based on Schnock, F. (1907). Canton with suburbs and Honam

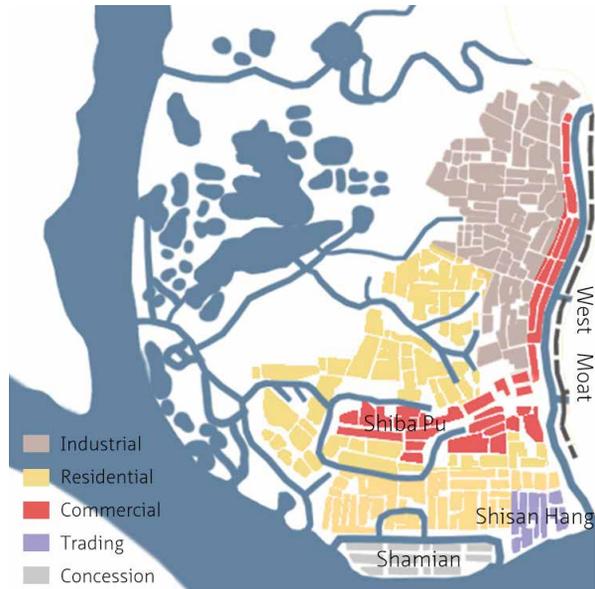


FIGURE 4.9 Land use map of the Xiguan area
 Source: drawn by author based on Schnock, F. (1907). Canton with suburbs and Honam

The development of these districts was sequential in relation to water, urban and flood defence systems. First, the West Moat became the main navigation route for goods transport, which stimulated the development of commercial streets alongside. To protect a larger low-lying area against flooding, local farmers and residents built small dikes along the streams and rivers in Xiguan, which enabled urban development in protected areas. Commercial development also drove industrial and residential development in the surrounding areas.

During the late Ming and early Qing period (around the 17th century), Guangzhou and its surrounding areas abounded with cotton and silk production, which stimulated the textile industry in Xiguan. It was recorded that over 2,500 textile factories were established in or near Guangzhou at that time, with an average of 20 handicraft workers in each factory. Most of these textile factories were located in Xiguan (Shang, 2000). The rise of the textile industry also drove the flourishing development of other light industries, such as printing and dyeing, clothing, footwear, etc. and thus, Xiguan became increasingly prosperous and populous. Consequently, large tracts of land in the western part were developed into residential and commercial areas. In the late Qing dynasty, Xiguan became a commercial and trading centre because of its geographical advantage adjacent to the treaty port and Concession (Zhou, 2005).

At this stage, water played a significant role in facilitating urban development and structuring the urban fabric of Xiguan. As a result of the prosperous shipping in the Pearl River, the development of the Xiguan area maintained a close relationship with the Pearl River. Major roads in the east-west direction had a higher density and more convenient connections. In contrast, relatively fewer roads were in the north-south direction, many of which were perpendicular to the Pearl River. This kind of water-structured spatial organisation enhanced the convenience of shipping and logistics. It also contributed to the urban microclimate with good ventilation by bringing wind from the riverside to the city (Qiu, 2009).

Based on the water-city interrelationships and water values, three main types of water-structured spatial patterns can be identified in Xiguan before the 1920s; the eighteen commercial streets area (Shiba Pu 十八甫) along the West Moat and the Xiguan River, the thirteen factories area (Shisan Hang 十三行) along the Pearl River, and the Concession area (Shamian Island 沙面岛) (Figure 4.9).

1. Eighteen Commercial Streets (Shiba Pu)

Xiguan used to have a large area of farmlands and wetlands with dense streams before the Qing dynasty. Urban development in Xiguan originated from the moat streets along the West Moat. Thanks to the convenient shipping, eighteen commercial streets (Shiba Pu) were built along the Xiguan River and the West Moat in the Ming dynasty (Figure 4.10). The streams and dikes shaped the orientation of the streets and lanes, resulting in irregular and fragmented neighbourhoods.

To facilitate the transport of goods, each street had its own wharf (goods loading areas) by the water. Shops were closely packed facing the main streets, with the backside of the houses connecting to the goods loading areas (Figure 4.11, 4.12). Due to highly valued land, outdoor public space and green space was lacking. There were several trade and craft associations in this area, which were referred to as “guilds” (assembly houses), such as the Zhongzhou Guild and the Shanghang Guild. “Guilds” were normally gathering places for certain business sectors or for certain groups of businessmen from the same regions in China. They functioned to regulate the operation of commerce and support social interactions within each association (Zhu, 2006).



FIGURE 4.10 Layout of the eighteen commercial streets (in yellow)
 Source: *Map of land divisions and boundaries of Guangzhou in the republican period 民国经界图*
 The red square indicates the 7th and 8th streets, see Figure 4.11



FIGURE 4.11 Layout of the 7th and 8th streets
 Source: *Map of land divisions and boundaries of Guangzhou in the republican period No. 97 民国经界图*



FIGURE 4.12 Residential and commercial streets of Canton in 1880
Source: Restored by R.H. Brown, the original image is collected by the Royal Geographical Society in the UK

2. Thirteen Factories (Shisan Hang)

The second spatial pattern shows the interactions between local businessmen and foreign traders in an area of foreign quarters. The establishment of the Canton (Yue) Customs in Guangzhou stimulated the development of ancient foreign trade. In 1757, the national government closed Min, Zhe and Jiang Customs, leaving Canton Customs the only one in China for foreign trade - which is called the “Canton System” (1757–1842). Foreigners’ quarters accumulated in the thirteen factories area (Shisan Hang), which was established in 1686 mainly for foreign trade affairs until it burnt down in 1856 (Liang, 1999). The thirteen factories area was located along the north bank of the Pearl River and to the west of the West Moat, for convenient shipping and management of foreign trade (Figure 4.13).

The spatial form of this area was closely related to the Pearl River (Figure 4.14). The street layout was parallel to the West Moat and perpendicular to the Pearl River with wharfs at the riverfront (Figure 4.15). Three main commercial streets were connected to the Shisanhang Street to the north, Old China Street (Jingyuanjie 靖远街), New China Street (tongwenjie 同文街) (Figure 4.16), and Hog Lane (Xindoulanjie 新豆栏街). Retail shops were lined up in the streets selling a wide variety of Chinese goods, with showrooms on the ground floor and family quarters in the overhanging second floor (Figure 4.17) (Van Dyke & Mok, 2015).



FIGURE 4.13 Canton harbour and factories with foreign flags, c. 1805
 Source: Peabody Essex Museum 2007, Photo Jeffrey R. Dykes

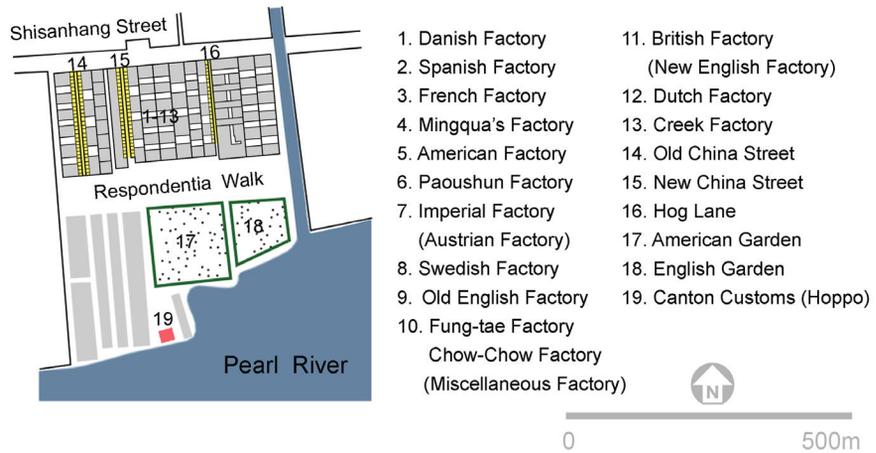


FIGURE 4.14 Plan of the Canton Factories
 Source: Adapted from two drawings
 Drawing of 1856: Hosea Ballou Morse, 1910. *The International Relations of the Chinese Empire. Volume 1. P70.*
 Drawing of 1840, W. Bramston, engraved by James Wyld; Published by Jas. Wyld, Geographer to the Queen, Charing Cross, East London. Entered at Stationer's Hall

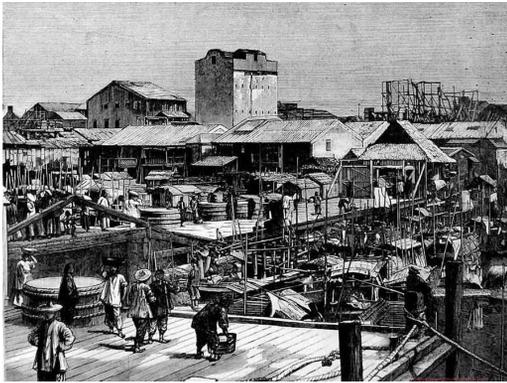


FIGURE 4.15 Riverfront: Wharfs at the thirteen factories area for foreign trade
 Source: Peabody Essex Museum 2007, Photo Jeffrey R. Dykes

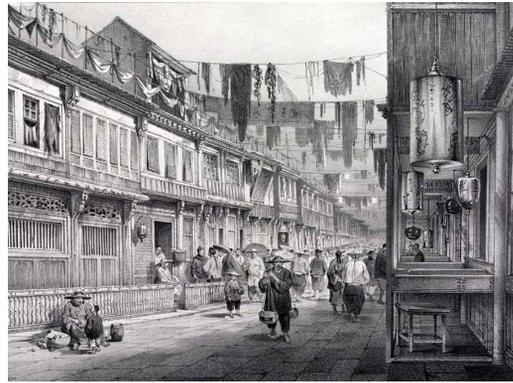


FIGURE 4.16 New China Street in Canton, 1836-1837, by Lauvergne; lithograph by Bichebois
 Source: National Library of Australia



FIGURE 4.17 Guangzhou thirteen factories
 Source: painted by Cheng Keng (陈铿, 油画《远航之梦-广州十三行》)

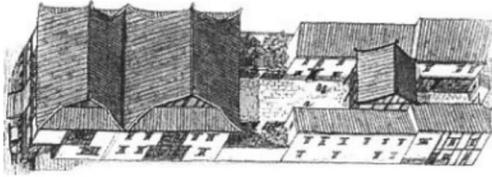


FIGURE 4.18 Swedish Factory in 1740
Source: Li & Lin, 2006



FIGURE 4.19 View of the hong at Canton after 1807
Source: Painted with oil on silk by the follower of Spoilum (possibly Lam Qua), collection of Hong Kong Museum of Art

Foreigners used to live in the buildings called “factories”, which were composed of living quarters, warehouses and offices for trade. The Chinese called them “hongs”, or merchant shops (Perdue, 2011). Each factory contained 2-3 floors, with warehouses on the ground floor and apartments on the first and second floors. Although the facades copied the Western classical design, the layout and interior of the buildings followed typical Cantonese style - Zhutongwu (tube house). The factory buildings had a narrow frontage with a width of 15m to 17m, and long hallways up to 150m in the middle connecting rooms off to the sides. Each building was divided into 5-8 units interconnected by courtyards (Figure 4.18, 4.19).

Initially, factories were built near the waterfront. It was not until the 19th century that a large piece of land was reclaimed in front of the factories as recreational space, called the “Respondentia Walk”, making the factories 100 yards (91.4m) away from the river. Adjacent to the Pearl River, two fenced gardens were designed for foreign merchants – the English Garden and the American Garden. The design of the American Garden for example, was a neat layout of grass and thriving plants, showing the style of “Gardenesque⁶” (Figure 4.20) (Farris, 2016). Although serving a strictly limited number of users, these gardens brought the Western sense of public space to Guangzhou for the first time. However, the development of the foreign trade area on reclaimed land accelerated the shrinking process of the Pearl River. As a result, the narrowest part of the Pearl River was formed in this area before the 1920s, thus created a bottleneck for river discharge and increased the flood risk (Zeng, 1991).

6

The term “gardenesque” was introduced by British landscape architect John Claudius Loudon in 1832 to describe a style of planting design with formal features and botanical variety in accordance with his “Principle of Recognition”.



FIGURE 4.20 View of the American Garden, 1844-1845, Gouache
 Source: Essex Museum 2007 Mark Sexton Photo

3. Shamian Concession

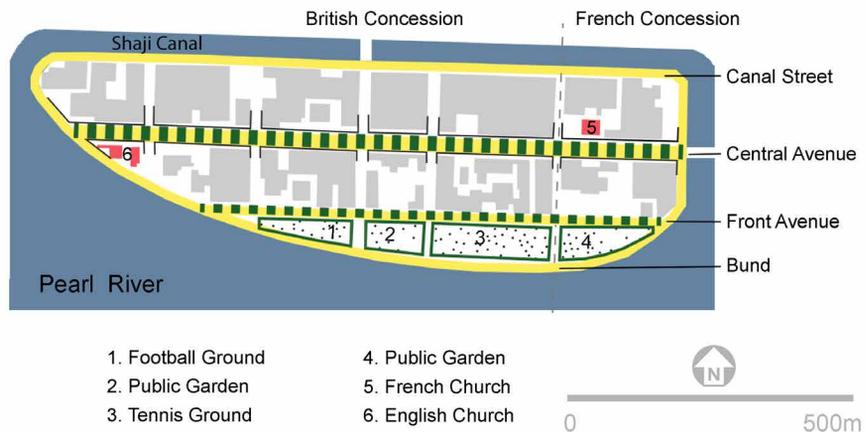


FIGURE 4.21 Shamian Concession
 Source: MAP Braga Collection Col./67

In contrast to the commercial streets area and the thirteen factories area, Shamian Concession was planned and constructed completely in a Western style (Figure 4.21). In 1857, the Qing government was defeated in the Second Opium War and the British and French allied forces set up the "Canton Commission" to control the city. As the thirteen factories area burnt down in 1856, the Chinese government agreed to reclaim a new artificial island - "Shamian" - as a concession for foreigners in Guangzhou. The Shamian island occupies an area of 900m by 300m adjacent to the Pearl River to the southwest of the location of previous Shisanhang. To maintain independent management and strict control, the concession area was separated from the old city by a 30m-wide canal (Shaji Canal). Four fifths of the island was leased to the British and the rest to the French in accordance with their quota of loss in the fire of Shisanhang (Chen, 2012).

Compared with the rest of the city, the street plan of Shamian was more spacious and European style in nature (Garrett, 2002). One of the main planning principles was to reserve public space by the river for leisure and to create an attractive riverfront. Therefore, the southern stretch of the island facing the Pearl River became a site for a football ground, tennis courts and public gardens. A ring road was built around the island by the river as the traffic route and a pleasant walking space. Compared with the tube-like factory lot, the proportion of the concession lot was more spacious. Two tree-lined boulevards in the west-east direction (the Central Avenue and the Front Avenue) and five streets in the north-south direction divided the whole island into sixteen quarters (Smith, 1938).

There was a sharp contrast between waterfront images of the two sides of the Shaji Canal. Shamian was planned and developed in a Western fashion, while the rest of the city continued the traditional practice of utilising waterfront space. As shown in the photo (Figure 4.22), the right side of the canal is the Shamian Island featuring a beautiful promenade lined with flourishing banyan trees. The view is completely different on the opposite side, where a row of two-floor houses with a narrow frontage was built next to water. The ground floor of the houses was used as warehouses opening directly onto the canal, connecting to a large amount of boat dwellers (Chen, 2012).



FIGURE 4.22 Sharp contrast between the two sides of the Shaji Canal along Shamian
Source: Lai Afong, 1880

§ 4.3 The changing values of water

§ 4.3.1 Flood safety – flood-stricken delta city

Exposed to the subtropical climate with intensive typhoons and storms in summer, Guangzhou suffered from frequent fluvial flooding before the 1920s. There were three main sources of flooding at this stage: river flooding from the North and West River; mountain flooding from the Liuxi River as well as high tides caused by storms. It is recorded that from 1550 to 1920, Guangzhou was flooded 253 times with the average flooding frequency being once every 1.5 years. The most severe flooding occurred in July 1915, when the river discharge in the North River and the West River simultaneously reached high levels with a return period of 200 years. It was estimated that over

432,000 ha of farmland and 3.78 million residents were affected with casualties of more than 100,000 in the whole delta region (Figure 4.23). Being a densely populated city, Guangzhou suffered from great losses. The low-lying Xiguan area was seriously flooded for 7 days with an inundation depth of 0.5-1m, while the inner city was well protected by the city wall (Shanghai News, 1915; Guangzhou Water Conservancy Chronicles, 1991) (Figure 4.24).

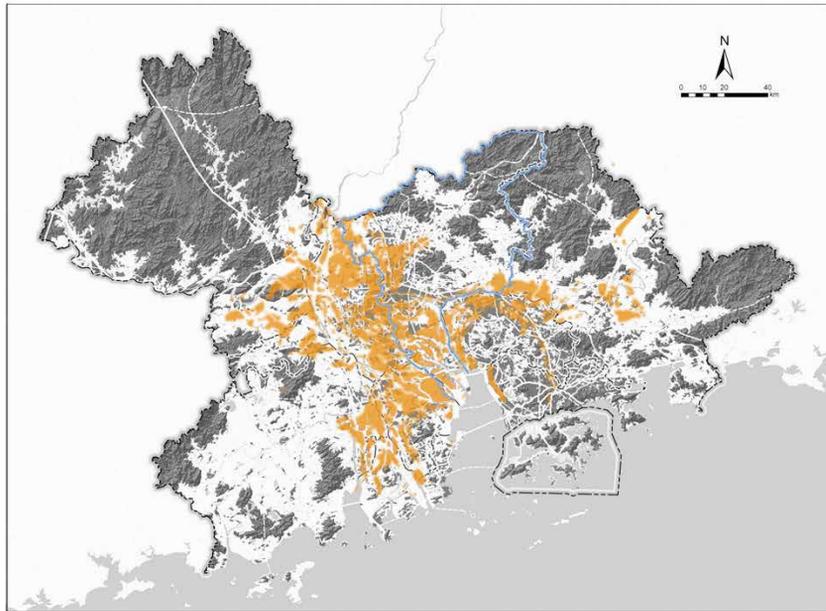


FIGURE 4.23 The flood-stricken area (in orange) of Guangzhou and the Pearl River Delta in 1915
Source: Guangzhou flooding areas (*Huaguo News 华国报*, 20th July, 1915)
PRD flooding areas (the Pearl River Hydraulic Engineering Bureau, drawn in 1953)



FIGURE 4.24 The long dike road in Guangzhou during the 1915 flood
Source: Presbyterian Archives Research Centre

Both diking and reclamation at the delta scale accelerated the process of sedimentation and channelised watercourses, which caused higher flood risk for the city. In order to obtain more land for agriculture, farmers initiated land reclamation. First, they threw stones in the sea to block the upstream sediment, accelerating the process of silting. Then they built dams at the mouth of the sea, which blocked deep-water channels, thus impeding the flow velocity and accelerating the silting, while the waterway was gradually narrowed. When the rain came, the flood risk became higher due to blocked drainage outlets. In the face of such unplanned reclamation, local officials made some flood defence measures such as embankments however, the poor quality of the embankments could not efficiently contribute to flood safety due to the low levels of budget and management (Xian & Wang, 2005). In addition, land use change from a natural landscape to urban functions in the low-lying area increased the vulnerability of the floodplain. As more estates were built on low-lying land and drained ponds, these areas frequently suffered from destructive flooding, as in 1880, 1885 and 1908 (Universal Circulating Herald; The Chinese Mail).

§ 4.3.2 Economy – prosperous treaty port

As one of the most important treaty ports and Customs in China in ancient times, water played an essential role in driving the economic development of Guangzhou. Before the large-scale construction of roads and the spread of cars, navigation in the canals, moats and the Pearl River was the most dominant means of transportation. Correspondingly, the area on the north bank of the Pearl River became a commercial and trading centre in Guangzhou. The prosperous commercial streets along the canals and moats stimulated urban development in the Xiguan area (Gray, 1875).

The adoption of the Canton System (“one-port-foreign-trade” policy) by the Qing government propelled the development of light industries in Xiguan. A large number of Chinese goods were exported, such as tea, silk, porcelain and lacquerware. The growth rate of foreign trade through the Canton port started to increase from 1785. For example, the total value of foreign trade increased more than 170% in the period between 1785-1829 as compared to that of 1757-1784 (Yan, 2012). Among which, the value of tea export was the highest (193,134,525 silver bullion (银元), accounting for 61% of the total export value during the period of 1817-1833), followed by satin, raw silk and nankeens (Morse, 1926). In return, the Hong merchants imported tin, copper, lead, iron, wool and linen from Western countries. Foreign trade development not only benefited the local economy of Guangzhou, but also drove the economy of the whole delta by commercialising some agricultural products. The silk export for example, increased substantially from 25,000 piculs⁷ in 1723 to 1100,000 piculs in 1828. In 1860, the amount became four times as much as in 1828 (So, 1986). As a result, the delta experienced the prosperous development of silk and tea markets, and accompanying processing factories in some towns that later became the local commodity exchange centres in the Pearl River Delta (Agriculture Archives of the Pearl River Delta, 1976). Although the national policy of foreign trade facilitated the economic development of Guangzhou and the whole delta, the administrative power was in the hands of the Qing Empire for stabilising its feudal regime. Consequently, economic development in the Qing era was limited to certain industries, was centrally controlled and fell into decline after the Opium Wars (Li, 1986).

Although the dependence on inland navigation has greatly decreased today due to the disappearance of the canal system in the historical centre, the economic significance of water remains in Guangzhou. Most of those original canal streets and foreign trade areas are still the liveliest gathering points for dealing in traditional economic products.

7

Picul is a unit of weight used in China and Southeast Asia, typically in the silk trade, recorded as early as 1588. One picul is equal to 133 $\frac{1}{3}$ pounds, which is the load a grown man can carry.

§ 4.3.3 Environment – beauty of the delta landscape

The Pearl River Delta was initially developed as an agricultural delta with large tracks of farmland and fishponds. Local farmers invented the unique dike-pond system with high environmental values according to the natural conditions of the delta landscape. In the suburb of Guangzhou, there was a large area of wetlands, ponds and orchard gardens (Zeng & Liang, 2006). The beauty of the delta landscape was highly appreciated at this stage, especially in foreigners' eyes (Ni, 2007), as described in some books over a century ago.

'Nothing can exceed the beauty of the scenery on both sides [of the Pearl River], through its whole extent, particularly upwards, the low grounds being richly cultivated, and the high banks, raised to prevent inundations, planted with orange, peach, and other trees.' (Burford, 1838).

'Large quantities of rice and sugar cane are grown. A great number of fruit trees are also growing all over the plains and near the river, such as mango, guava, wampee, lychee, longan, orange and pumelow. Besides, there are cypress, thuja, banyan, fig trees, water pines, water lily and lotus, are grown near the sides of the river, embanked in the same manner as the rice fields.' (Littell, 1845).

However, the expansion of the urban area in Guangzhou caused decreased environmental quality. The continuous diking and land reclamation, as well as the land use change from nature to built-up area, accelerated the process of silting and narrowing of waterways. Urban expansion also brought environmental issues. In the late Qing era, canals were polluted and blocked due to domestic sewage and waste disposal, thus the drainage capacity of the canals decreased (Gong et al., 2013) (Figure 4.25).



FIGURE 4.25 Interior canal of Canton in 1917
Source: Sidney D. Gamble Photographs, Archive of Documentary Arts, Duke University

§ 4.3.4 Society – social diversity and vitality

From the first settlement next to the river to the prosperous waterfront trading centre and public gardens in the Ming and Qing dynasties, water contributed to diverse cultures associated with different social groups in the city by shaping the urban fabric and supporting the social life. The essence of ancient Chinese philosophy and Feng Shui thought provided the initial cultural basis for the site planning of Guangzhou, especially the attitudes toward water as an essential part of nature. The traditional Chinese culture was challenged by Western culture when Guangzhou became the most important treaty port in China. A strong distinction between spatial patterns can be perceived regarding the water-city interrelationship. The foreign impact on the development of indigenous areas was not immediate, but was far-reaching (Chen, 2012). The Western-style urban fabric is highly valued today and has become part of Guangzhou's identity. Shamian Island for instance, has been listed as a national-level historical heritage protection district since 1998 (du Cros, 2006).

The three spatial patterns in Xiguan reflect different social values of water. In the eighteen streets area, the prosperous commercial and trade culture shaped the city with dense and narrow canal streets. Waterfronts functioned as docklands and goods loading areas, facing the backside of the buildings on the streets. On the contrary, the concession island of Shamian was built entirely in a European style, with physical beauty and orderliness, showing a strong distinction between waterfront land uses. Compared to the local Chinese, the Westerners highly appreciated the recreational and aesthetic values of water and nature. A large area of land facing the Pearl River was intentionally left open and designed as squares, parks, and open spaces for recreation. Fewer such places can be found in the walled city. In between the traditional city and the concession, the thirteen factories area was shaped by a fusion of both Chinese and Western values, affecting the organisation of streets, public spaces, plot layouts and building styles. Foreign merchants used to exercise by walking in the square called the “Respondentia Walk”. When the weather was pleasant, they took short excursions rowing and sailing up and down the river, occasionally landing at inviting spots and enjoying the luxury of a *fête champêtre* (Downing, 1838).

In addition to the local Cantonese culture and the Western influence, a special ethnic group called Tankas (or boat dwellers) developed their unique culture closely related to water (see chapter 5). During the Qing dynasty, the Pearl River served as the living space for a large amount of boat dwellers. It was estimated that in 1833 around 252,000 people (20% of the total population of Guangzhou) were living in 84,000 boats on the river close to the city (Bridgman, 1833). Guangzhou was described as a floating city due to a great amount of ships and boat dwellers on the river. The images of vivid waterscapes can be found in many books from the 19th century (Bridgman, 1833; Littell, 1845).

‘At festival times, the river has a gay and striking appearance, particularly at night, when the lanterns are lighted, and boats gaily decorated with them move up and down in front of the factory...Throughout the whole of this large floating city, the greatest regularity prevails; the large boats are arranging in rows, forming streets, through which the small craft pass and repass, like coaches and other vehicles in a large town.’ (Littell, 1845).

Water was an important interface for social interaction between different social groups and between Chinese and Westerners. The role that water played in social interaction was two-fold. On the one hand, water facilitated the interaction between different social groups. For centuries, Chinese emperors restricted foreign traders to particular parts of a city by creating gated foreign quarters, in order to minimise disruptions in the traditional functioning of the city. Foreigners were forbidden from associating directly

with Chinese people except their Chinese counterpart – the Cohong⁸ merchants. With a blurry boundary, the Pearl River became a vital interface serving the interactions between Chinese boat dwellers and foreign merchants. As an extension of the dwelling space of the factories and a place of respite for foreigners, the riverfront in the thirteen factories area offered opportunities for foreigners to find interesting and less restricted interactions with the Chinese (Farris, 2016). On the other hand, water was used as a physical barrier for political isolation. The Shaji canal that separated Shamian from the rest of the city created segregation between the Western Concession and the traditional Chinese city.

§ 4.4 Conclusion and discussion

§ 4.4.1 Transitions of water values

Before the 1920s, the values of safety, economy and society were dependent on each other (Figure 4.26). The water environment of the Pearl River Delta structured the spatial form of Guangzhou. The artificial water systems, flood defence systems, land uses, street layouts, and building types all reflected certain levels of adaptation to the natural landscape, especially topography, climate and the natural water system. Both urban development and water management respected natural features. Influenced by Fengshui and the ancient site planning culture, the historical city centre of Guangzhou was built on the high ground of the floodplain. Following the natural landscape and topographic features, water was managed in a well-connected system of canal-moat-river for storage, drainage and navigation. Waterways also contributed to the attractiveness and identity of the city by structuring elements of the urban fabric such as street layouts and public spaces. Correspondingly, the main streets were mostly built parallel to the Pearl River in the east-west direction, and dense small lanes were organised perpendicular to the river with wharfs at the waterfront.

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The Cohong was a guild of Chinese merchants or hong s who operated the import-export monopoly in Guangzhou during the Qing dynasty (1644–1911).

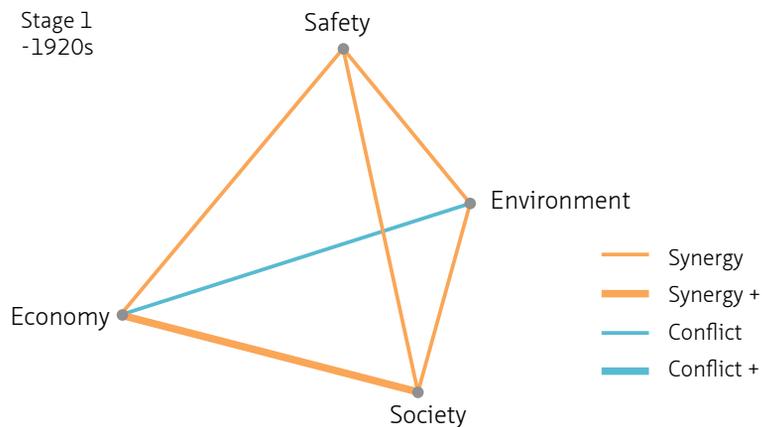


FIGURE 4.26 Relations between water values

Thanks to the national policy of the “Canton System”, Guangzhou became a monopolistic treaty port and experienced prosperous development of ports and foreign trade. These economic activities were also an important part of social life, facilitated by the organisation of canal streets. The long-term commercial and foreign trade development enriched the cultural diversity of Guangzhou featuring an international port city. Diverse cultures found their own places and coexisted in the city, such as the local Lingnan culture, the Western culture, and the Tanka culture. The prosperity of trade attracted many foreigners, who brought exotic culture and a far-reaching impact to the city.

As an agriculture and aquaculture based delta, the environmental values of water were highly appreciated by foreign traders. For example, they built public squares and elegant avenues at the waterfront of the foreign quarter and designed wetland parks in the suburb for recreation. Aside from the nature-based water management approach in the walled city, water management in rural areas also made full use of the natural environment. The local farmers’ adaptive approach of creating the dike-pond system near the estuaries of the delta largely contributed to both agricultural productivity and flood mitigation. However, the opposing position of environment and economy reflects the negative impact of urban expansion on nature. Due to rapid economic growth and great migration driven by port development and foreign trade in the Ming and Qing dynasties, the Pearl River Delta experienced long-term land reclamation facilitated by diking. This process undermined the environmental values of water by bringing problems such as silting and narrowing of waterways as well as declining ecosystems.

§ 4.4.2 Underlying forces of the transitions

The transitions of water values are driven by political, socio-economic and cultural forces. First of all, culture plays an important role in influencing water values in society. The Chinese philosophical concepts on city site planning and Feng Shui thought shaped the initial layout of the city in a mountain-water setting. The three-level multifunctional water system reflects the wisdom of the traditional Chinese culture of integrating water management in city planning based on natural conditions. Due to cultural differences, waterfront development in the traditional city and foreign quarters displayed distinctive features with sharp contrasts.

Secondly, national decisions had a strong impact on the development of the city. To simplify the management of Customs and control the influences from foreign countries, the Qing government adopted the Canton system (single treaty port policy). Due to its geographic location for foreign trade, Guangzhou port was chosen as the only one in China open to foreign trade for 85 years during the Qing dynasty. The adoption of the Canton system stimulated the economic development and prosperity of the city. The policy laid a solid cultural foundation for the city as a historical commercial and trading centre. It also brought new values to the city such as designing waterfront public spaces for recreation and leisure.

Thirdly, the social structure determines the responsibility and power of actors. Both the government and public shared the responsibility for achieving flood safety at this stage. In the walled city where the administrative centre was located, the government built a well-connected artificial water system to facilitate transport, trade and drainage. Both the provincial government and county-level government (Nanhai county and Panyu county) conducted continuous maintenance work to ensure a smooth connection of water systems and avoid flooding. In suburban areas, local farmers built small dikes to protect their agricultural land. This kind of flood management approach allowed site-specific solutions at the local level. In some cases value conflicts occurred among diversified social groups who represented different interests and administrative power. For instance, local farmers saw river flooding as a big threat to their farmland so they initiated small-scale dikes along waterways. In the Ming and Qing dynasties, the “gentry class⁹ (士绅阶级)” played a role in promoting the local autonomy. They attempted to own the local administrative power by intervening in water management. Around the end of the Qing dynasty, some businessmen were also involved in local

9

The gentry class (or scholar-officials) refers to the elite that held privileged status and shared political power in the late imperial China after passing the imperial exams.

water management. Distinct from farmers and the gentry class, the businessmen suggested river dredging to enhance the navigation capacity of rivers, which increased the vulnerability of the territory to flooding due to the tidal effect and storm surges. On the delta scale, flood risk was associated with the accelerating process of silting due to long-term land reclamation and diking activities, showing a lack of cross-scale consideration in flood management and city development.

5 The Functional City (1920s-1970s)

§ 5.1 Urban development background

§ 5.1.1 Political and socio-economic background

The urbanisation of Guangzhou was driven by industrialisation and modernisation at this stage, which resulted in great land use changes in waterfront areas, showing an industry dominant spatial form. The main driving force for industrialisation was closely related to radical political transitions. There were two essential turning points of the political transition: the termination of Imperial China after over 2000 years by the establishment of the Republic of China (ROC) in 1912; and the start of the socialist period by the establishment of the People's Republic of China (PRC) in 1949. These two important events led to dramatic socio-economic transitions in China. These political transitions were also the main mechanisms for both urban development and water management in Guangzhou. Divided by these two political transitions, this chapter mainly refers to two key periods: the republican period (1912-1949) and the socialist period (1949-1978). In between these, there are two other passive stages when urban development stagnated or even went backwards: the Second Sino-Japanese War (1937-1945) and the Cultural Revolution (1966-1976). These two periods are not the focus of this chapter.

The republican period saw a major effort to modernise Chinese cities. City walls were torn down; streets were widened; new types of transport, engineering and public utilities were introduced; public spaces were created for recreation and aesthetics; Western-style architecture was widely built and moreover, modern institutions were established (Esherick, 2002). In 1921, Guangzhou set up the administration office (市政厅). The formal municipal government was established to administer the city as a political and socio-economic entity.

Both the republican period and the socialist period can be regarded as the industrial stage for Guangzhou in which the development of modern industries was significantly

accelerated. The republican period witnessed the transition of Guangzhou from a traditional commercial city to a light- industry based city. After the founding of the PRC, the national government adopted the Soviet economic model of “Five Year Plans” for national economic and social development from 1953 (Xie & Costa, 1993). The guiding ideology for urban development was to transform Guangzhou from a consumptive (commercial) city to a productive (industrial) city. As such, urbanisation and modernisation had to be driven by the large-scale development of heavy industries. After 1949, national land reforms facilitated the industry led development by means of land regulations. For instance, urban land became state-owned and land transaction was banned by the constitution (Zhang, 1997).

The transition of the development ideology was also associated with the political attitudes toward nature. In the republican period, the founding father of the ROC - Sun Yat-sen - proposed an ambition to tame great rivers by diking and damming. Such kind of hard engineering approach to water management was developed further by Chairman Mao Zedong in the socialist period. Challenging the traditional Chinese philosophical notion of the “unity of humans and nature (天人合一)”, Mao advocated that “humans can conquer nature (人定胜天)”. Casting away traditional values and beliefs, he promoted the value of environmental manipulation and exploitation (Ball, 2016). Flooding was therefore considered a threat that should be conquered. As for flood risk management, the state built regional scale water infrastructures such as dike rings and dams to ensure flood safety.

Besides the ideological transition, the modernisation process also featured the subdivision of disciplines and professions as urban planning/design and water management sectors had their own roles in spatial development. Urban planning/design at this stage, was influenced by both the traditional Chinese planning culture and Western concepts of modernist planning. Meanwhile, hydraulic engineering was introduced as a modern technology underpinned by science, much of it based on principles developed in Western countries.

§ 5.1.2 Urban planning sectors and spatial strategies

Since the founding of the ROC in 1912, Western planning ideas have been gradually introduced into China and Guangzhou was one of the first cities where these ideas influenced the development of industry, transport and public facilities (Feng, 2013). The first mayor of Guangzhou - Sun Ke (son of Sun Yat-sen, also known as Sun Fo) - who had studied city planning and politics at UCLA in Los Angeles and Columbia

University in New York, brought Western planning ideas to the city. As few Chinese cities historically possessed open public areas, Sun Ke propelled his father's "Garden City" vision for Guangzhou and proposed to build public gardens and squares for leisure (Tsin, 2002). Henry Murphy, an American architect who was also Sun Ke's friend, promoted the idea of the "City Beautiful Movement"¹⁰. Murphy's 1927 plan for Guangzhou featured two main proposals: upgrading harbour facilities and establishing a civic centre with grand avenues radiating from a prominent monument. These plan proposals were not immediately realised but embedded in the later spatial development of Guangzhou (Cody, 2001).

The transition of the planning ideology was also accompanied by the modernisation of institutional structures and Guangzhou became one of the major testing grounds for the Western-style municipal management (Cody, 1996). The official specialised sector of urban planning and design as well as the Urban Design Committee of Guangzhou were set up in 1928. Along with the establishment of the urban planning and design sector and the promulgation of the city's first master plan, Guangzhou began to develop under control by the city government. Urban planning has become a tool to direct and control urban development based on planning documents and blueprints (Zou, 2012). Planning has also been playing an increasingly important role in spatial transformations of water and the city.

During the republican period, several important plans were proposed to regulate the city's development with modern features. In 1920, Sun Yat-sen put forward an international development scheme (实业计划) to assist the readjustment of post-war industries in the transitional period. One of the most important plans in the scheme was to develop Guangzhou (Canton as indicated in the program) as a first-class seaport - "Great Southern Port Plan" - with strong international significance. The program stressed the development of Guangzhou as an international port and fishing harbour, as well as the improvement of the waterway system (Sun, 1922). Although the plan was not realised in the end, it had a great impact on the planning ideology of positioning Guangzhou as a world-class port city. These ideas were reflected in subsequent plans, such as the "Action Plan of Guangzhou Public Works" (1929) (广州工务实施计划) and the "Draft Summary of Guangzhou Urban Design" (1932) (广州市城市设计概要草案). The idea of urban function partition was first raised in the "Draft Summary of Guangzhou Urban Design" and embodied in the urban layout, preliminarily resulting in several major functional zones such as the administrative centre, the commercial

10

The City Beautiful Movement was an American urban planning movement that flourished during the 1890s-1920s. The movement was aimed at enhancing the aesthetic value of cities by designing the city's civic centre with wide boulevards, elegant parks, recreational waterfronts, and monumental architecture.

centre, the industrial zone, and the residential zone (Figure 5.1). The commercial zone was planned along the urban waterfront and the industrial zone occupied remainder of the waterfront, connecting to both the inner port of Baietan and the outer port of Huangpu. There were two types of residential land. The upper-class residential area was located in the suburbs with high environmental quality, while communities for workers were situated adjacent to industrial areas.

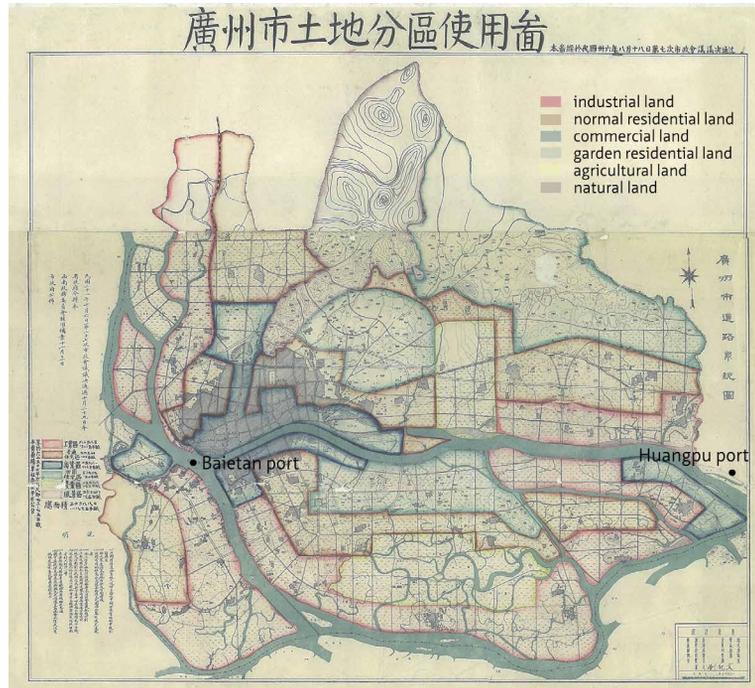


FIGURE 5.1 The first land use zoning in Guangzhou (1947)
 Source: *Guangzhou Urban Planning Bureau & Guangzhou Urban Development Archives, 2010*

This kind of industry-driven development was reinforced after the founding of the PRC. At the beginning of the socialist period, urban planning played a subordinate role to economic planning. Following the guidance of the first “Five Year Plan” (1953-1957), cities were defined as the bases for industrial development (Ren, 2013). Like many other big cities in China, the main planning ideology was to transform Guangzhou from a commercial city to an industrial city. Based on this, thirteen master plans were made between 1954 and 1976, where the development of industrial and port areas was one of the most important strategies for shaping the spatial structures via the guiding of urban growth and land uses (ECGUPDR, 2006).

§ 5.1.3 Water management sectors and spatial strategies

The establishment of regional water management authorities at the beginning of the republican period altered the social structure of water management. Originally, local farmers built and managed dikes at a rather small scale for flood protection and agricultural development. To avoid separation in water management, the national government promoted the integration of water management at multiple levels (Wu, 2012). At the delta level, the first official institute of river basin management in the PRD - Canton River Management Committee (督办广东治河事宜处) was set up in Guangzhou in 1914. The institute was mainly in charge of water management and flood control issues in the Pearl River catchment, as well as coordinating port construction. At the city/county level, the city construction department within each city or county was responsible for local water management. Flood protection along the Pearl River in Guangzhou however, was regarded as a regional matter. The first dike road in Guangzhou for example, was built by the general provincial governor - Zhang Zhidong in the late Qing dynasty (1889) - and was later extended to facilitate riverfront transport as well as for city beautification.

A more specific division of sectors occurred in the socialist period. In 1954, the hydraulic department of Guangzhou was established as the first formal water management sector at the city level. To simplify management issues, water management has adopted a centralised approach. The hydraulic department initiated three main centralised strategies for flood risk management during the socialist period (Guangzhou Hydraulic Archives, 1991).

(1) Flood defence system – dike rings construction (联围筑闸)

From the republican era, especially since the 1950s, the national government has constructed regional dike rings by connecting small-scale dikes along the main rivers and at the estuaries of the delta for centralised management. With a long history of dike construction from the Song dynasty (around 996), the PRD used to have more than 20,000 scattered dikes before 1949. Owing to large-scale dike connections and reorganisations, this amount was reduced to 2950 dikes in 1949, 441 dikes in 1961, 218 dikes in 1982, and eventually 53 regional dikes have remained at present (Huang & Zhang, 2004). The dike connection enabled land reclamation on the regional scale, thus accelerating the process of urbanisation as the original agricultural land within the dikes was rapidly urbanised (Figure 5.2).

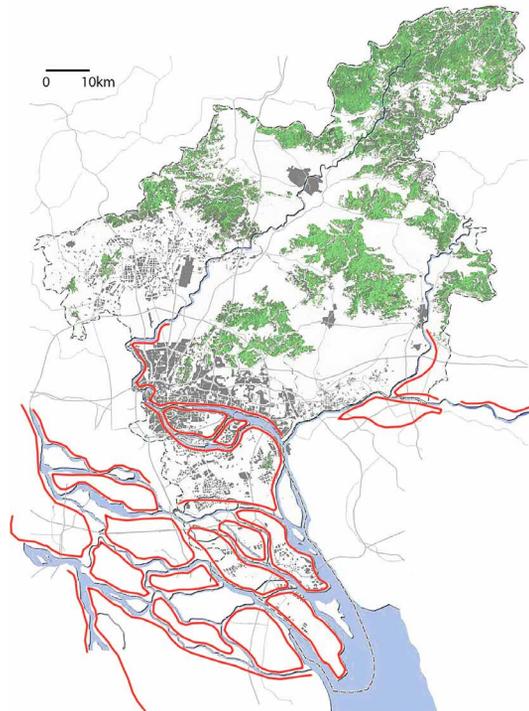


FIGURE 5.2 The dike-ring system in the Pearl River Delta in the 1950s
 Source: drawn by author based on *Guangzhou Hydraulic Archives, 1991*

(2) Retention system

Almost during the same period, creating large-scale retention areas was another strategy for dealing with flooding. There were two kinds of retention systems: reservoirs and ponds in the upper catchment of the delta as well as artificial lakes in the suburb of Guangzhou. According to *Guangzhou Hydraulic Archives*, 2286 reservoirs and ponds were built before 1985, with a total water retention capacity of 1.6 billion m³. Water retention was combined with other functions such as recreation and ecological preservation. After 1958, four major artificial lakes (see Figure 5.3) were created on the low-lying land in the suburb of Guangzhou for water retention and flood mitigation, these were connected to the canal system with sluices.

(3) Drainage system

In ancient Guangzhou, the drainage system was a combination of the natural landscape and an artificial water system (canals, ditches and moats) that was in accordance with topographic features. Rainwater and sewage was discharged into

the Pearl River through this drainage system. However, as surface water was gradually polluted, silted up or blocked by informal dwellings, the city government began to transform the surface drainage system by covering most of the canals in the old town and constructing underground drainage pipes after 1949. It has been recorded that 147km out of 335km of ditches and canals were covered in 1957, followed by a rapid growth in drainage pipes (EBGC, 2000). Within the historical centre, most canals disappeared during this period with only the East Moat (see Figure 5.3) remaining.

§ 5.2 Morphological analysis of water and the city

§ 5.2.1 Spatial structure and transport guided urban expansion

The spatial structure of Guangzhou experienced a rapid expansion along the Pearl River to the east and the south. Before the 1920s, urban growth in Guangzhou mainly took place on the north bank of the Pearl River. Continuous land reclamation towards the south and the construction of bridges across the Pearl River enabled urban development to gradually overcome the constraints of this natural boundary. Initially, new development at the periphery was not connected to the old city centre. The in-between land was later filled with urban functions, resulting in an “L shaped” urban form along the Pearl River (Figure 5.3).

Regarding the transition of different systems in the morphological framework, the transport system guided the direction of urban expansion (Figure 5.4). The modern means of transport increased the accessibility of the south bank of the Pearl River and extensive suburban areas. Newly built roads and bridges across the Pearl River, together with regional railways substantially replaced the navigation function of moats and canals. Major roads were built in the east-west direction parallel to the Pearl River. In order to strengthen the connection between the north and the south sides of the Pearl River and to drive urban growth, the first bridge in Guangzhou - Haizhu Bridge (see Figure 5.6) - was constructed across the Pearl River in 1929. The Haizhu Bridge also stimulated the development of the first traffic square - Haizhu Square - as an important transport hub on the north bank of the Pearl River connected to the bridge. The square and its surrounding areas thus rapidly became one of the main public centres of Guangzhou in the 1950s-60s (Mo et al., 1995).

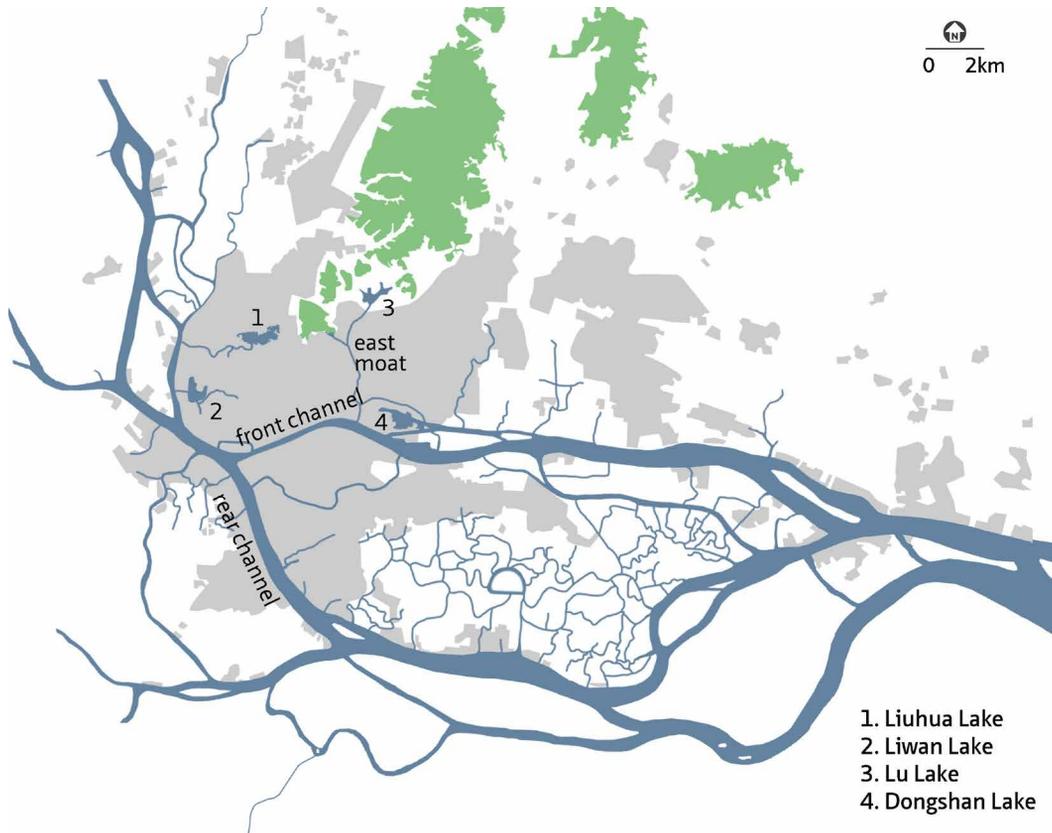


FIGURE 5.3 Built-up area and water system of Guangzhou in the 1970s

Meanwhile, the introduction of the railway system brought new opportunities for port and urban development in Guangzhou at the beginning of the 20th century. Between 1901 and 1911, three terminuses were built along the main navigation courses of the Pearl River and the railway development became an impetus for dike road construction. The development of the Guangzhou - Sanshui Railway with the terminus at Shiweitang, the Guangzhou - Hankou Railway (part of current Guangzhou - Beijing Railway) with the terminus at Huangsha, and the Guangzhou - Kowloon Railway, with the terminus at Dashatou, enabled the dike road to be extended to connect with the railway system (EBGPC, 1996) (Figure 5.4). The railway system also accelerated port development and the eastward expansion of the city by taking full advantage of the Pearl River. The Huangpu port for example, was the shipping centre in South China, which stimulated industrial land development in the surrounding areas.

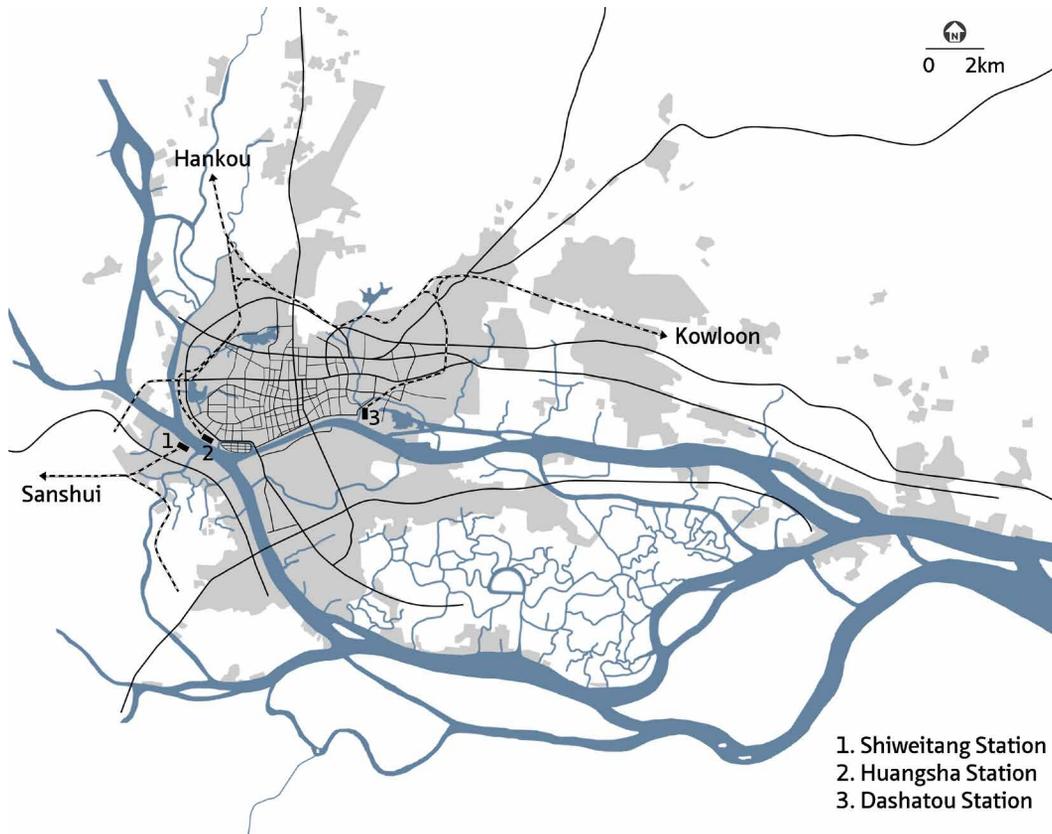


FIGURE 5.4 Railway and road systems in the 1970s

§ 5.2.2 Land use change

During this stage, the largest land use change was water. It was calculated that the area of the Pearl River decreased by 157.28 ha and the average width dropped from 438m (in 1907) to 288m (in 1968). It was estimated that 13.3% of the decreasing river area became residential and industrial land use, and 5.6% was for the development of the transport system (Ji, 2009). The decrease in the river area was mainly caused by continuous land reclamation and the process was hastened owing to dike and transport development along the Pearl River.

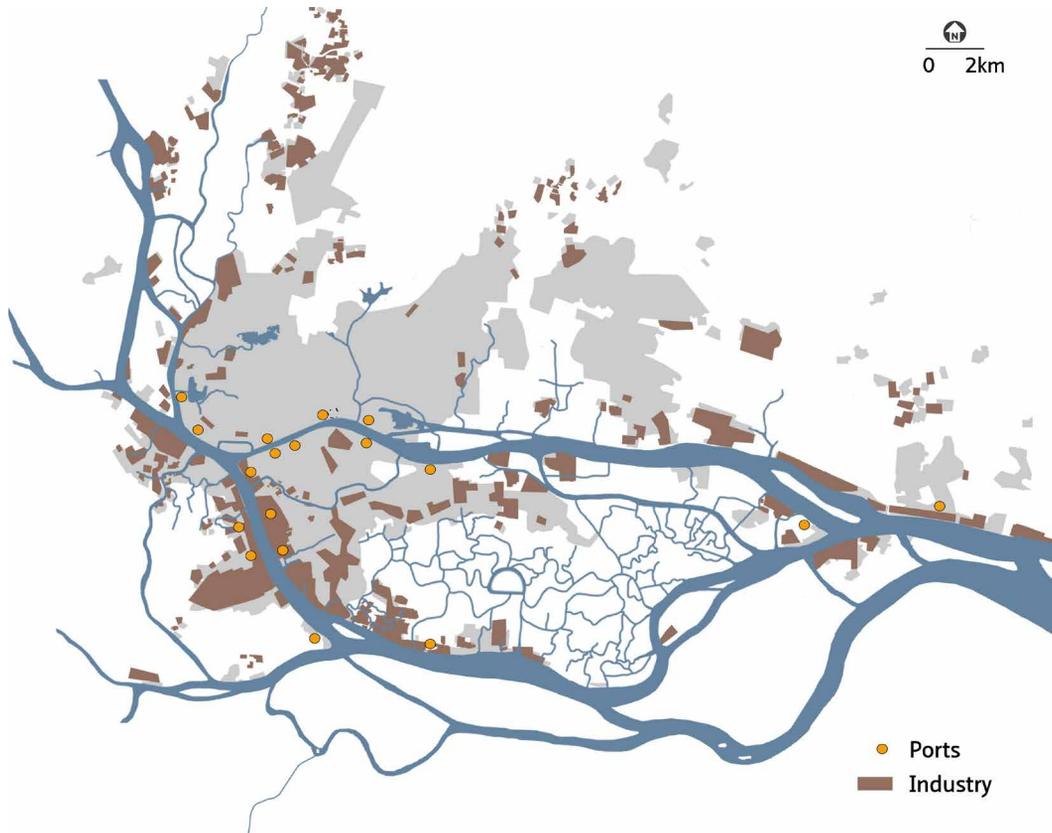


FIGURE 5.5 Ports and industrial land in Guangzhou in the 1970s
 Source: based on 1982 Guangzhou City Map (EBGC, Guangzhou Archives, Volume 3)

Driven by the force of industrialisation in the socialist period, industrial land was the most dominant land use at the waterfront, leading urban expansion and spatial transformations. Most industrial land was located along the rear channel of the Pearl River and major transport routes extending to the east and the south acted as the main incentive for urban growth (Figure 5.5). There were two main types of industrial development from the 1950s, small-scale industry was scattered in the old town (Liwan, Yuexiu and the western area of Haizhu district) while medium and large-scale industries were located in the periphery of the city along the Pearl River in the 1960s. The latter form was developed to rely on convenient navigation via the Pearl River and the main roads along the river. In the late 1960s, many large-scale industries emerged mainly in the port area, demonstrating an eastward extension along the Pearl River and the main roads towards the north (Guo, 2008).

§ 5.2.3 Urban fabric of the dike road and the central axis

1. The dike road development

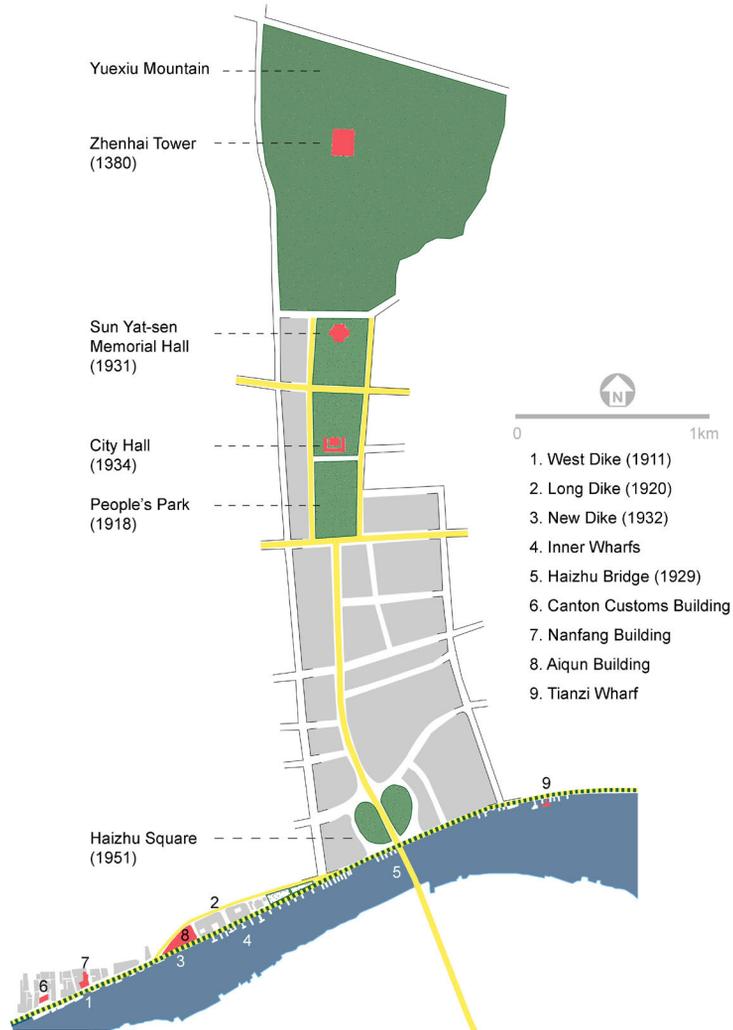


FIGURE 5.6 The dike road and the traditional central axis of Guangzhou
Source: based on Mo, 1995 & the 1955 Aerial Map of Guangzhou

Modernisation and new transport patterns have changed the traditional urban fabric since the 1920s with the most dynamic transitions taking place at the riverfront. Although industrial land gradually occupied the riverfront areas, the front channel of the Pearl River close to the old city centre followed its traditional role for commercial and recreational development. One of the most important driving forces was the dike road construction along the north bank of the Pearl River (Yang, 2002) (Figure 5.6). The dike road construction was initially proposed by local merchants and implemented by the general provincial governor - Zhang Zhidong in the late Qing dynasty (1889). The entire extension project however, took a long time before its completion in the 1930s. Inspired by the beautification of the adjacent Shamian Concession, Zhang's main idea for the dike road was to compete with Shamian in terms of prosperity, beauty and modernity. His most famous slogan was 'Chinese learning as substance, Western learning for application (中学为体，西学为用)' (Zhang, 1898), meaning that the Chinese society should maintain its own Confucian tradition as the basic substance while learning from Western countries for practical applications in developing China's infrastructure, technology and economy.

Following this idea, the dike road was designed to be broad and modern with trees lining the Pearl River for pedestrians. The road was 16m-wide and 3621m-long with arcade streets alongside, featuring as the broadest and the longest road in Guangzhou at that time (Figure 5.7). Before then, roads in the walled city and Xiguan were notoriously narrow with shops and houses packed tightly. The dike road stimulated economic development and enhanced riverfront beautification to a large extent by attracting investments from expatriate Chinese overseas. A great deal of Chinese-Western style department stores and landmark buildings emerged alongside, including the twelve-storey Nanfang Building (or the Sun Co., Ltd.), and the fifteen-storey Aiqun Building - the tallest building in South China in the 1930s. A new urban centre took shape at the riverfront with a prosperous and vital atmosphere, known as "the Bund of Canton" (Lee, 1936) (Figure 5.8). The Bund also propelled the development of wharfs and ports and it is recorded that nine large wharfs were built between 1912 and 1921 (Zhang & Le, 1993). Despite all the benefits of the Bund, local residents were opposed to the extension proposal, as they believed that the dike construction and river regulation would disturb the natural hydrological process and create a higher flood risk (Peng, 2006).

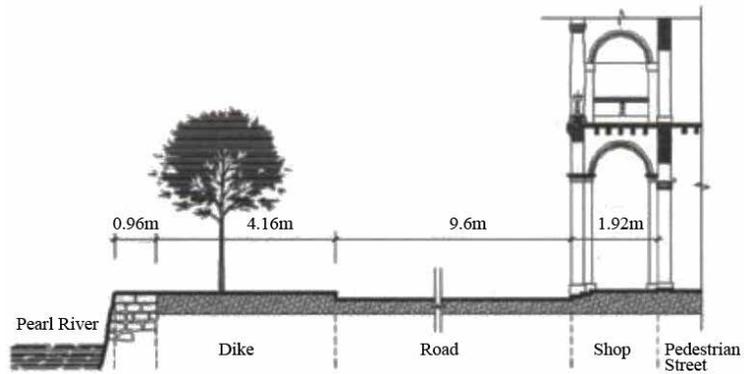


FIGURE 5.7 Section design of the dike road along the Pearl River by Zhang Zhidong in 1889
 Source: Peng, 2006



FIGURE 5.8 The dike road of Canton in 1925
 Source: Canadian Pacific

2. New public centre and the central axis

An important spatial characteristic of Guangzhou following the “mountain-water” landscape is the emergence of the central axis. Around the 1950s, a clear central axis can be recognised in the north-south direction of the city linking Yuexiu Mountain in the north and the Pearl River in the south. Some iconic public buildings and parks were aligned alongside the axis from north to south; the Zhenhai Tower (1380), the Sun Yat-sen Memorial Hall (1931), the City Hall (1934), the People’s Park (1918), the Haizhu

Square (1951), and the Haizhu Bridge (1929) (Figure 5.6). This central axis however, was not designed by the planning authority, but coincidentally took shape after all the individual buildings and places were built (Zhu, 2002). The central axis strengthened the natural layout of the “mountain-water” landscape, and it has a far-reaching impact on the current spatial structure of Guangzhou. Its value as the core and identity of the city has been gradually highlighted over recent decades. In 2003, the municipal government launched an urban design project to strengthen the traditional central axis with enhanced cultural, social and ecological meanings (Pan et al., 2007).

Within the axis lies the most important node, Haizhu Square (Figure 5.9), situated at the intersection of the dike road and the central axis with an extension to the south bank of the Pearl River. To revitalise the area that was bombed in the Sino-Japanese War near Haizhu Bridge, a reconstruction plan of the square and its surrounding areas was made in 1958 to address two main objectives (Figure 5.10). First, the square should function as an important transport hub and recreational space at the riverfront. Second, the adjacent area should be reinforced as a modern urban centre for commercial and cultural activities such as foreign trade and import-export fair events (Mo et al., 1995).



FIGURE 5.9 Haizhu Square in 1951
Source: *Yangcheng Evening News*, 26 Nov. 2016

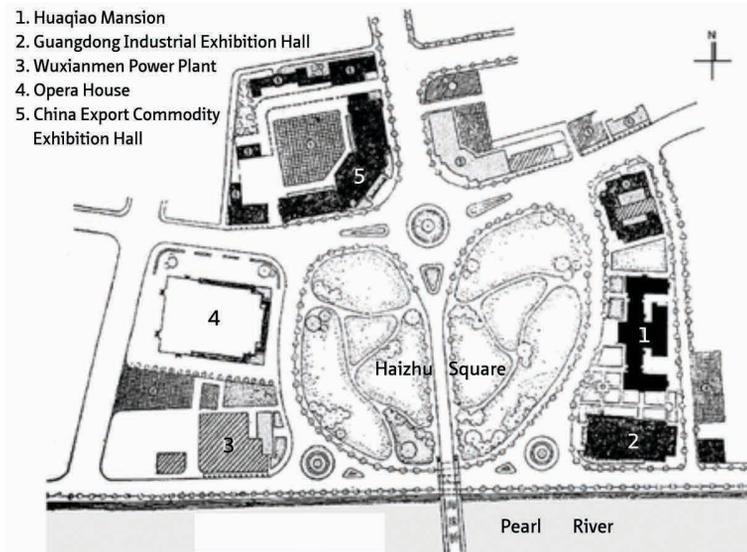


FIGURE 5.10 Design layout of the Haizhu Square reconstruction in 1958
 Source: *Yangcheng Evening News*, 26 Nov. 2016

§ 5.3 The changing values of water

§ 5.3.1 Flood safety – regional engineered defence

The establishment of modern water management institutions at both the regional and city levels brought new science and technology from the West that greatly enhanced the protection level against fluvial flooding (Olivecrona, 1925). From 1918 to 1935, the area of non-agricultural land protected by regional dikes was around 2,898,656mu (approximately 1932km²) in Guangdong Province (Faculty of Agriculture, Sun Yat-sen University, 1935).

Although beneficial to flood control, modern water infrastructures can shift flood problems by altering the natural hydrological process. From the 1950s, the construction of regional dike rings and sluices was the main strategy for dealing with fluvial flooding, however the dike rings accelerated the silting process and led to the concentration of water discharge in the main watercourses. As a result, water levels rose and dikes had to be constantly heightened causing an increased distance between water and land and so, higher flood risks (Li, 1985).

Another negative impact of hard engineering approaches to water management was the aggravation of pluvial flooding in the city. For example, the connected dikes with sluice control blocked small flood discharge channels and created barriers for water to flow, while water can only flow in arterial and tributary watercourses. Furthermore, these arterial and tributary watercourses were partly reclaimed or occupied by wharfs and houses, leading to a decreased flood discharge capacity and higher water levels. According to statistics, under the condition of no dike breach along the North River, the water level of the Pearl River was less than 2m (above sea level) before the 1950s. After the construction of dike rings and sluices, the water level surpassed 2m twice in the 1950s, seven times in the 1960s, and almost every year after the 1970s where the high tide level can reach 2.7m. The changing water level of the Pearl River intensified waterlogging in low-lying areas such as the Long Dike Road and the Xiguan area. As shown in Figure 5.11, the ground level of these areas is below or around 2m (above sea level), so the underground drainage pipes are lower than the water level of the Pearl River in case of high tides (2.7m) (Guangzhou Hydraulic Archives, 1991).

In the meantime, urban development increased flood risk as a result of development on low-lying floodplains. Urban development came at the cost of decreasing areas of

surface water and natural land such as some areas in the north of the city that used to be fishponds and wetlands and road construction for example, caused some flood problems in the old town. As was analysed in chapter 4, the Xiguan area was developed in the Ming and Qing dynasties on the low-lying land with a dense stream network. After the 1920s, new roads were basically constructed above the original streets and alleys, and new housing was developed on filled land about 2.8m above the sea level, higher than the ground level of the old residential area. Therefore, low-lying houses in the old residential area often suffered from pluvial flooding especially during the flood season (Zeng & Yang, 1996) (Figure 5.11).



FIGURE 5.11 Elevation of old and new residential areas

§ 5.3.2 Economy – industry-driven economy

Experiencing fundamental political transitions, economic development was greatly prioritised at the national level. During the republican era, most water streets that used to be prosperous markets in the Ming and Qing dynasties declined as a result of new types of transport. Concrete roads and modern water infrastructures replaced the canals and moats that previously functioned as navigational watercourses and rainwater discharge channels. The decline of the walled city brought new opportunities for economic development in riverfront areas. Dike and bridge constructions stimulated new urban development in the surrounding areas by facilitating economic activities. At the beginning of the 20th century, the dike road construction along the north bank of the Pearl River and the railway system connected to the ports enhanced the economic values of water. Modern technology and transport systems enabled Guangzhou to develop as a light-industry based city and in 1932, Guangzhou's industrial output ranked second in China (Liu, 1937). At the same time, the development of transport and banking put Guangzhou on track to be a modern economy, followed by the early stages of the real estate industry, invested in by Chinese living overseas.

The national government reinforced this type of industry-led development after the 1950s. At the beginning of the socialist era, the most urgent challenge for China was to recover from the Chinese Communist Revolution by rapidly developing its economy. Following the national policy of developing industrial cities, economic development in Guangzhou was largely driven by industrialisation. The industrial output increased from 0.3 billion Yuan in 1949 to 7.4 billion Yuan in 1979 (Guangzhou Archives). The swift development of heavy industries resulted in massive industrial land and port development along the Pearl River. Industrial development was accompanied by the construction of new ports to enhance (inter) national trade and drive urban expansion towards the east along the Pearl River.

§ 5.3.3 Environment – conquering nature

During the republican period, nature was appreciated and considered in city planning and design. Influenced by Western planning philosophy, the Garden City idea of creating more public spaces reinforced the environmental and aesthetic values of water. The traditional central axis linking mountains in the north and the Pearl River in the south followed the ancient site planning culture of Feng Shui. At the same time, the city experienced rapid urban expansion owing to modernisation and industrialisation. Urban development came at the expense of shrinking waterways and wetlands. For instance, the area to the northwest of Liwan Lake (known as the Lychee Bay) was farmland and wetland before the 1920s and a dense network of streams was connected to a large area of wetlands. Local farmers built dikes around the wetlands to plant lychee trees on the dikes and to develop fish farming inside but this kind of self-sustained ecosystem was gradually consumed by urban land. The change to surface water systems also upset the balance of ecosystems and aquatic plants and animals disappeared when the original canals and streams were covered.

During the socialist period and influenced by Mao's development manifesto that man can conquer nature, the environmental values of water were greatly impaired. Following the national policies in the 1950s, rapid industrialisation took place in Guangzhou, especially at the waterfront. Industrial buildings and ports occupied large areas along the Pearl River for convenient shipping and water usage. This kind of land use change and infrastructural development resulted in many environmental issues for example, large-scale heavy industries in the city caused water and air pollution (Figure 5.12; 5.13). Moreover, dike construction and reclamation activities led to severe environmental deterioration at the delta scale, such as deforestation, soil erosion, the silting of river channels and flooding.

From the 1940s to the 1970s, the greatest width decrease of the Pearl River waterways was recorded (162m) and the siltation height reached 4m in some places (Huang, 1994b).

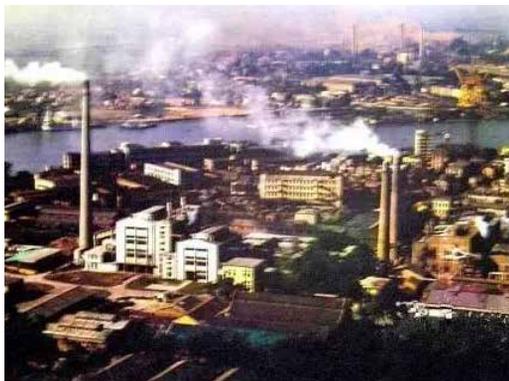


FIGURE 5.12 Industrial development of Guangzhou along the rear bank of the Pearl River in the 1970s
Source: www.ycwb.com



FIGURE 5.13 Wuxianmen Power Plant 五仙门发电厂
Source: William A. Joseph, 1972
See the location in Figure 5.10 (No. 3)

§ 5.3.4 Society – from diversity to uniformity

In the republican era, the modernisation of Guangzhou's physical cityscape inherited the traditional social values of water shaping cultural diversity and social vitality. Rather than challenging the traditional Chinese culture, the modernisation process enhanced cultural diversity, characterised by a mixture of Chinese and Western, traditional and modern cultural elements (Ho, 2005). One of the major influences of Western culture is in the appreciation of aesthetics and leisure. Dike roads and new public centres were formed along the Pearl River led by the provincial and city government, functioning as the main recreational and gathering space. Although many canals disappeared, those that remained still functioned as living and communication spaces in the daily lives of local people, such as for laundry (Figure 5.14). In the socialist period, centralised water management approaches dominated. Four artificial lake parks in the periphery area of Guangzhou offered a pleasant environment for people to enjoy the beautiful scenery of water and nature (Figure 5.15). The informal waterfront public spaces for meeting and gathering were replaced with larger-scale lake parks.

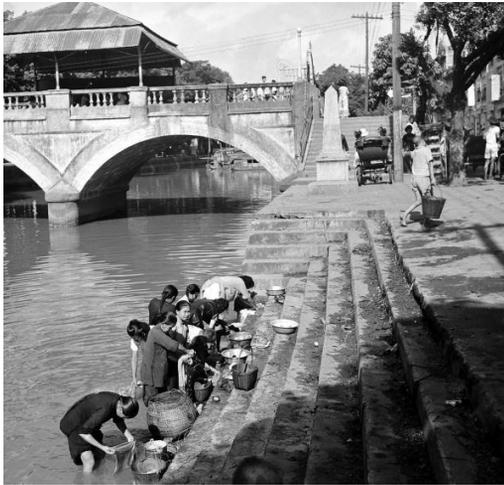


FIGURE 5.14 Shamian in 1949
Source: www.life.com_Photograph by Carl Mydans



FIGURE 5.15 The Dongshan Lake Park in the 1970s
Source: Flickr: llee_wu

By contrast, the socialist period was characterised by social uniformity concerning the water-city interrelationship. Two main aspects can be identified: declining water-featured cultural identity and declining social diversity. Due to the dominant development ideology advocated by the central government, Guangzhou discarded its former role as a commercial and trading centre. Instead, the city was developed with a strong industrial focus. As urban land is the property of the state, the development in waterfront areas had to prioritise industrial functions as guided by national policies. As a result of the land use change, the city lost its cultural identity as a lively living space shaped by water. Along with the dike construction and the decrease in surface water, especially after the waterfronts were occupied by industrial functions, some cultural activities also disappeared, such as dragon boat racing, fishing and folk singing in the boats. Besides, a special type of lifestyle vanished along with its unique culture in the 1960s. Before the dike construction, a large amount of boat dwellers (Tankas) used to live in boats on the Pearl River (Figure 5.16, 5.17). They are a special ethnic group in Southern China, who traditionally lived on the junks in coastal areas of the Pearl River Delta and pursued their livelihood of fishing, raising aquatic products, transporting and farming on sandy fields. More than 5000 boats used to dwell in the Pearl River before the establishment of the PRC (Chen, 1946). These boat dwellers have the imprint of the water environment in life, diet, language and religious belief. At the beginning of the 1960s, the national government promoted new community developments to settle a large amount of boat dwellers. This special group has been relocated to the resettlement housing on land.



FIGURE 5.16 Tankas on the Pearl River in 1949
Source: www.life.com



FIGURE 5.17 Tankas on the Pearl River in Guangzhou
Source: Robert Carl Cohen, 1957

§ 5.4 Conclusion and discussion

§ 5.4.1 Transitions of water values

Spatial development of Guangzhou from the 1920s to the 1970s was guided by modernisation and industrialisation, which promoted functional zoning and waterfront development. Urban development was mainly based in the old town while spreading towards the east, south and north along major riverfront industry and transport routes. At this stage, the relations between water values experienced radical changes influenced by centralised and manipulative governance in water management and urban development. However, the two political periods resulted in different attitudes toward water, particularly regarding the relationship between economy and society (Figure 5.18).

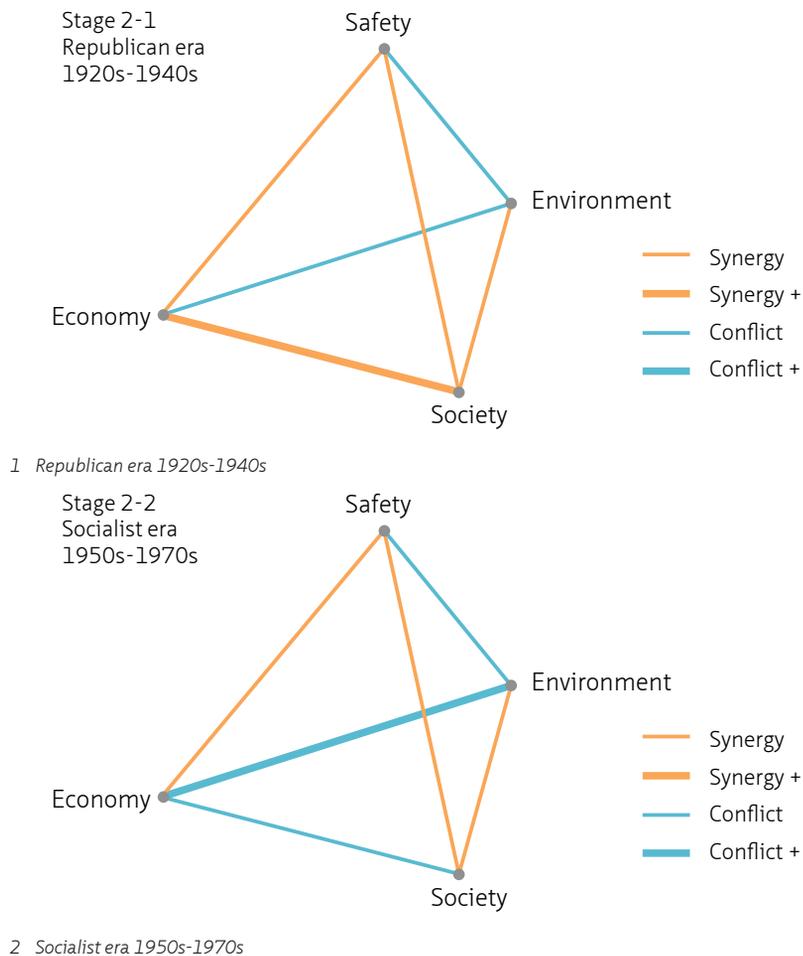


FIGURE 5.18 Relations between water values

In the republican era, the synergy between safety, economy and society was maintained at the urban waterfront by the introduction of dike roads and new public centres. At the beginning of the 20th century, the modernisation of Guangzhou brought new types of transport, technology and Western planning ideas. In contrast with the imperial stage, the city government promoted the modernisation process in Guangzhou. The prosperous development of the Bund, broad dike roads, central axis, public gardens and parks, together with the Western style of high-rise commercial buildings were not colonial legacies but designed and financed by the Chinese. The modernisation process was conducted with a fusion of Chinese and Western cultures, such as the appreciation of the aesthetics of water and the creation of waterfront public spaces.

On the other hand, the socialist period witnessed a gradual loss of the social functions of water as urban fabric became less related to water. The ignorance of social values in the socialist period is influenced by the ideological change regarding economic values that prioritised productivity. As elsewhere in China, the transition of development ideologies from a commercial city to an industrial city had a far-reaching impact on various dimensions of spatial patterns and social organisations. The industrial land - which was facilitated by water systems, transport systems and ports - was the most dominant land use that shaped urban form, especially in riverfront areas. Original water streets along the moats also declined as a result of the disappearance of surface water.

During this phase, safety and environment were detached due to the change in water management measures, from a nature-based surface water system to a centrally controlled infrastructure system. To enhance flood protection, water management was dependent on engineering approaches, including the construction of hydraulic infrastructures such as regional dike rings and the underground drainage system. The impact of this highly controlled flood defence system on water values was two-sided. Hydraulic infrastructures facilitated urban expansion by lowering the fluvial flood risk in previous flood-stricken areas, but hard engineering solutions impaired the natural dynamics of the water environment and ecosystems. Long-term land reclamation and dike construction along the Pearl River greatly narrowed the width of the river. A centralised underground drainage system replaced the original drainage function of the surface water system made up of canals and streams.

In the meantime, the conflict between economy and environment was aggravated. Compared with the multi-functional role of water before the 1920s, water was intentionally utilised as a resource to enhance economic productivity in planning and design at this stage. On the delta scale, the process of land reclamation towards the sea was accelerated. Agricultural land was gradually urbanised to accommodate more of the population and development on the floodplain. On the city scale, the riverfronts near the old town were rapidly occupied with commercial streets as well as industries and ports in the periphery of the city. Meanwhile, the natural characteristics of water as part of the ecosystems and flood discharge paths were gradually lost. By and large, water was managed in a manipulative way for the benefit of urban development and economic growth. Urban expansion resulted in a great loss of wetlands, farmland and fishponds in suburban areas. Heavy industries also brought environmental issues such as water and air pollution and as a result, the environmental values of water were impaired. However, the negative impact of this kind of industry dominated and infrastructure-led development and associated environmental awareness was only realised decades later.

§ 5.4.2 Underlying forces of the transitions

There are several reasons for the changing values of water. Firstly, the roles and functions of water changed substantially due to urban and technological developments. On the one hand, canals and moats were replaced with roads, as they were no longer needed for military defence and navigation. The decline of inland navigation also led to a recession of canal streets. On the other hand, modern hydraulic infrastructures such as dikes enabled the city to develop in low-lying areas and brought prosperity in new public centres along the dike roads.

Secondly, from modernisation and industrialisation to socialism, the guiding development ideologies determined the focal values of water. During the republican period, Western culture and planning thoughts such as functional zoning and waterfront modernisation influenced many aspects of city development. For instance, the dike road construction along the north bank of the Pearl River was affected by the values of waterfronts for both city beautification and commercial activities. During the socialist period and following the national planning ideology to develop an industrial city, riverfronts were occupied by industry and logistics related functions.

Thirdly, political power played an important role in guiding urban development and shaping dominant values. The transition from the imperial era to the republican era completely changed the seclusion governance and brought Western planning ideas to the city. In the socialist period, the state owned the greatest administrative and economic power, resulting in highly centralised approaches to both flood risk management and urban development. Urban planning functioned as a public policy to assist in implementing the political will as representing the national interest. Urban land is the property of the state, so the development in waterfront areas had to conform to national policies for high economic efficiency and productivity. However, this kind of top-down governance came at the cost of some local interests such as the social values of water for citizens.

Finally, the transition of institutional arrangements led to a multi-level and multi-sectoral institutional structure with distinctive values and priorities in spatial development. The establishment of modern institutions caused a professional divergence regarding the management of water and land. As the distinction between sectors became clearer, problems occurred due to the lack of coordination between different sectors, especially between the urban planning sector and the water management sector. On the one hand, urban development increased flood risks by building on low-lying floodplains and occupying natural watercourses. On the other hand, centralised flood risk management by means of large-scale dikes and drainage

pipes undermined the environmental and social values of water. In general, both urban planning and water management neglected the natural dynamics of water and tried to manipulate urban development across natural constraints with the power of planning and modern technology.

6 The Pluralistic City (after the 1970s)

§ 6.1 Urban development background

§ 6.1.1 Context of rapid urbanisation

Since the implementation of the Reform and Opening-up Policy (also known as the Open-door Policy) at the end of 1978, China has experienced enormous socio-economic transitions. The reform is accompanied by radical changes in political and socio-economic regimes, driving rapid urbanisation in the post-reform era. First, the economic transition from a centrally planned economy to a socialist market economy has altered the role of urban planning, from direct concrete arrangements to the guidance and regulation of urban development. Market forces therefore influence urban development under the supervision of the government and the marketisation process in China is regarded as neoliberalism with Chinese characteristics (Harvey, 2005). Second, the land reform in the late 1980s was another impetus for urbanisation. The introduction of the land market, namely the land leasing policy, allows transfer of land use rights that has triggered a massive process of city centre (re)development and urban expansion into new areas (Wu & Yeh, 1997) and as such, land has become a commodity beneficial for local revenues (Ng & Xu, 2000). Third, the post-reform era has witnessed the devolution of administrative and economic power. The municipal and district government has gained more autonomy in land and financial management as well as infrastructural development. Finally, the society has become more pluralistic, where the interests of different sectors and social groups have become more recognisable. Since the development of the market economic system, the main body of the economic operation has changed from the original single public ownership (including state-owned enterprises and collective units, etc.) to a variety of economic actors whose interests are highly diversified. Public interest has regained its broader sense representing varied social needs rather than unified national or collective interest (Shi, 2004).

By serving as the reform's "experimental field", the Pearl River Delta was one of the first areas in China to experience marketisation in the 1980s. The geographical proximity with Hong Kong and Macau propelled the PRD to develop from an originally agriculture and industry based region into a world-class manufacturing base and an export-oriented economic zone. Driven by market forces, rapid urbanisation has taken place in the PRD since the 1990s (Figure 6.1). For example, the increase in the amount of residential housing construction between 1991 and 1995 was 12.8 times more than that between 1949 and 1978 (Guangzhou Statistical Yearbook). Functioning as the labour market of China, the PRD has attracted a large population from the western part of China. The population of the PRD therefore increased dramatically from 20 million in 1982 to 60 million in 2016, a tripling within three decades (Guangdong Statistical Yearbook). Aside from governmental reforms, mega-events have also impacted the city with associated pilot projects introducing new economic, social, cultural and environmental visions. In 2010, the Asian Games in Guangzhou was another driving force for urban regeneration and new town development in the greater metropolitan region.

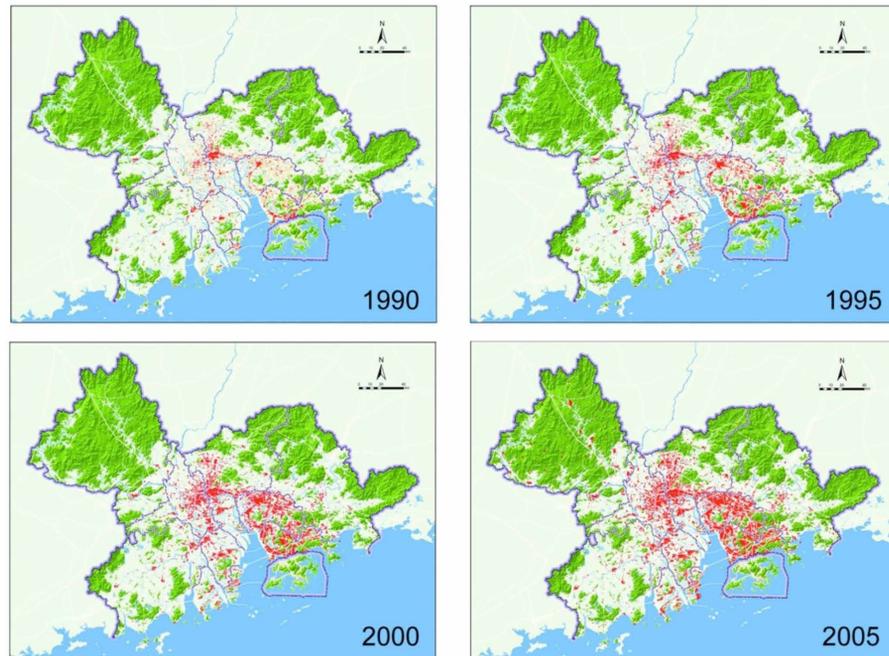


FIGURE 6.1 Rapid urbanisation of the PRD since the 1990s
Source: *The Pearl River Delta Urban-rural Integration Plan 2009-2020*

§ 6.1.2 Urban planning sectors and spatial strategies

At the early stage of the post-reform era, urban planning had to deal with the urgent task of repositioning Guangzhou as the political, economic and cultural centre of the PRD, while enhancing its international significance. Since the 1990s and facilitated by the land policy reform, the local government has started to work closely with developers in urban regeneration and the development of new urban sub-centres. The Pearl River New Town is one of the extreme cases that the “tabula rasa” planning concept was adopted to build a new CBD at the riverfront, leading to some environmental and social problems. Facing the uncontrolled and intense development driven by the market forces of urban development and regeneration, the municipal government has been seeking to optimise the employment of market forces for a win-win situation. Since 1992, policies and regulations regarding the involvement of developers have been adjusted with a retrospective view on the negative impacts of the market economy (Wang, 2007).

The reform also saw a rapid pace of urbanisation at the regional level. To eliminate the limitation on urban expansion presented by municipal boundaries, Guangzhou expanded its jurisdiction by merging adjacent counties into the city in 2000, therefore restructuring the territory and reallocating the resources within a larger metropolitan region. From then on, the city has been developing a polycentric spatial structure with one main centre and six sub-centres, adopting the spatial policy of “exploring the south, optimising the north, advancing the east, and connecting the west” (Lin et al., 2006) (Figure 6.2). The extension of the administrative boundary though, has also exacerbated the conflicts between land and water resources.

Advocated by the central government, urban planning has begun to address the plurality of emerging water values since the 2000s. In 2003, the central government brought forward the “Scientific Outlook on Development (科学发展观)” to develop a sustainable development model that integrates the needs of economic and social development. Urban planning is now positioned as an important public policy that aims to address public interests concerning development, safety, and justice (“Measures for Formulating Urban Planning 城市规划编制办法, 2006”). The current role of urban planning and design in Guangzhou is multi-dimensional, concentrating on two main directions: urban regeneration within the historical city centre and former industrial sites, and new town development. Historical preservation plans were made to incorporate the social values of water with development needs. Since 2008, Guangdong provincial government has launched a series of redevelopment programmes such as the “three olds transformation (三旧改造) – namely the redevelopment of old villages, old factories and old urban areas”. Historical preservation however, sometimes disguises

the actual goal of city branding and economic profits so as to drive a larger scale of urban development. In the meantime, under the premise of regional infrastructures such as ports, airports, highways and railways, the Pearl River Delta has witnessed a rise of new town development. Nansha New District in Guangzhou is one such case as the southern part (Panyu and Nansha Districts) has been included in the metropolitan area of Guangzhou since 2000 and there is a growing trend to make Nansha District an industry and logistics based coastal new town.

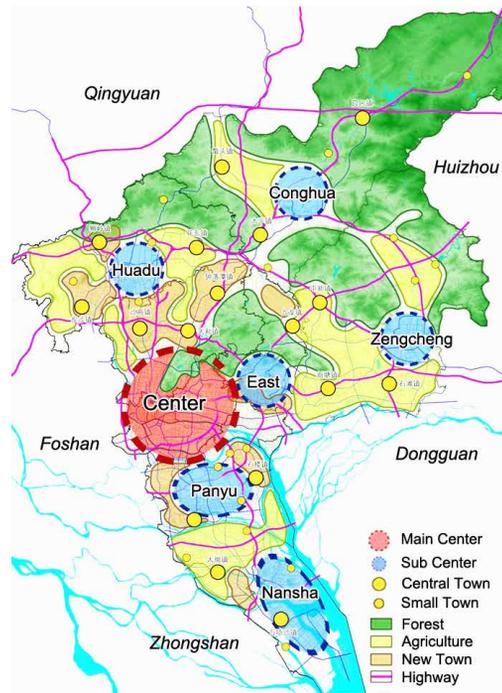


FIGURE 6.2 Guangzhou 2020: Strategic Planning of Urban Development
Source: Guangzhou Urban Planning Bureau

Due to increasing environmental pressures, attempts were made at the regional level to address environmental values in planning visions and guidelines. In 2008, the National Development and Reform Commission issued an important guideline “The Outline of the Plan for the Reform and Development of the Pearl River Delta (2008-2020)” to reinforce the protection of farmland and ecosystems, such as the river mouth ecosystems, coastal swamps and mangrove forests, as well as to promote efficient

use of land and water resources. Following the guideline, greenway¹¹ planning was adopted as a regional spatial strategy in 2010 to enhance the environmental quality with a green-blue network, that green corridors were designed along canals, historical heritage and green spaces (Carmona et al., 2014) (Figure 6.3). However, the actual contribution to the environment is very limited as some greenways are too narrow and disconnected from the natural system, and the public use of greenways is limited due to their remote locations (interview 1).



1 The Greenway Network Master Plan of the Pearl River Delta 2010
Source: Guangdong Urban and Rural Planning & Design Institute



2 Greenway along the East Moat in Guangzhou

FIGURE 6.3 Greenway development in the Pearl River Delta as an emerging green-blue strategy

§ 6.1.3 Water management sectors and spatial strategies

During this stage, institutional specialisation and obligation division in water management have become more complex at both the vertical and horizontal levels. At the vertical level, fluvial and coastal flooding is managed by the national and provincial governments. Hydraulic authorities such as the Pearl River Water Resources Commission are mainly responsible for managing water resources and hydraulic infrastructures in the Pearl River basin. To deal with fluvial and coastal flooding, the

¹¹ Greenways are multifunctional corridors incorporating the quality of natural and manmade systems. Greenways can conserve open spaces and protect riverine ecosystems, vegetation, soil and geomorphology that are essential to the health and vitality of the local landscape (Flink & Seans, 1993).

“Pearl River Basin Flood Control Plan 2025” focuses on dike construction and river regulation such as concreting, deepening and channelising watercourses (Carmona et al., 2014). On the other hand, pluvial flooding is managed by the Water Affairs Bureau affiliated with the municipal government and various district-level administrative units. Besides different vertical levels, there are also many parallel authorities involved in flood risk management in Guangzhou such as the Disaster Prevention Bureau, the Water Discharge Bureau, the Canal Management Bureau, and the Dike Management Bureau. The complexity of the institutional arrangement creates challenges for coordination among multi-level administrative authorities.

As a continuation of the engineering approach developed from the 1950s, water management in Guangzhou has focused on the improving the systems of flood defence, water retention and drainage by means of canal restoration, sewage treatment and water diversion (Guangzhou Hydraulic Archives, 1991).

(1) Flood defence system - strengthening regional dikes

To cope with the fluvial flood risk from the north and the coastal flood risk from the south, the Pearl River Water Resources Commission has been continuously strengthening the regional dikes that were constructed from the 1950s. Current flood defence projects are based on the standard of a 200-year return period along the Pearl River and a 50~100-year return period along the Liuxi River (The Pearl River Basin Flood Control Plan 2025).

(2) Retention system - increasing water storage capacity

The flood defence system is combined with large water reservoirs in the north as well as lake creation and canal restoration in the city centre. In fact, the tradition of lake creation for water storage started in the 1950s when the four artificial lakes were constructed. However, urban expansion has resulted in a sharp decrease in water storage capacity since the 1990s, such that the total water surface area of the lakes has decreased from 128ha to the present 103.6ha. In recent years, new artificial lakes have been built in combination with ecological parks for water storage, flood mitigation and recreation. Next to lake creation, canal restoration is another strategy to increase the storage and discharge capacity of water systems. Guangzhou has 231 canals in the city centre with a total length of over 913km, among which 121 canals with a total length of 388km were included in the “Canal System Planning in the City Centre of Guangzhou” in 2005.

(3) Drainage system - facilitating artificial drainage system

Meanwhile, higher standards for the drainage system are applied to deal with increasing pluvial flooding. It is estimated that the discharge of 90% of the rainfall relies on the underground drainage system in Guangzhou. The capacity of this drainage system however, is not sufficient due to ageing facilities, out-dated standards and more frequent extreme climate events. The current drainage system has remained unchanged for over 20 years. Among the 6000km of drainage pipes in the city centre, 83% are maintained at the standard of a one-year return period for pluvial flooding, while only 9% meet the requirement of a two-year return period. The rest of the drainage pipe infrastructure only achieves a half-year return period (Water Affairs Bureau). To deal with over 200 waterlogging spots in the city centre, Guangzhou has invested over RMB 900 million Yuan in the reconstruction of the drainage system since 2009, including the enlargement of drainage pipes and the establishment of new pump stations.

§ 6.2 Morphological analysis of water and the city

§ 6.2.1 Current spatial structure of Guangzhou

Driven by the land reform in 1987, Guangzhou has experienced rapid urban expansion. The adjustment of the municipal boundary removed the restriction on urban development towards the south, the east and the north, turning Guangzhou into a coastal city. This action altered the spatial structure of Guangzhou from “mountain-city-river” to “mountain-city-river-agriculture-sea” (Figure 6.4). Based on the conditions of landscapes, water discharge features and spatial patterns, the current metropolitan region of Guangzhou can be divided into three morphological zones from the upper catchment (north) to the lower catchment (south). These three zones generally represent three levels of urbanisation with different dominant flooding and urban development challenges. Zone 1: initial stage (urbanisation rate < 30%), Zone 2: mature stage (urbanisation rate > 70%) and Zone 3: medium stage (urbanisation rate: 30%-70%).

The upper catchment (zone 1), is the ecological preservation area at the foot of the mountains where urban development is constrained by natural conditions. Fluvial flooding from the upper streams of the Pearl River is the main threat to this area. The middle catchment (zone 2), is the densely occupied urban centre where water from the upper catchment and high tides from the estuaries of the delta threatens the historical urban centre. Generally, pluvial flooding is the most urgent problem in the city centre, which is intensified by increasingly frequent storms. Limited space calls for more adaptive and multi-functional spatial strategies with both urban (re)development and flood mitigation functions. The lower catchment (zone 3), is the potential development zone in transition where new towns (such as Nansha New District) and industrial ports are expected to act as new economic incentives. Land reclamation, together with dike construction, is carried out to protect the city from coastal flooding from the South China Sea, meanwhile facing enormous uncertainties from sea level rise caused by climate change.

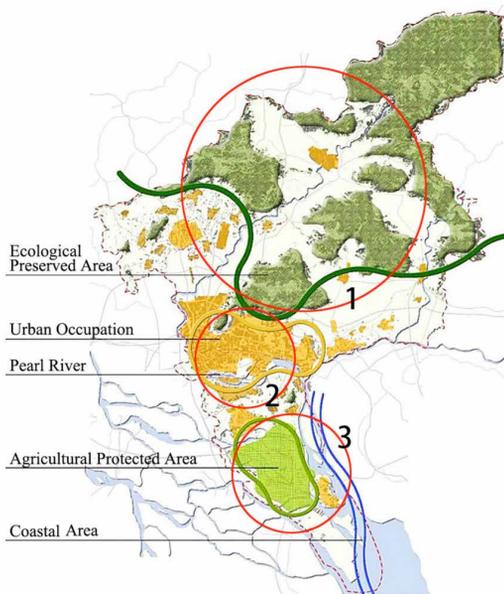


FIGURE 6.4 Three morphological zones in Guangzhou
Source: Guangzhou Urban Planning Bureau

Regarding the transformations of the city centre, the transport system shows a strong tendency towards regional connections and influences land uses. During this stage, the main development of the road system was the construction of two ring roads circling the city centre (Figure 6.5). The direction of urban expansion is from the city centre to the upstream and downstream areas, resulting in a substantial loss of agricultural land and wetlands. To strengthen the “mountain-water” cultural landscape, a new central axis has taken shape to the east parallel to the traditional central axis (see Figure 6.13). The new central axis was purposely designed by the planning authority with landmarks and mixed land uses on both sides of the Pearl River, including the functions of a CBD, high-quality residential districts, riverfront recreation and tourism.

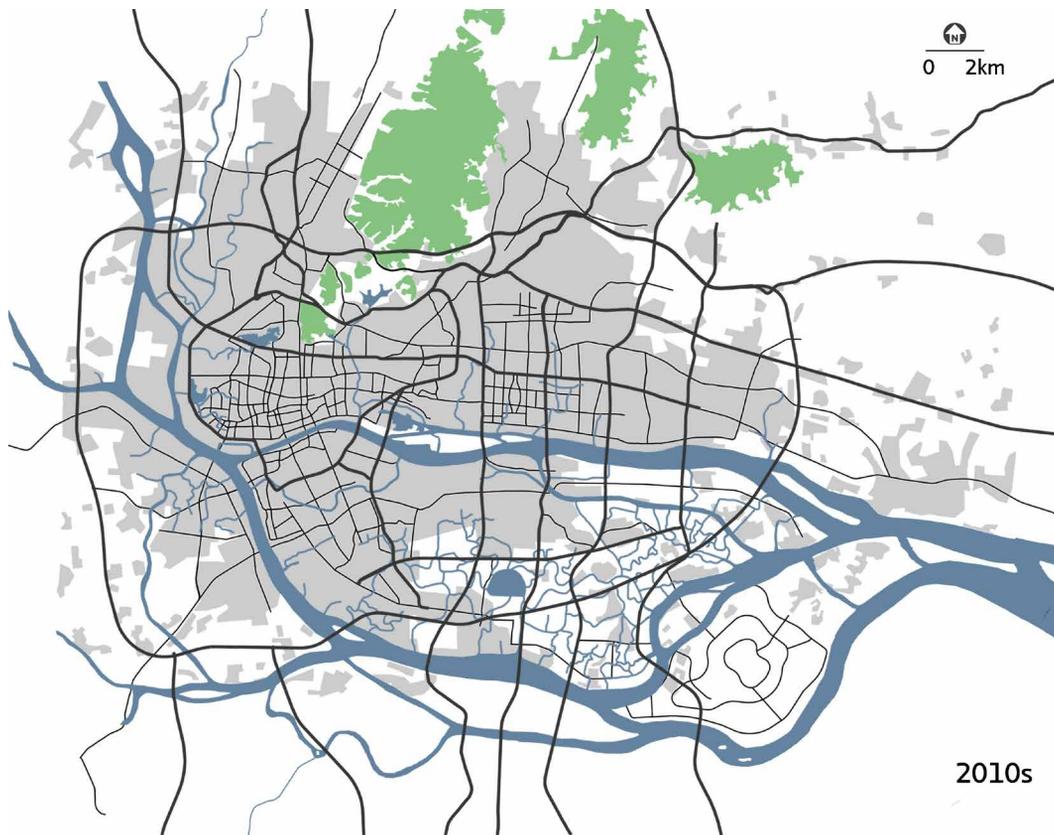


FIGURE 6.5 Road and water systems in the city centre of Guangzhou

§ 6.2.2 Port-oriented urban expansion

Being a historical port city, the urban development of Guangzhou followed the pattern of eastward extension along with the development of ports, including inner-river ports, Huangpu ports and the Nansha port (Yang & Luo, 2008; Gong & Liu, 2009) (Figure 6.6). Along with the decline of inner-river navigation, the role of Guangzhou port as a river port has been weakened while its position as a seaport has been strengthened (Liang, 2008). To compete with other ports in the PRD such as the Shenzhen and Hong Kong ports, Guangzhou began to build the Nansha deep-water port in 2000. Nansha is located at the southern end of Guangzhou's metropolitan region near the estuaries of the South China Sea and in the geographic centre of the PRD. Several large and medium sized cities are all within 60km of Nansha, including Hong Kong, Shenzhen, Zhuhai, Macau, Dongguan, Jiangmen, Zhongshan, Foshan and Huizhou (Figure 6.6). This therefore, helped to establish Nansha's strategic position as the PRD region's transport hub. Furthermore, and supported by the PRD's hinterland, Nansha has the strategic potential to connect the city-regions within South China and Southeast Asia.

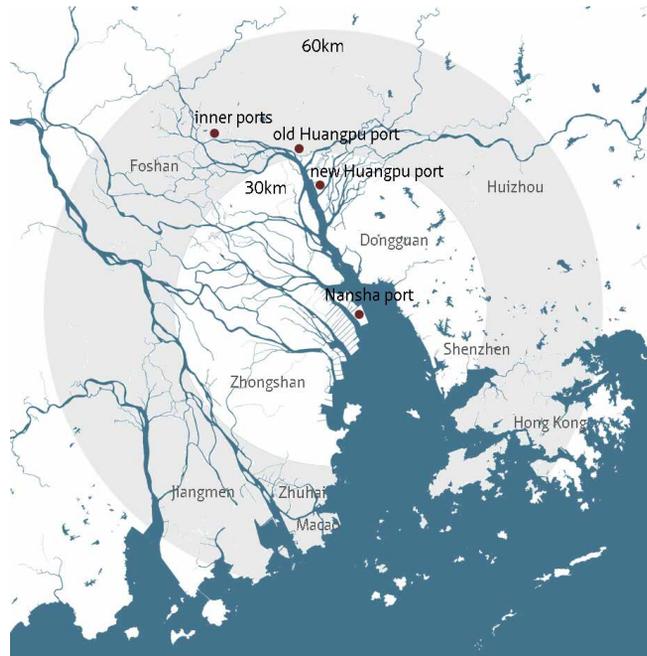


FIGURE 6.6 Nansha port in the PRD

Source: Guangzhou Port Group

As part of the development strategy of “exploring the south”, Nansha New District was formalised as part of the Guangzhou metropolitan region in 2005 and was designated in 2012 as China’s sixth state-level new development zone. The development of Nansha New District is intended to take advantage of its strategic location to create new opportunities for an industry and logistics based maritime economy, so as to shape a second centre of Guangzhou and to improve the city’s international competitiveness. Nansha - a former fishing village that used to rely on aquaculture and agriculture - entered the era of rapid development of manufacturing industries, logistics and maritime economy. Currently, Nansha’s main industries include car manufacturing, advanced equipment manufacturing, modern services and high-tech industries. Since 2015, part of Nansha has been approved as the national “free trade zone”, which is supported by the central government through a series of preferential tax, land management, financial innovation and industrial development policies. These policies have triggered debates on the dilemma between urban development and environmental sustainability.

§ 6.2.3 Waterfront (re)development

In the city centre, dynamic development has taken place at the urban waterfront along the Pearl River driven by market forces (Figure 6.7). The Pearl River New Town is one of the extreme examples of urban development completely altering the original landscape. Located on the north bank of the Pearl River to the east of the historical downtown, this area used to be farmland and fish ponds connected to a natural water system. Since the 1990s, ambitious urban planning has turned this area into a new CBD for Guangzhou with high Floor Area Ratios (higher than 5), which have completely altered the natural environment and water system (Figure 6.8). Modern buildings were designed by world-renowned architectural firms, such as the Canton Tower by Information Based Architecture, the Opera House by Zaha Hadid, Guangzhou Library by Nikken Sekkei, and Guangdong Museum by Rocco Design Architects.



FIGURE 6.7 The current riverfront of Guangzhou

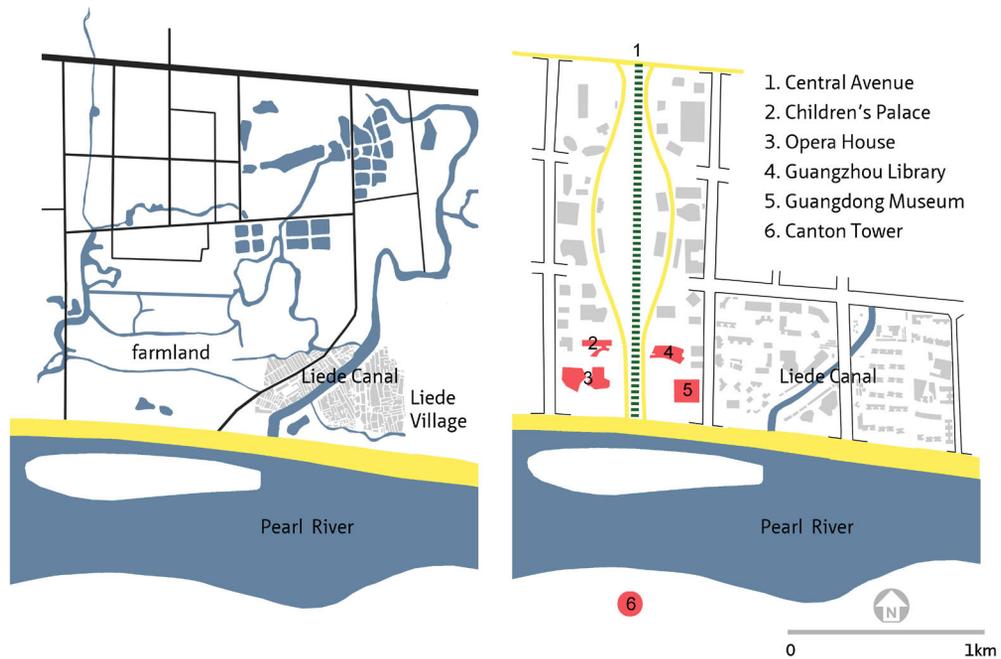


FIGURE 6.8 Liede village and the Pearl River New Town then and now
 Left: Liede village and surrounding farmland in 1978 (based on the 1978 Aerial Map of Guangzhou)
 Right: Pearl River New Town and the existing Liede area (based on Baidu Map)

Influenced by market forces and the concept of waterfront modernisation, urban villages in the central area adjacent to the Pearl River have undergone tremendous transformations. These villages have been gradually displaced by real estate development due to increasing land values. Liede village¹² is one such example. Liede village was located on the north bank of the Pearl River, to the east of the Pearl River New Town and with Liede Canal passing through. Liede Canal is an important watercourse in the eastern part of Guangzhou city centre, mainly functioning as a drainage canal. Almost every year, serious pluvial flooding occurs in the areas along the upper stream of the canal (Ruan & Qiu, 2011).

Under the redevelopment pressure driven by increasing land prices adjacent to the Pearl River and the PRNT CBD, the village was completely demolished in 2007. As distinct to the urban area, the village collectively owned the land, making the redevelopment process complicated. Instead of adopting a conventional top-down approach of land requisition, the municipal government allowed the collective to work out a market solution with developers directly, while supervising the redevelopment scheme. As a result, land was leased to the developers via land auction to finance redevelopment projects including replacement housing, infrastructures and public facilities. The Liede village redevelopment model reflects a local authority's willingness in exploring the neoliberal approach of management in coordination with market forces in the process of urban (re)development (Li et al., 2014).

Although considered a successful urban village redevelopment model in China, the area experienced great socio-economic transitions. The demolition of urban villages associated with a huge displacement of people has changed both the area's spatial and social structures (Figure 6.9). To bring back the atmosphere of a Lingnan-style water village, after the demolition a 300m-long bar district named the "Hunter Lane" was built along the Liede Canal with buildings that imitated traditional forms. The traditional lifestyle and the local culture have given way to the consumer culture (Tao & Ye, 2015). In addition, social equity issues are generated as the migrant workers who used to rent villagers' houses were excluded in this redevelopment process.

12

Liede village has a long history of over 900 years, occupying an area of 33.7ha. It used to accommodate a registered population of 7000 people and a migrant population of 8000 in 2007.



1 Liede village in 2000
Source: www.news.gz.fang.com



2 Liede village now
Source: www.gznews.gov.cn

FIGURE 6.9 Transformation of the Liede village

§ 6.3 Pilot water projects

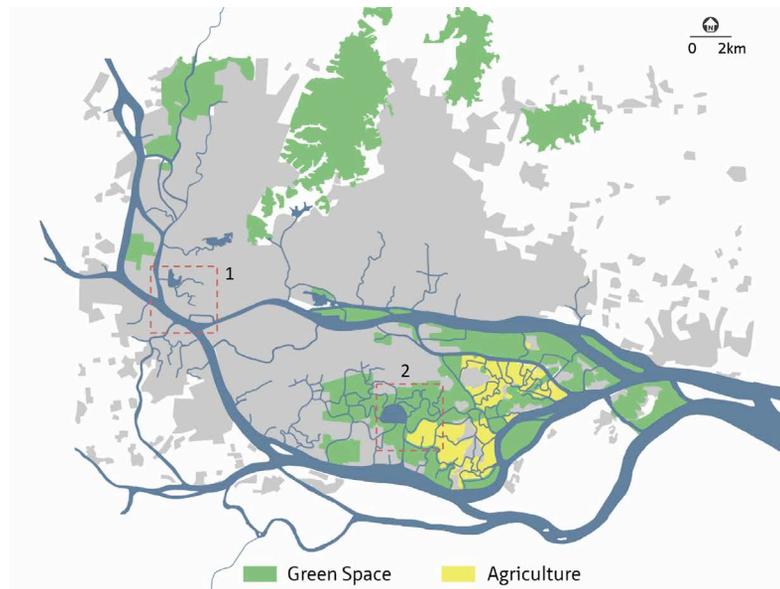


FIGURE 6.10 Site locations of the Lychee Bay project (1) and the Haizhu Lake project (2)

Compared with the hydraulic solutions to flood risk management issues at the previous stage, there has been a tendency towards more integrated strategies since the 2000s. Water management is partially included in urban development visions that require collaboration with many other sectors especially the planning sector. In recent years, some pilot water projects have been implemented that combine multiple values in urban water management. In this section, two cases in Guangzhou representing this trend are selected and analysed: the Lychee Bay project in the historical centre, and the Haizhu Lake project at the southern extension of Guangzhou's new central axis (Figure 6.10).

§ 6.3.1 Canal revitalisation as a catalyst for urban regeneration



FIGURE 6.11 The Lychee Bay canal revitalisation project

The urban fabric in Guangzhou's historical centre has experienced a substantial transformation from a water-structured pattern to a paved street network. Consequently, the original surface drainage capacity has been undermined causing serious pluvial flooding during the monsoon season. The decrease of surface water not

only brings flood issues, but also erodes the identity of Guangzhou as a historical water city. Taking the opportunity of urban regeneration, re-opening the previously covered canals is a strategy aiming for improving spatial quality while mitigating flood risks. Led by the city and district levels of government, the Lychee Bay canal re-opening project is a pilot redevelopment project to recall the watery landscape and culture of Guangzhou (Figure 6.11).

Located in the western part of the historical centre, the Lychee Bay area used to be a recreational garden on flat marshland along the Pearl River with dense streams and ponds over 2000 years ago. In the Ming dynasty, the image of fishermen singing in Lychee Bay was one of the eight representative scenes of Guangzhou. The Bay area experienced its most prosperous period from the Qing dynasty to the Republic of China (Zeng, 1991). The most distinguishing feature of the Lychee Bay area is the cultural characteristics representing Lingnan. Not only the architectural style in an elegant garden setting, but also the daily scenes of floating village lifestyles that have been documented in poems and photos and presented a water-featured cultural identity and a strong collective memory for the local people (Figure 6.12). Since the 1980s, the water quality in Lychee Bay has worsened due to pollution from domestic and industrial sewage (Mai, 2011). As a result, the watercourses were gradually contained within culverts and in 1992 the last part was covered and displaced by an antique market (Pan, 2012).

Being a low-lying territory with a growing impervious surface, the Lychee Bay area has always suffered from pluvial flooding (Zeng & Yang, 1996). Catalysed by the hosting of the 16th Asian Games in Guangzhou in 2010, the municipal government initiated several water projects to tackle pluvial flooding while recalling the historical water culture of the city. The “Lychee Bay Cultural and Leisure Zone Plan”, proposed by the local district government, was approved in combination with urban regeneration plans and huge investments were made to enhance the attractiveness and environmental quality of the area (Lai & Yuan, 2010). Experiencing three phases from 2009 to 2015, traditional housing was rebuilt along the canals for tourist, commercial and leisure activities. Bridges, waterfront pavilions and terraces were built, while historic mansions and arcade buildings were preserved and transformed into museums, teahouses and theatres (Su, 2010) (Figure 6.13). As indicated in planning, the project was expected to achieve multiple water values regarding flood mitigation, enhancing environmental quality and regaining the cultural landscape of water (interview 2). Above all, a high economic return was expected to drive 0.8km² of the redevelopment area and attract a direct investment of RMB 28 billion Yuan.



FIGURE 6.12 Lychee Bay in the 1930s
Source: *Guangzhou Daily*



FIGURE 6.13 Current Lychee Bay

In terms of social equity however, the project is highly controversial due to the conflict between development goals and local interests as the project required the demolition of a large amount of housing and an antique market.¹³ Consequently, 157 antique shops had to relocate after operating in the area for over a decade. Although over 100 local people, including the shop owners, collectively led a protest to reclaim their rights, very limited influence was evident in the decision-making process of the redevelopment (Yangcheng Evening News, 2009). In addition, and contrary to the promised goal of flood mitigation for the surrounding 1.72km² area, neighbouring residents have suffered from more frequent waterlogging due to waterways blocked by sluices for pollution control. As the capacity of the canals for stormwater conveyance and storage is deficient, the municipal government planned to build an additional deep-tunnel drainage system as an alternative solution to prevent flooding (Yangcheng Evening News, 2013).

§ 6.3.2 Artificial lake creation

Creating artificial lakes has always been one of the main strategies of water management in Guangzhou. Since 2012, the municipal government has launched a new round of lake creation projects following the previous episode in the 1950s. According to current planning, Guangzhou will have 17 artificial lakes in total, with at

13 A total area of 157,090m² housing was demolished and about 3386 people were relocated. An estimated RMB 4.9 billion Yuan was spent on the project, including RMB 3.2 billion Yuan compensation for housing demolition and relocation (Guangzhou Daily, 2011).

least one lake on average in each district. Haizhu Lake (among others) is one of the pilot projects in this ambitious plan. The lake occupies an area of 1.5km², including 0.53km² of surface water and it is located on the low-lying floodplain connected with a dense water network and Lingnan traditional villages. Most of the land is only 1-2m above the Pearl River with high flood risks. The area is famous for massive orchard land (originally around 12km²) but since the 1990s, one third of the orchard land has disappeared as a result of real estate and infrastructure developments as well as the spread of informal houses for local farmers.

The design of the new central axis in Guangzhou and the planning strategy of the Haizhu area adopting an “ecocity model”, accelerated the process for the site selection of the lake (e.g. Guangzhou Haizhu Eco-city Regulatory Plan) (Wu, 2015b). Following the lake construction, the surrounding area was transformed into a big wetland park. The development of the wetland park adopted a policy of land requisition without changing land uses, meaning that the land was retained as orchards, arable land and water, while the land ownership was transferred from collective property to state-owned. The project is situated at the southern end of the new axis and was planned as the green-blue ecological core of Guangzhou (Figure 6.14, 6.15). The site selection and design of the lake and wetland park were based on the landform and the original water system. As advocated by the municipal government, Haizhu Lake would enhance flood safety including stormwater retention and water recharge by taking advantage of the tidal effect (He, 2013). Apart from flood control, both the lake and the park were expected to bring environmental, economic and social benefits to the city, such as ecological preservation, microclimate adjustment, leisure and tourism (Cai et al., 2014).

However, such a lake creation model is not always successful and should not be duplicated without site-specific considerations. Although all of the artificial lakes were initiated as water management projects mainly for solving local flooding problems with a potential environmental value, it is controversial concerning the real objectives, especially the hidden economic benefit of the lake for the potential land value it could bring. Due to huge investments in construction and maintenance, the local government considers the added land value an important financial resource. In some cases, the surrounding price of housing increased rapidly immediately after the completion of the lake and as a result, the actual function of the lake for water management is undermined. The site of the Jiulonghai Lake for instance, was selected on the mountain ridge and could therefore hardly store stormwater for the surrounding areas (interview 3).



FIGURE 6.14 Haizhu Lake, together with the wetland park was designed as the ecological core of Guangzhou
 Source: *Guangzhou Urban Planning Bureau*



FIGURE 6.15 South of Guangzhou new central axis urban design
 Source: *Guangzhou Urban Planning Bureau*

§ 6.4 The changing values of water

§ 6.4.1 Flood safety – increasing pluvial flooding

Thanks to continuously strengthened regional water infrastructures, the frequency of fluvial flooding has decreased compared with the previous stage (Figure 6.16). Instead, pluvial flooding has occurred more frequently, especially since the 2000s, and threatening public safety, infrastructure, agriculture and urban systems. During the annual monsoon season, many cities in China experience fatal floods. According to the State Flood Control and Drought Relief Headquarters Office (中国国家防汛抗旱总指挥部办公室), the direct economic loss from floods in China amounted to around RMB 1.1 trillion Yuan for 2000-2010 and RMB 712.2 billion Yuan for 2011-2013. This means that the average annual loss rose from RMB 100 billion Yuan to RMB 237.4 billion Yuan in recent years.

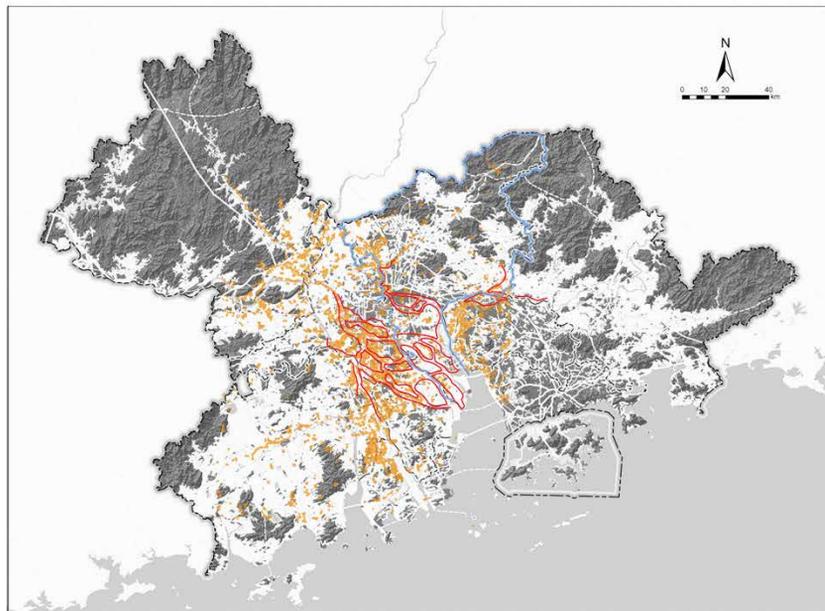


FIGURE 6.16 Fluvial flood stricken area (in orange) in the PRD between 1997 and 2002
Source: Flood area based on MODIS FLOOD MAP, NASA

The situation in delta regions is even more urgent due to their climate sensitivity. The Pearl River Delta is exposed to rising flood risks induced by climate change effects such as extreme typhoons and storms in summer. Climate change also brings the uncertain consequences of sea level rise with an estimated 30cm sea level rise projected for the PRD between 2000 and 2030 that will increase coastal flood risks (Huang et al., 2004). Occupying a vast low-lying floodplain around the sea level, Guangzhou (as well as the whole PRD) is greatly threatened by the estimated consequences of climate change (Figure 6.17). Based on the prediction of a 1m sea level rise, the current flood defence system is not sufficient to cope with future flood risks. As a result, an area of 7,823km² will possibly be flooded in the southern part of the delta. This prediction is crucial for the development of Nansha in Guangzhou as extensive areas of land are newly reclaimed and prone to coastal flooding.

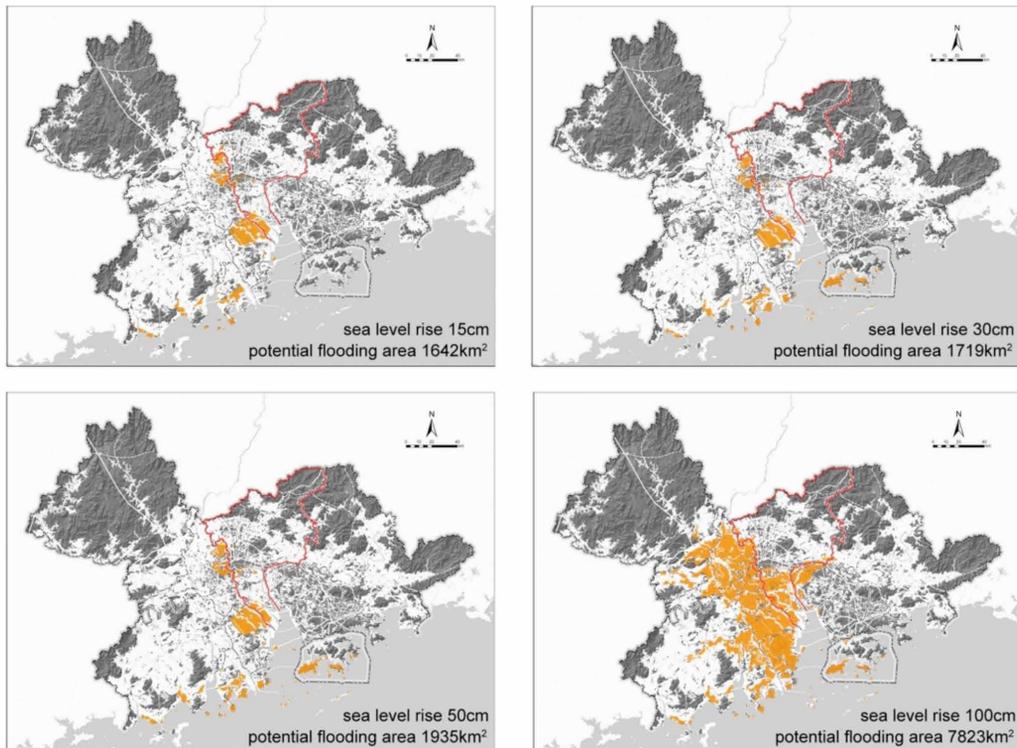


FIGURE 6.17 Potential flooding areas (in orange) of the PRD with current flood defence (with a return period of 1 in 100 years)
 Source: Data from China National Marine Basic Information Network Service System

§ 6.4.2 Economy – land finance

Economic reforms since 1978 have led to the devolution of economic power from the central government to local authorities. The city government has gained increased autonomy to pursue economic profits guided by a growth-oriented development ideology. A new phenomenon emerged which is often referred to as “land finance” (Xu & Ng, 1998; Wu & Yeh, 1999). Land release has become the main source of local revenue for the development of local infrastructures and public facilities. In 2013 for instance, the land transfer fee for building a new CBD - Guangzhou international city - amounted to RMB 13 billion Yuan, which was one third of the whole land transfer fee in Guangzhou in 2012. The dependency on land use revenues becomes a challenge for the implementation of national policies such as the “eco city” and “sponge city” (de Jong et al., 2016). For example, some water management projects are intended to act as a catalyst to bring economic profits to the surrounding area. The lake creation movement in each district shows that the economic values of water have been reinforced in urban development as it increases land prices and brings investment potential.

The economic profile of Guangzhou has been reinforced in order to enhance regional, national and international competitiveness. The expansion of the administrative boundary offered an unprecedented opportunity to reinforce its port economy on the regional scale. Port development together with industrial upgrades has brought economic opportunities to the city by taking advantage of the Pearl River and maritime resources. Since 2008, Guangzhou port has become one of the top 10 container ports in the world (Hong Kong SAR Marine Department). In particular, Nansha port gained an 8% growth in annual throughput, ranking 1st among global container ports in 2016 (Port of Nansha). The port economy will continue steering regional GDP growth and local urban development under the latest “One Belt One Road”¹⁴ initiative.

For the waterfront area in the city centre, urban planning and design has transformed the traditional water structured urban fabric into a modernised urban texture. The demolition of urban villages along the Pearl River for real estate development has shifted the values of water from social functions to economic development by restructuring waterfront land uses.

14

The “One Belt One Road” initiative refers to the “Silk Road Economic Belt” and the “21st-century Maritime Silk Road”. It is a development strategy proposed by President Xi Jinping in 2013 to promote China’s lead in the global trading network.

§ 6.4.3 Environment – environmental alert

The on-going process of urban expansion and industrial development is accompanied by a deterioration of the natural environment. The land use change and land reclamation activities at the estuaries have altered the original ecosystems, resulting in the loss of wetlands, the coastal mangrove system and biodiversity. For example, the wetland area in Nansha decreased 10.9% from 1996 to 2000 (Li et al., 2004). Unsustainable development also caused serious water and air pollution. According to the “Overall Environmental Planning of Guangzhou 2014-2030”, urban development of Guangzhou has surpassed its ecological carrying capacity by 19 times. Although major projects of infrastructure development in China have been subject to environmental impact assessment (EIA) since the issue of the EIA law in 2003, its implementation and guidance for planning remains inefficient in some cases (Tilt, 2014).

As in the case of Nansha, ambitious urban development plans were drafted to reclaim more land from the sea and to establish Nansha as Guangzhou’s second centre and the transport hub of the Pearl River Delta. This idea triggered an on-going debate, especially over the ecological carrying capacity for development. A study on the appropriate scale and density for Nansha’s development based on environmental sustainability and the water resource capacity, indicated that the living environment and water resources are the two main constraints for future development of Nansha. These constraints are closely related to the unique delta landscape and the spatial patterns in the area. Nansha is situated on newly reclaimed land in the Pearl River Delta estuaries, with dense waterways, numerous lakes and ponds, and abundant agricultural land. The landscape is structured by the irrigation system and surrounding villages (Figure 6.18) that serve as an ecological preservation zone with a system of wetlands and natural mangroves on the alluvial flats of the PRD (Figure 6.19). The annual ecosystem services provided by the wetland ecosystem in Nansha is estimated to be worth RMB 61.5 billion Yuan (Zhang et al., 2014). Moreover, facing the threat of coastal flooding, the natural flood defence system including wetlands and mangroves is of great importance to the whole delta. The flood risk caused by climate change however, whether it concerns urban extension based on a large area of land reclamation from the sea, is not recognised as a factor in planning (Interview 4).



FIGURE 6.18 Unique landscape structured by the irrigation system and villages in Nansha
 Source: www.gd-info.gov.cn

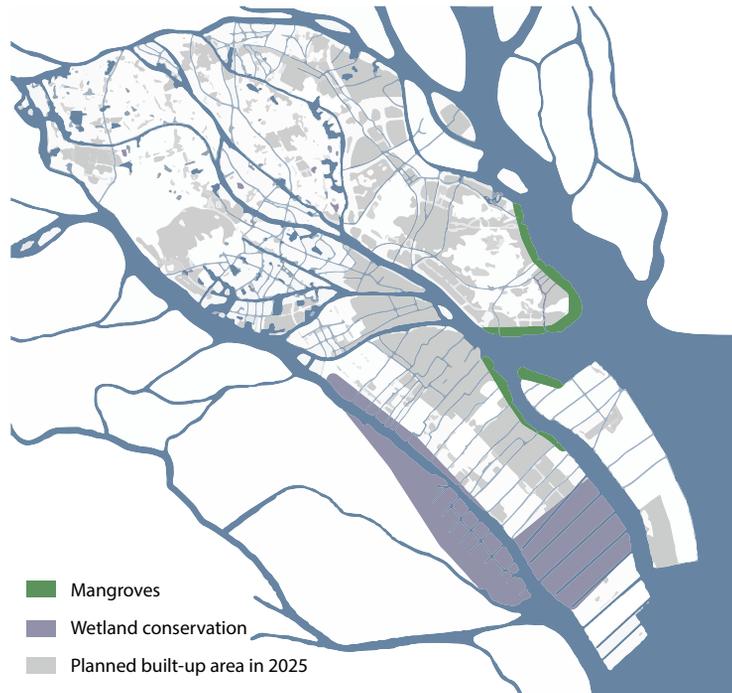


FIGURE 6.19 The ecological value of water in Nansha
 Source: based on *Guangzhou Nansha New District Master Plan 2012-2025*

In fact, a growing environmental concern has arisen in Chinese society. In order to attract more economic benefits to the PRD by taking advantage of the deep-water port and available space, a plan for a petro-chemical plant in Nansha was proposed in 2005 by the Guangdong provincial government. After a long debate however, the proposal was officially rejected in 2009 because of strong public opposition to the plan given its threat to air and water quality as well as wetland ecosystems. The opposition was mainly presented by three social groups including the local residents, professionals such as environmentalists and planners, and authorities from adjacent cities including Zhongshan, Shenzhen, Zhuhai and Hong Kong. Despite the fact that Nansha is a district of Guangzhou, its location in the centre of the delta creates tensions with the neighbouring cities owing to high environmental impacts that might accompany urban development here.

§ 6.4.4 Society – social polarisation

The social values of water have become growing concerns in the pursuit of a better quality of life and greenways, public spaces and parks have been created along the waterways to provide recreational spaces. As a historical water city in the South of China with a unique “mountain-water” landscape, there is a growing awareness of the historical and cultural meaning of water. Since the 1980s, the importance of cultural heritage as having a societal value is becoming more recognised in China (Ruan & Sun, 2001; Du Cros & Lee, 2007). In 1982, the State Council included Guangzhou in the first designation of “National Famous Historical and Cultural Cities”. Several waterfront sites were listed as historical protection districts with cultural significance including the arcade streets, the contemporary architecture conservation district in Shamian Concession, the Western-style buildings along the dike roads, and the industrial heritage along the rear bank of the Pearl River. These nodes embody the historical image and the city’s identity of incorporating a diverse variety of cultures. They represent the prosperous history of Guangzhou as a port as well as a commercial and trading centre and also indicate the close relationship between water and the city through history.

In some cases however, water is used as an urban design tool for city branding and tourism. Instead of its former role in Feng Shui culture, the Pearl River is regarded as a name card and tourist attraction for Guangzhou. Compared with the traditional axis, the new central axis is purposely designed to address the contemporary culture and strong economic competitiveness in the context of globalisation. Water villages have become popular tourist attractions where people can experience a sense of nostalgia

through social and cultural activities while enjoying the water environment. In the cases of Lychee Bay and Haizhu Lake, a great number of visitors were reported after their completion. Furthermore, the trend towards industrial restructuring and tourism made the former industrial sites hot spots for redevelopment. Being a historical port city, Guangzhou used to have a great amount of land along the Pearl River for ports, industries and warehouses (Figure 6.20). Along with the emergence of new ports in the eastern part of the city, the original industrial land was released for development and transformed into commercial and recreational spaces. The main redevelopment model however, is a repetition of the bar districts, such as along the dike road, in Baietan and Shamian.



FIGURE 6.20 Industrial heritage by the river – Taikoo Wharf (former British firm Butterfield & Swire)
Source: www.alighting.cn

Appreciation of the recreational and aesthetic values of water is accompanied by the rising market value of the land at the urban waterfront. Thus social polarisation in waterfront areas has become more obvious, which is reflected in two main aspects: limited accessibility to the waterfront and fragmented public space as well as the large displacement of local residents for real estate development.

The White Swan Hotel in Shamian was one of the most controversial cases concerning equal opportunities for public to access the waterfront. Before the hotel was built, Shamian Island was highly appreciated for its pleasing waterfront boulevard with a

panoramic view of the river. In the early 1980s, a 28-floor, 90m-tall hotel was built at the edge of Shamian Island and moreover, a ramp was constructed for cars to enter the hotel through its second-floor entrance. The construction of the hotel triggered strong opposition from urban designers and the public due to its blocking of the view of the Pearl River and the destruction of Shamian's cultural landscape (Zheng, 1987). Instead of serving the public, the riverfront was turned into a "private garden" for the guests of the hotel (Lin & Li, 2002) (Figure 6.21). This kind of phenomenon is the result of a lack of strict control and guidance in land leasing, which ultimately reflects a disregard for public interests in some urban (re)development.



FIGURE 6.21 White Swan Hotel in Shamian blocked the view of the Pearl River in the 1980s
Source: Photo taken by Huang Ruguang 黄汝广, published in *Guangzhou Daily*

Since the 1990s, land reform has led to a swift increase in land prices driven by market forces. A great deal of market-led real estate development in waterfront areas has caused social polarisation in Guangzhou. The large displacement of local residents, businessmen and farmers in waterfront (re)development projects indicates a tendency

towards waterfront gentrification. Upscale gated communities and top-grade entertainment venues have emerged alongside the river and middle class housing is mainly concentrated in urban waterfront areas (Zhou et al., 2016) (Figure 6.22). Such a development model focuses on short-term economic values and through this process, developers and the local government have enjoyed high profits at the cost of some social values for the public (Bao & Liu, 2005). In the Haizhu Lake project, social conflicts occurred as local farmers that collectively owned fruit orchards next to the lake, saw the land property transfer as a threat to their interests. Besides the development's occupation of part of the farmland, original waterways were cut off by sluices to maintain the water quality in the lake for tourism. This caused some fruit orchards to be inundated with stagnant and polluted water (Interview 5) (Francesch et al., 2017).

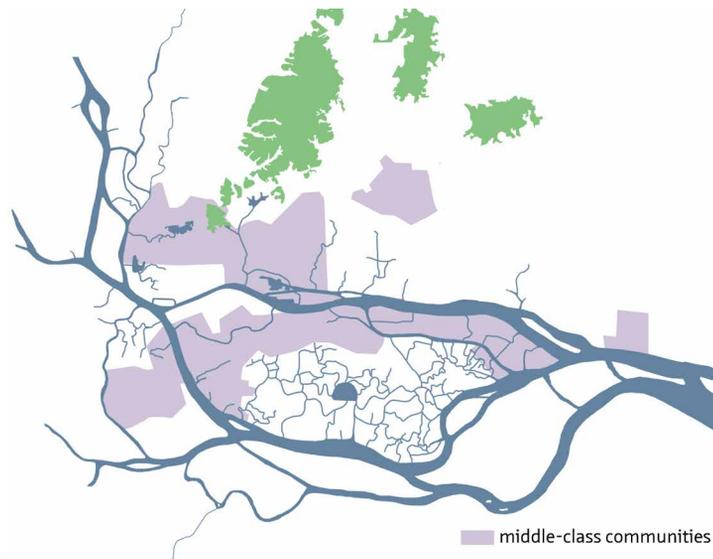


FIGURE 6.22 Locations of middle-class communities in Guangzhou around 2010
Source: drawn by author based on Zhou et al., 2016

§ 6.5 Conclusion and discussion

§ 6.5.1 Transitions of water values

Benefiting from the open-door policy and land reform, market forces have influenced various aspects of spatial development since the 1980s. The Pearl River Delta is an experimental field and Guangzhou is one of the first cities in China to experience a market-oriented socio-economic system. Two types of water-related spatial development have been observed: waterfront (re)development in combination with urban regeneration and coastal new town development. Compared with the mono-dimensional economic value of water for productivity in the socialist period, this stage is characterised by an increased consensus in society on the plurality and diversity of water values, such as cultural diversity and environmental sustainability. The Pearl River is highlighted as a name card for Guangzhou and water related cultural heritage represents emerging social values of water in spatial development. Urban planning and design is focused on waterfront redevelopment and revitalisation through the enhancement of both tangible and intangible cultural heritage, such as the industrial heritage and historical canals. Meanwhile, Guangzhou's new central axis is taking shape in the north-south direction following the traditional concept of a "mountain-water" structure with new socio-economic incentives.

At this stage, rapid urbanisation and economic development has increased the tension between economic and other values (Figure 6.23). The transition from a centrally planned economy to a socialist market economy altered the role of urban planning to be more growth-oriented at the local level. Waterfronts are regarded as an economic engine with great development potential. The downsides of marketisation have also attracted the attention of urban planners in terms of waterfront gentrification and social segregation issues. The conflict between economy and society is indicative of the trend towards social polarisation where different social classes are spatially segregated and associated with unequal access to water as determined by high waterfront land prices. The waterfront (re)development process with its strong emphasis on real estate development, often comes at the cost of some local interests as the original social groups are displaced.

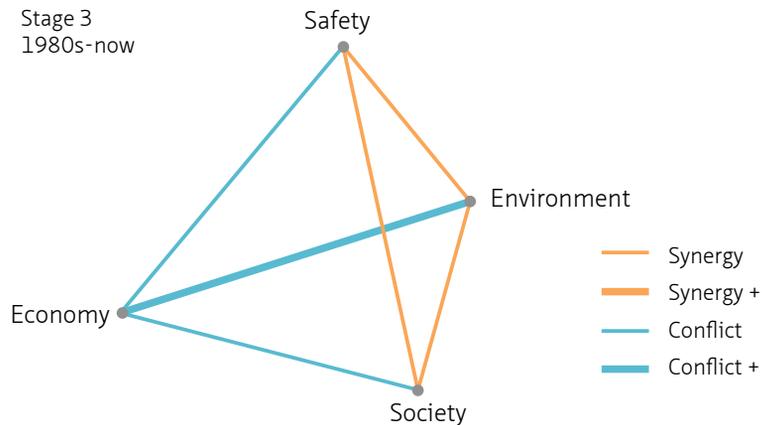


FIGURE 6.23 Relations between water values

Growing conflicts between economic development and environmental sustainability are evident. The Pearl River New Town is one of the most extreme examples where urban development has no relevance to natural conditions and previous land uses. The natural water system and farmland was completely altered by the development of this new CBD. Water is mainly used as a design tool for city branding while ignoring its hydrological characteristics. The adjustment of the municipal boundary in 2000 enabled the city to develop towards the north and the south in a large metropolitan region. This administrative adjustment stimulated the economic values of water by means of land finance. The development of the seaport and new urban centre in Nansha came at the cost of natural and agricultural landscapes with insufficient consideration for the ecological carrying capacity and long-term environmental impacts. Meanwhile, a growing environmental concern has arisen in Chinese society such as the public opposition to the development of heavy industries in Nansha. The public dispute is a reflection of the awareness of sustainability as a core value for environmental quality with a long-term vision.

The link between safety and environment is strengthened, showing a growing trend since the 2000s towards more multi-functional and nature-based water management approaches. As a result of uncontrolled urban expansion in low-lying areas and the outdated drainage system, pluvial flooding has occurred more often since the 1980s. The traditional engineering approach to water management is not sufficient to deal with growing flood risks. In the face of complicated interests and multiple goals for spatial development, the local municipal and district governments have initiated some pilot water projects. Water management is partially included in urban development visions, requiring collaborations among multi-level sectors. Lychee Bay and Haizhu Lake are

two recent projects aiming for a combination of both urban development and water management goals. However, different contexts and site conditions posed a challenge to the realisation of water values. Haizhu Lake and wetland park were designed to be the ecological core of Guangzhou so that the original agricultural and natural land uses were preserved. The Lychee Bay project however, was driven by the Asian Games in the historical city centre as a showcase of urban regeneration. The artificial water landscape cannot function as the original natural water system. The actual contribution to flood safety and environmental quality is limited while a hidden economic incentive is suspected.

§ 6.5.2 Underlying forces of the transitions

First of all, political and economic transitions lead to radical changes in the development ideology. In the post-reform era, the transition from a centrally planned economy to a socialist market economy altered the role of urban planning and design. The transition of development ideology led to a dramatic acceleration of urbanisation and a fundamental change in the social structure. Throughout history, political force has been a powerful determinant of the transition of water values in Guangzhou. Compared with the top-down and highly centralised governance in the socialist period, the devolution of administrative and economic power has guided urban development in the post-reform era. Facing the pressures from huge investments in urban development and expected GDP growth, the local government has attempted to take advantage of market forces in order to acquire economic profits. The unequal power held by various actors results in an imbalance in public interests as those that benefit from the redevelopment projects are usually not the ones who used to live there. Local interests were sacrificed by some groups such as the shop owners and residents in the Lychee Bay project and the farmers in the Haizhu Lake project. The lack of synergy among water values and the deficiency of social equity are rooted in the tradition of vague public participation and consensus building in the planning process. The empowerment of actors, especially the poor and the vulnerable clearly has a long way to go.

Secondly, institutional arrangements continue to influence the relationships between diverse values. As public interests are becoming more diversified, the local government has been promoting cross-sector collaborations via pilot water projects. In the two projects discussed above, the planning institute proposed the main concepts while many other sectors were involved in the planning process, such as the sector of water affairs, environmental protection, cultural preservation, and transport and horticulture

greening, etc. The unclear division of responsibilities and a great divergence among government departments however, caused difficulties in realisation of an optimal balance of values.

Finally, in the context of globalisation, mega-events play an important role in the infrastructure-led city profiling. The Asian Games in 2010 was one of the major catalysts for urban regeneration and city branding, followed by a series of water management projects. Water was regarded as a strong cultural characteristic for Guangzhou. The international event accelerated the process of canal restoration in a short period of time. However, the actual achievement of the proposed objectives in planning and the balance between short-term and long-term values require more value-based thinking.

PART III **Conclusions and implications**

7 Conclusions and implications

§ 7.1 Introduction

Chapters 4, 5 and 6 demonstrated how to apply the value concept in the empirical studies of Guangzhou by defining three main development stages. The dynamic transitions and interrelationships between water values for each stage were analysed from a historical point of view. Guangzhou's experience shows a shift in focal water values over time, reflecting the society's response to emerging risks and development orientations. This chapter aims to summarise research findings on the interrelationship between water values and spatial development by responding to the three research questions raised in chapter 1. Based on this, discussions are organised to address the implications of the value analysis for Guangzhou's urban development, especially the role of urban planning and design in negotiating and balancing conflicting values across scales. This chapter concludes with the implications and transferability of the value concept across the broader context of urbanising deltas by linking value theory and design practices. Finally, the contribution to the methodological development in defining and demonstrating water values in the analytical framework is discussed.

Section 7.2, 7.3, and 7.4 will answer the following research questions respectively:

Q1. What transitions of water values are reflected in spatial transformations?

Q2. What are the interrelationships between water values?

Q3. What are the implications of value transitions for urban planning and design towards sustainable urban water environments?

§ 7.2 Transitions of water values and underlying forces

Water values have undergone dynamic changes throughout Guangzhou's history along with the changing contexts of spatial development and social structures. From a historical perspective, water has played a multifunctional role in structuring delta landscapes and spatial patterns, as well as facilitating socio-economic activities. From the system of canal-moat-river, to regional dikes and drainage pipes, transitions in water management reflect fundamental changes in people's perception of water. The transition of water values is influenced by changes in social structures that involve the interrelationship between actors and their power and responsibility in influencing spatial development. Based on the morphological analyses of the three development stages of Guangzhou, the transition features of the four key aspects of water values and the main actors involved at national, regional and local levels can be summarised as follows (Table 7.1) (Appendix 3).

TABLE 7.1 Overview of value transitions in Guangzhou

STAGE	1920S		1970S	
	The Waterways City (Imperial period)	The Functional City Republican period	Socialist period	The Pluralistic City (after the open-door policy)
Actors	<ul style="list-style-type: none"> National/provincial/county-level government Gentry class Farmers Merchants Foreign traders Tankas 	<ul style="list-style-type: none"> National/provincial government City planning & design department City hydraulic department Overseas Chinese Tankas 	<ul style="list-style-type: none"> National/provincial government City planning & design department City hydraulic department 	<ul style="list-style-type: none"> National/provincial government City planning & design department City hydraulic department Market, society, NGOs
Water management	<ul style="list-style-type: none"> Canal-moat-river system Self-managed dikes 	<ul style="list-style-type: none"> Regional dikes 	<ul style="list-style-type: none"> Regional dikes Artificial lakes 	<ul style="list-style-type: none"> Pilot projects (canal restoration; lake creation)
Flood safety	<ul style="list-style-type: none"> Fluvial flooding 	<ul style="list-style-type: none"> Fluvial flooding 	<ul style="list-style-type: none"> Fluvial flooding 	<ul style="list-style-type: none"> Pluvial flooding Coastal flooding
Economic values	<ul style="list-style-type: none"> Treaty port & commercial development 	<ul style="list-style-type: none"> Light industry 	<ul style="list-style-type: none"> Centrally planned economy Heavy industry 	<ul style="list-style-type: none"> Socialist market economy Land finance
Environmental values	<ul style="list-style-type: none"> Nature and agriculture based delta landscape 	<ul style="list-style-type: none"> Declined environmental quality 	<ul style="list-style-type: none"> Declined environmental quality 	<ul style="list-style-type: none"> Declining coastal ecosystems Increasing environmental concern
Social values	<ul style="list-style-type: none"> Fengshui culture Social and cultural diversity 	<ul style="list-style-type: none"> Leisure and social vitality 	<ul style="list-style-type: none"> Declined social and cultural diversity 	<ul style="list-style-type: none"> Plurality of water values Quest for liveability Social polarisation

During the imperial period, national, provincial and county-level governments were in charge of managing flood defence systems and major waterways, while the society (the gentry class, farmers and merchants) shared the responsibility for flood protection and waterway management at the local level, such as in areas outside the walled city. The social values of water vary among diverse social groups such as the local Chinese, Tankas and foreign traders regarding the relationship between their community lives and water. Spatial development during the second stage was driven by industrialisation and institutional modernisation such that water values were shaped by the radical shift in political systems. From the republican era, institutional separation took place and specific tasks were allocated to individual departments such as urban planning/ design and water management. Influenced by Western cultures, the city government promoted the modernisation of urban waterfronts, which was partially financially supported by the overseas Chinese. The socialist period however, adopted a complete top-down management system that the national government highly prioritised the value of economic productivity through the development of heavy industries at the waterfront, which undermined social and environmental values. Nature was regarded as a barrier that humans could conquer, therefore water management adopted a centralised approach with regional dike rings and underground drainage systems. The post-reform era from the 1980s has seen a devolution of administrative and economic powers that has changed the interrelationship between diverse actors including the state, market and society, representing plural water values in spatial development. As a result of previously prioritised economic values, the urgency of environmental decline has stimulated the growth of environmental NGOs and local groups that play a role in influencing development in environmentally sensitive areas since 2000. Meanwhile, shared values over liveability, equity and cultural identity have gradually taken shape in Chinese society. As pluvial flooding has become more evident, decentralised approaches to water management have been developed in combination with urban development goals which involve multi-level institutions and actors. The following discussion gives more detailed illustration on the four main aspects of water values in relation to this general trend of value transitions.

§ 7.2.1 Flood safety

The value of flood safety in this research focuses on the protection levels of the city against flood risks. Situated in a low-lying delta area, Guangzhou is exposed to three main types of flooding (fluvial, pluvial and coastal flooding) from the upper catchment to the lower catchment of the Pearl River Delta. Destructive historical flood events such as the one in 1915 triggered the action of developing and constant strengthening of

regional flood defence by the national government. Referring to the formula “flood risk = probability x consequences” (Hall et al., 2003), the probability of flooding (the chance of flood events) has decreased due to enhanced technology and hydraulic infrastructures such as dikes, dams and reservoirs. However, flood risk still increases as the consequences (the level of damages and losses) of flood events have grown due to a larger exposure of population and assets in flood-prone areas. Meanwhile, the dominant type of flooding has changed. If we compare past flood events with future flood risks (Figure 7.1), the most urgent flood issues have shifted from fluvial flooding from major rivers in the upper catchment to more frequent pluvial flooding in the densely built city centre, with a tendency towards coastal flooding at the estuaries due to a seaward expansion of the metropolitan area and sea level rise caused by climate change. Consequently, newly developed areas on reclaimed land such as Nansha are highly exposed to coastal flooding.

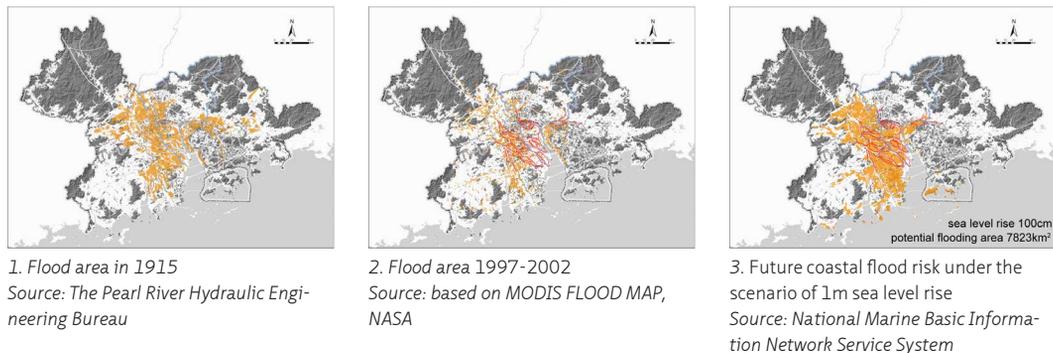


FIGURE 7.1 Shift in main flood risks in the PRD (flood-stricken area in orange)

§ 7.2.2 Economic values

As a historical commercial city in China and a pilot city in foreign trade and economic reforms, economic values have always been prioritised in urban development that influence other values. The changes in spatial patterns are related to the transition of economic development models. Owing to a dense water network and convenient navigation, Guangzhou used to be the leading treaty port and commercial centre in ancient China. During the Ming and Qing dynasties, many commercial streets emerged along waterways that facilitated trading and commercialised agricultural

products in the delta such as tea and silk. The second stage marked a huge impact of new economic models on water values through changes in waterfront land uses and regional hydraulic infrastructures. This trend was reinforced during the socialist period when industrial land occupied the waterfront along the rear channel of the Pearl River. The economic values of water were based on the utilisation of water for industrial productivity and port development. The changing economic models and their impacts on spatial patterns are associated with the prioritisation of economic values and in most cases representing national values. At the beginning of the socialist period, overall poverty and a great scarcity of materials and resources were more urgent than other threats. Such that urban planning had to focus on quickly achieving economic growth, following national economic plans such as the “Five Year Plan”. Since the launch of the open-door policy in the 1980s, a socialist market economy has replaced the previous centrally planned economy, pulling urbanisation towards the direction of higher efficiency. Influenced by the national land reform, the municipal government prioritised the economic values of water through land exploitation for local revenue, which is referred to as “land finance”. Consequently since the 1990s, the most dynamic spatial development has taken place along the Pearl River and urban waterfronts have been developed into upscale gated communities, central business districts, and commercial centres. Meanwhile, water is positioned as a catalyst to attract investment and tourists. Economic incentives also drive some water projects, such as the lake creation movement and canal revitalisation.

Nowadays, the economic definition of a delta has overtaken its original geographical sense. The PRD is more often referred to as an economic zone, functioning as a centre of advanced manufacturing and modern service industries, as well as a hub for international shipping, logistics, trade, conferences, exhibitions and tourism. As the capital and central city in the PRD economic zone, the strategic position of Guangzhou being an economic engine has been reinforced in the context of regional integration and global economic competition. This trend has been extended towards coastal areas, where new development facilitated by the deep-water port in Nansha District is a new strategy to enhance the city's economic profile.

§ 7.2.3 Environmental values

The environmental values of water are associated with hydrological and ecological systems as well as the living environment of people. Guangzhou was built in a natural surrounding between mountains and the Pearl River with large areas of wetlands, fishponds and farmlands. Both local people and foreign merchants highly

appreciated the environmental values of the delta landscape for centuries before the industrial stage. The natural landscapes of the delta previously functioned as the major receiving body for precipitation through the natural processes of infiltration and retention. Diking, damming, dredging and land reclamation activities largely reduced the storage and discharge capacity of the natural water systems and balance within the ecosystems. Upstream damming and river channelisation caused serious erosion of the coastal landscapes due to the disturbance of natural sedimentation processes. Rapid urbanisation and industrialisation came at the expense of water and air quality as well as causing a great loss of wetlands. Decreasing surface water has broken the balance of ecosystems and biodiversity, such as in the Lychee Bay. In new development areas like Nansha, a high intensity of urban development and radical land use changes as indicated in planning are threatening the environmental quality of the delta, including massive farmlands and wetlands, the coastal mangrove system and other sensitive ecosystems at the estuaries. Since the 2000s, a growing concern over water's environmental values has been apparent in both the government and society in the context of increasing environmental issues and the quest for sustainable development. The value of water as an important part of the ecological system carrying ecosystem services and supporting biodiversity has been indicated in recent development plans. At the regional level, the Greater Pearl River Delta Integration Plan and greenway planning are regional plans addressing the environmental values of water resources and ecosystems. At the city level, the Haizhu Ecocity Plan has been promoted as a catalyst to enhance the environmental values of water, including the design of the Haizhu Lake and ecological park. Although these plans attempt to incorporate long-term environmental values with short-term socio-economic values, the actual realisation of promised values remains a challenge due to complicated interests involved across spatial, institutional, hierarchical and temporal boundaries. Meanwhile, local communities and environmental NGOs are challenging the planning policies regarding long-term environmental sustainability through public debates and environmental protection initiatives.

§ 7.2.4 Social values

The transition of the social values of water is multi-dimensional. The empirical studies of Guangzhou focus on three main aspects of social values namely, cultural diversity, social interaction and social equity. Being a historical water city that has been developed through radical political and social transitions, the society regards water as a strong identity for Guangzhou. This kind of identity is characterised by the coexistence of diverse cultures that have been developed alongside water throughout

history. The presence of water offers spaces and opportunities for social interactions among diverse social groups and also between humans and nature. Canal streets and riverfronts used to function as the main public spaces facilitating social interaction and public life in the past. The processes of modernisation and globalisation have caused a reduction in cultural diversity by means of cultural homogenisation. Although Western influences have long been rooted in Guangzhou due to its international significance as a treaty port, it was not until the republican period that modernist planning has taken place with a far-reaching impact on indigenous cultures through the popularisation of Western cultures. During the socialist period, the occupancy of waterfronts for industrial development and other economic activities detached social interaction from water. Some cultural activities that used to be organised in or by water also disappeared. For example, a large quantity of boat dwellers, who developed their own water culture vanished as the waterfronts were regulated and modernised in the 1950s. The city lost its water-related cultural identity along with the loss of surface water and the change of waterfront land uses.

In the current context, the influence of urban development on the social values of water is two-fold. On the one hand, the society has formed shared values on the importance of water for the quality of life. The social values of water are emphasised in the agenda of urban regeneration in combination with culture preservation. To recall its water culture, the municipal government has made considerable investments in enhancing the attractiveness of waterfronts for tourism and the city image since the 2000s. Mega-events like the Asian Games stimulated canal restoration to recover the water landscape. Filled canals were reopened and waterfronts were redeveloped in combination with greenways, parks and squares. On the other hand, contemporary Chinese cities are increasingly confronted with an identity crisis (Chen, 2011). For example, the authentic culture of water villages is under threat that foreign bars and cafes in iconic buildings have become a business model. The economic incentive is disguised within city branding to attract investments, talent and tourists.

In the meantime, a growing concern over social equity has emerged in Chinese society, particularly concerning waterfront accessibility and public interests. For example, waterfront (re)development has raised the issues of social segregation and gentrification, and the improvement of public facilities and services in the city centre has led to increased land prices. The municipal and district governments take the opportunity for urban regeneration to replace urban villages and old residential areas with high-rise communities and financial centres at the waterfront. As a result, some parts of the waterfront are occupied as backyards attached to particular social groups, usually the higher class. The White Swan Hotel and gated communities along the Pearl River are examples that demonstrate the neglect of the waterfront as a public domain. They blocked the waterfront view and destroyed the continuity of the waterscape. In the

redevelopment process of waterfront urban villages, a large number of local residents were relocated and the conflicts became more intense when the land property issue was involved. Although the villagers received extensive compensation for displacement, their water-related lifestyles, community relations, and traditional water cultures disappeared. The redevelopment process usually came at the cost of the interests of the tenants, most of whom were migrant workers or new college graduates who could not afford commercial housing. In addition, although publicity is obligatory in the planning process for large projects in Guangzhou, and public opinions are increasing expressed via social media, public participation is still weak and not yet involved at the initial phase of planning (interview 6). It is a great challenge to reach a well-balanced consensus that reflects diverse public values.

§ 7.2.5 Underlying forces of value transitions

Several main underlying forces have influenced the transitions of water values, such as political power, technological development, institutional arrangement, and a growing awareness of plural values in society.

Firstly, political power plays a key role in the decision-making process for spatial development, which determines the orientation of values. Adopting a top-down model of governance with a high political hierarchy, the central government is the most powerful actor steering China's urban development. Since the 1900s, three major political transitions have taken place in Guangzhou. The first, from the imperial era to the Republic of China, marked the influence of modernisation from the Western world to China that brought some new values to the city such as aesthetics and functionality. The second turning point was the establishment of the People's Republic of China in 1949, which shifted the position of Guangzhou from a leading commercial and trading centre of China to a normalised industrial city. This kind of value uniformity was gradually changed by the open-door policy and especially since the 1990s, Guangzhou has been repositioned as the political, socio-economic and cultural centre in South China, as well as the transport hub in the PRD with great international significance. The reform is also accompanied by political devolution regarding the division of power. The introduction of market mechanisms in the post-reform era has reshaped the previously highly centralised governance model. The municipal government has gained more autonomy and power in economic and administrative management. As some initiative projects are financed locally, urban development at the local level tends to be market driven. Although power transfer enables more consideration of local needs in urban development, the state is still dominating in the decision making of spatial plans so that conflicts are inevitable

between national, regional and local values. For example, to facilitate the development of Guangzhou at the regional level, Nansha was supported by national policies as a national-level new district and a free trade zone, with little consideration of the interests of local farmers and residents. Moreover, the risks of environmental decline and coastal flooding have also triggered strong opposition from local communities and neighbouring cities.

Secondly, technological development has fundamentally changed the relation between water and the city. Before modernisation, spatial development such as building the streets, canals and houses had to follow natural conditions due to limited technology. Water was managed in its hydrological path according to the natural landscape so as to avoid flooding. Benefitting from modernisation and industrialisation, new types of transport such as roads, bridges and railways, replaced original inland navigation that relied on canals and moats; the regional flood defence system (dikes, dams, etc.) and the underground drainage system altered the traditional way of water management. All these achievements in science and technology enabled urban expansion on low-lying or reclaimed land across the natural constraints of rivers and the sea. Although modern technology has brought enormous benefits, it has created problems at the same time. Hydraulic infrastructures for instance, have caused great disturbances to natural sedimentation regimes, hydrological cycles and ecosystems. Moreover, this kind of centralised approach has decreased the capacity of resilience and increased the vulnerability of delta cities to flood risks in case of technological failure, as water management is regarded as the government's responsibility.

Thirdly, institutional (re)arrangement causes the divergence of values and responsibilities among sectors. Before the establishment of formal institutions in Guangzhou, flood risk was managed spontaneously by local farmers, businessmen and inhabitants on small scales, especially in the suburbs. The extensive spread of dike-pond farming in the Pearl River Delta is a good example reflecting the local wisdom of living with water by using natural dynamics to develop local economy, ecology, culture and lifestyle. From the republican period, institutional modernisation caused the separation of disciplines, sectors and responsibilities, which created a great divergence of development priorities. As a result, urban planning and water management sectors are in charge of separate issues with different priorities on values. On the one hand, the municipal planning bureau carries out urban development plans, including land use plans and regulatory plans, to facilitate socio-economic development. Urban development increases flood risks by building on low-lying floodplains and occupying natural watercourses. The natural capacity of dealing with flooding by means of pervious surfaces and natural storage has been greatly undermined. On the other hand, the separation of water management as an independent sector creates some urban issues. Centrally controlled hydraulic engineering works are carried out as common practice to control flooding that the original connection between water and urban fabric has gradually lost. Although urban planners and designers are

becoming increasingly concerned about the social and environmental aspects of water, and hydraulic engineers have begun to pay more attention to the negative impact of engineering flood defence structures on environmental quality, a lack of institutional integration concerning cross-sectoral and cross-boundary aspects increases the complexity of strategy development. Regarding cross-sectoral issues, the cooperation and coordination between the authorities of urban planning, environmental management, hydraulic engineering and other sectors is important for achieving synergies among water values (interview 7).

Finally, a growing societal influence has guided the value orientation towards multi-dimensional. Same as other places in the world, a transition has taken place in China since the 1970s towards the awareness of plural values other than previous focus on economy. As economic development has been achieved to a certain level, accompanied by growing environmental and social issues, an increasing public voice has emerged in China seeking a higher level of liveability and sustainability. Irrational urban development in the past has triggered a growing concern over the negative impact of rapid urbanisation on the natural environment and quality of life. Public opposition has begun challenging the government on the decision-making in big projects with environmental threat, by means of extensive social media and informal networks. Some development plans of heavy industries in coastal new towns were stopped due to strong public opposition concerning the vulnerability of natural systems and water resources on the newly reclaimed land. Increasingly, NGOs such as WWF-China, Friends of Nature, and CrossBorder Environment Concern Association have taken initiatives in environmental protection. Next to environmental awareness, there is a growing concern over the social aspect of values, such as cultural heritage, local identity, social interaction, tourism, leisure, health and safety. In fact, some national plans have already addressed the importance of environmental and social values in urban development. In 2014, the national government unveiled the “National New Urbanisation Plan 2014-2020”, with the goal of steering China’s urbanisation onto a human-centred and environmentally friendly path. The plan criticises the profit-centred mind-set and the unsustainable pattern of urban sprawl in recent decades that relies on land finance. It further stresses that new development should explore the existing stock of urban land, rather than occupying rural and natural land. This guideline indicates the transition from urban sprawl to urban regeneration and the importance of land use restructuring for more efficient and compact development within existing urban areas (Zou, 2013). The national government has advocated a more sustainable model of urbanisation that concerns with the preservation of ecosystems and cultural heritage, and the enhancement of the adaptive capacity of flood protection during extreme weather events (State Council of China & World Bank, 2014). Furthermore, water has been emphasised in the agenda of China’s 13th “Five-Year Plan” (2016-2020), aiming at building an eco-friendly environment.

§ 7.3 Interrelationships between water values

Taking an overview of value transitions in Guangzhou based on the discussions in chapters 4, 5 and 6, the relations between the four key aspects of water values demonstrate both synergies and conflicts at different urban development stages and across multiple scales (Figure 7.2).

At the initial stage, synergies were achieved between flood safety and economic and social values of water thanks to a well-connected water system conforming to the natural conditions of the delta landscape. Decentralised surface water systems facilitated diverse economic, social and cultural activities. Waterfronts were developed as commercial streets and at the same time, functioned as principal public spaces for social interaction. The synergic relation between values can be observed in the persistence of traditional values. In the long-term transformation of spatial and social developments of Guangzhou, some core values have remained persistent through. For instance, the traditional cultural meanings of water in Chinese cities have been rooted in society since ancient times as an essential shared value. Although Guangzhou has developed through different phases such as industrialisation, modernisation and internationalisation, the fundamental cultural meanings of water remain and continually adapt to the changing spatial patterns. The traditional mountain-water painting and Fengshui concepts strongly influenced the city site selection when the walled city of Guangzhou was initially established thousands of years ago. This idea was further developed in the concept of “shanshui city” and “ecocity”, that the mountain-city-water axis has been repeatedly addressed in planning as an intrinsic cultural identity.

In the meantime, some values conflict with each other when complex issues and multiple targets are met across scales. The conflicting relation between values drives changes in policy and spatial development. During the socialist period, the national goal of industrial development ignored local identity and long-term environmental impact. Also, the shift of flooding problems from fluvial flooding to more frequent pluvial flooding demonstrates the lack of cross-scale considerations in spatial development. In the current context, the market driven development model has resulted in many social and environmental issues, and has increased flood risks in the long term. As for planners and designers, the key issue is how to mitigate the conflicts and promote the synergies between economic development and other values by using spatial tools. Based on the value assessments of all the stages, four main conflicts can be identified with spatial relations. This part of the discussion lays the foundation for section 7.4, where reflections and implications for planning and design are addressed so as to turn these conflicts into synergies.

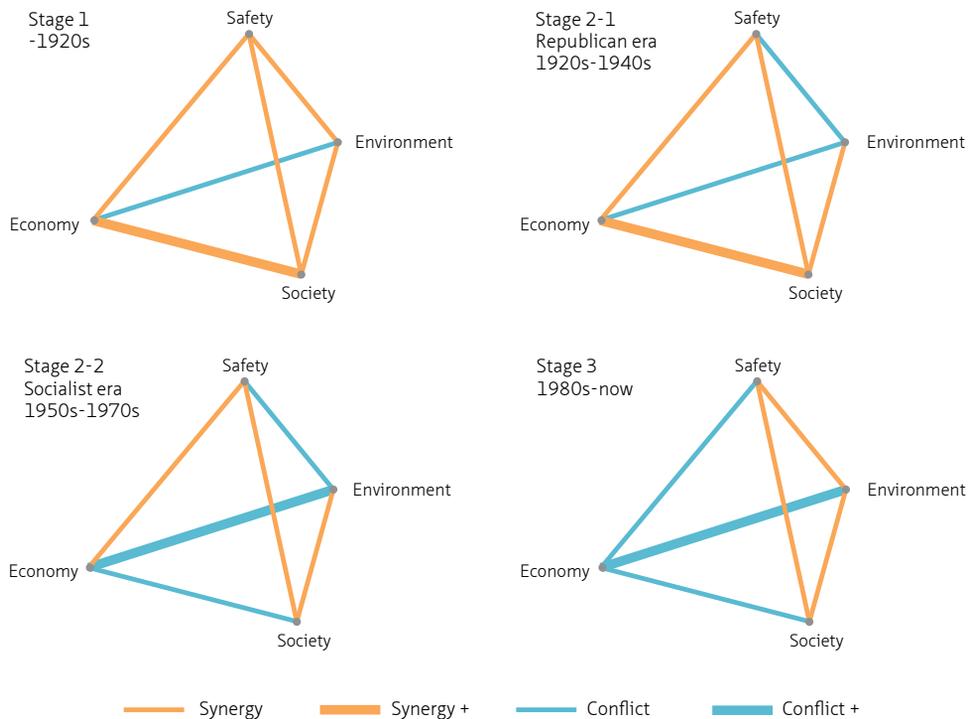


FIGURE 7.2 Changing relations between water values at three development stages

Firstly, the conflict between economic development and flood safety has become more evident. On the one hand, profit-driven urban development increases flood risks. Taking an overview of the flooding issues in Guangzhou, urban development in high-risk zones such as historical floodplains increases the vulnerability of the city to catastrophic flood events. The unprecedented urbanisation process has changed the spatial structures and land uses in Guangzhou as a delta city, leading to a great loss of surface water. The Pearl River has been narrowed by about 200m in a century, and the waterfronts that used to function as flood buffer zones have been occupied by urban functions. On the other hand, growing flood risks increase economic vulnerability in that a large number of assets and investments are exposed to flooding. The city has been suffering from tremendous economic losses in recent decades due to increasingly frequent storms. Considering the coastal flood risk aggravated by the trend of climate change, continuous investments and developments in coastal areas have put the city at risk. To meet the requirement that surface water accounts for at least 10% of the entire land area, the city has adopted a strategy of constructing artificial lakes. Although lake creation was initiated for flood mitigation, an increase in land prices around the lakes has shifted the focal value from flood safety to economic development.

Secondly, the conflict between economic and environmental values is shown in all the three stages with a growing sense of urgency due to the changing economic models. Deltas historically are hot spots for human settlements and economic activities, facilitated by long-term land reclamation and dike construction. From a commercial and trading city to a modern and industrialised city, the centrally planned economical model undermined the original link between water and society. Since the socialist period, the city has been confronted with significant environmental issues influenced by the national policy of conquering the natural constraints. The recent four decades have witnessed a rise of market forces in spatial development at the local level. Rapid urbanisation and development facilitated by infrastructures and heavy industries has aggravated the environmental crises, such as air and water pollution, and a decline of ecosystems. Several cases can verify the growing tensions between economy and environment, such as the Lychee Bay, the Pearl River New Town and Nansha. In such situations, slogans such as “eco-cities”, “sustainable development”, and “water sensitive cities” have been put forward in search of a balance between economic development and environmental sustainability. However, there is a misleading application of such slogans that the environmental value is regarded as a catalyst for boosting economic profits.

Thirdly, the developments of economy and society have shown a lack of synergy since the 1950s. The socialist period turned the waterfront into a mono-functional place for industrial functions that undermined the values of water for social interaction and cultural diversity. In terms of the conflict between economic development and social equity, the debate on efficiency and justice has attracted the attention of urban planners and sociologists. Although land reforms have brought benefits to economy by increasing local revenues in the post-reform era, it has caused social inequity due to the inadequate regulation of market forces (Ding, 2003). New land policies have led to extensive land use changes and social polarisation, especially concerning waterfront (re)development. Communities of poor people and migrants are displaced and marginalised, and waterfronts are redeveloped to accommodate those new communities that can afford expensive housing.

Finally, the conflicts between flood safety and environmental quality were intensified during the second stage when manipulative approaches towards large-scale hydraulic engineering were adopted. Compared with the traditional dike-pond system invented for local farming as well as the canal system, modern engineering approaches of flood defence by means of diking and damming have altered the natural hydrological processes and the deltaic landscape, and have caused severe environmental deterioration. For example, rivers have been narrowed and channelised and streams have been filled. The construction of hydraulic infrastructures created great disturbances to the natural water systems and destroyed the habitats of riparian

vegetation and aquatic organisms. In recent decades, some nature-based solutions for water management such as wetland and canal restoration have created alternative approaches to flood mitigation with a lower impact on the natural environment and ecosystems. Most of these initiatives however, while effective at the local level and in the short-term, are challenging to scale up with an adaptive capacity, considering the great uncertainty of climate change.

§ 7.4 Reflections and implications for planning and design across scales

§ 7.4.1 The changing roles of urban planning and design

This thesis advocates the essential role of planners and designers in addressing water values when making spatial plans. To better understand the challenges and opportunities of planning and design in the current setting of governance, this part gives a brief overview of how the role of planning and design and associated values have changed in history. Urban planning and design in China has a strong political orientation. At the initial phase of the socialist period in the 1950s, urban planning was utilised to consolidate the political power of the new Chinese government. Following highly centralised economic and political systems, urban planning was considered a spatial regulation tool that represented the values of the central government with a strong political intention. The top-down planning process followed the norms and principles of the former Soviet Union, with rational analyses and technical solutions. Although the economic transition to a market-oriented system altered the relation between the central government and municipalities with a growing involvement of different social groups, the political imprint of planning is still dominant. It has been recognised that the traditional labour-intensive industrialisation model and the dispersed urbanisation pattern have caused many issues such as environmental decline, cultural heritage damage, as well as social segregation and polarisation (Huang et al., 2009).

China is now experiencing a holistic transition regarding economic development, industrial restructuring, urban regeneration, and environmental protection. Since the 2000s, urban planning has begun to adjust its conventional role for GDP-centred development by addressing the ignorance and importance of other values in spatial

development. The main focus of planning has been shifted from incremental planning to inventory planning, that is from stimulating growth to restructuring existing space. The transition has also taken place at the strategy level. The national “Sponge City” programme has officially addressed the responsibility of flood management in planning for the first time. Meanwhile, provincial and municipal governments have initiated spatial policies concerning urban redevelopment issues. These transitions have created opportunities where diverse water values can be integrated into spatial strategies. Rather than a threat, water nowadays is regarded as a catalyst and opportunity for urban development. Given that these spatial policies are initiated with an attempt to enhance environmental quality and flood mitigation from the planning perspective, they are still restricted to quantitative indicators. The “sponge city” programme for example, has indicated the control of surface water ratio, green space ratio, and runoff control ratio (interview 8). Therefore, more qualitative criteria need to be embedded in planning and design to address other development challenges such as the social aspect.

By considering the challenges of localities instead of concrete plans and design solutions, knowledge transfer regarding concepts, values, principles and integrative approaches from local historical developments and international experiences are more valuable to guide future development. Urban planning and design can play a key role in promoting synergies among diverse values in society and influencing decision-making. The role of planning and design is no longer limited to the technical level such as blueprints and ground layouts, but is more concerned with the whole participatory process that the interests of diverse actors are fully considered. Furthermore, the planning framework also needs to be flexible and adaptive concerning the changing contexts and challenges.

Based on the empirical studies of Guangzhou, this section focuses on how to convert the knowledge of water values and their spatial indications through time and scale, and to address the dimensions and principles that urban planning and design may consider. The discussions and implications are concerned with three scales (delta, city, and district), with the focus on city and district scales. For each scale, focal values are suggested to strengthen the link between diverse water values in spatial development.

§ 7.4.2 Regional integration on the delta scale

On the delta scale, water values regarding flood safety (fluvial and coastal flood risks) and environmental sustainability are more evident in spatial development. In terms of physical systems (layers), landscape and infrastructure systems play an essential role in

structuring and guiding urban development. In practice, regional integration is difficult as there is no regional-level government in the Pearl River Delta and the administrative boundaries of water and city are different. The Pearl River Water Resources Commission is responsible for regional water management, while separate municipal government is leading urban planning and design. Conflicts occur due to the competitiveness and cooperation dichotomies between cities and institutions. In this regard, creating a common ground based on shared values is the key to bridge the language gap and set up common goals among multi-level authorities. It is important to address regional contexts and risks when applying spatial strategies to the city. Strategic regional and local plans should target optimising the whole delta as an integrated system by enhancing the synergy between water systems, ecosystems, urban systems and regional infrastructures, while taking local conditions and long-term impacts into account. The geographical characteristics of a delta region and the landscape dynamics that shape urban patterns should be considered as basic rules for spatial development. Compared with the traditional hard engineering approaches of regional flood defence, nature-based water management solutions offer alternatives to combine flood mitigation and urban development goals, which can bring added value to the living environment. The importance of ecological preservation in sensitive zones should be reinforced, especially in the bay area of the PRD where rapid urbanisation has been threatening the natural environment. Meanwhile, adaptive strategies are essential to deal with uncertain coastal flooding in face of climate change.

§ 7.4.3 Planning and design principles on the city scale

On the city scale, urban planning and design is associated with local conditions, such as historical, economic, social and cultural backgrounds, as well as the environmental carrying capacity. A value-based planning framework is needed to deal with complex and conflicting interests among actors. This requires a more efficient cooperation between different levels of authorities, especially between urban planning and flood risk management sectors. Accordingly, it is crucial to develop spatial strategies that incorporate flood risk management, master planning, and land use planning.

On the one hand, the diversity of spatial patterns and urban development pressures require site-specific strategies of planning and design according to spatial conditions. As discussed in chapter 6, three spatial patterns can be recognised from the upper catchment (north) to the lower catchment (south) in the existing spatial structure of Guangzhou metropolitan region, regarding landscape patterns, hydrology, dominant flood risks, and development intensity. The upper catchment area should focus

on increasing the retention capacity with natural wetlands and artificial reservoirs. Urban development in some locations must be strictly restricted, and land use planning in potential development zones should fully consider the negative impact on the natural system. For the historical city centre in the middle catchment, where dynamic socio-economic and cultural activities are taking place, it is more practicable to integrate flood risk management into urban regeneration plans. For example, abandoned industrial land in riverfront areas needs to accommodate new functions, which can be achieved with multi-functional land uses. Existing water systems, greenways, parks, and other public spaces can function as potential water storage spaces with added value to spatial quality. Finally, both safety and environment are essential values for coastal new towns in the lower catchment. New development should be highly controlled and regulated to deal with increasing coastal flood risk caused by climate change, and to preserve coastal and estuarine environments. An appropriate development intensity and site planning needs to consider the long-term environmental impact and carrying capacity of nature based on scientific assessments such as EIA (environmental impact assessment) and FRA (flood risk assessment). Infrastructure and urban system development should conform to the existing landform and water systems.

On the other hand, innovation is needed in flood risk management to overcome the drawbacks of current hard engineering approaches. To deal with increasing pluvial flooding, the most common and probably the most expensive and disruptive solution is to retrofit the existing drainage system with larger pipes and pumps. In the recent decade, increased waterlogging events show the lack of capacity of stormwater management with drainage-dependent approaches when facing frequent extreme rainfall. Moreover, these approaches have hardly any contribution to social and environmental values. In this regard, a well-connected green-blue network with green spaces and water systems offers an alternative that can not only increase water storage capacity, but also can create diverse attractive water landscapes. The key issue then, is what kind of water systems to design and where. Creating large artificial lakes may not be an optimal solution given the fact that pluvial flooding areas are rather scattered in Guangzhou. Thus, central water storage is not very effective for flood mitigation in case of collecting great amounts of stormwater in a short period of time. The empirical studies of value transition in Guangzhou indicate that, in principle, a dense, decentralised and well-connected surface water system has a multi-dimensional contribution to the synergy of water values. First, it can enhance flood safety by functioning as water storage and drainage system in the condition of heavy rainfall; second, a diversity of water bodies can support ecosystem services; third, water can play a role in facilitating social and cultural activities in the design of waterfront public spaces. Therefore, it is important to change the current drainage-dependent approach of flood management to more nature-based and decentralised approaches. Rainwater

should return to its hydrological cycle along natural pathways for retention, infiltration and discharge. These water bodies can be designed in the form of canals, ponds and wetlands. But in densely built cities like Guangzhou, how to add these patches into the existing urban fabric is a crucial question. Some water-related spatial patterns will be further elaborated on the district scale based on potential water values.

§ 7.4.4 Value-based spatial patterns on the district scale

The historical development of Guangzhou suggests that, the most dynamic transformations and also the most controversial developments have taken place in waterfront areas. There are some key criteria for waterfront (re)development, three of which are frequently mentioned: local identity (cultural diversity), mixed land use (land use functionality), and social equity (public access) (Chang & Huang, 2011; Fisher & Benson, 2004). First, in terms of identity crisis in the context of globalisation, local identity, which is featured by cultural diversity tracing historical development, needs to be strengthened. Second, mixed land use (land use functionality) in waterfront areas can be achieved by multifunctional flood defence systems, which can facilitate both flood safety and socio-economic activities. Third, the public access to waterfronts is a key indicator of social equity. Waterfronts should provide a variety of functions and opportunities for different social groups, regardless of their income and social status. However, these criteria do not necessarily hinder the economic value of the waterfront land. In the past years, the planning department of Guangzhou attempted to set regulations to reserve more waterfront open space for ecosystems, recreation, and public facilities by controlling the area and density for development in waterfront areas. These regulations greatly reduced the enthusiasm of developers as they think their investments are unprofitable. In such cases, Hong Kong's experience might be an option. Hong Kong stipulates that if developers reserve waterfront public space for the city by building bottom overhead or backwards, the floor area ratio can be increased accordingly as compensation.

On the district scale, three spatial patterns can be defined that urgent issues are confronted with transformation possibilities to integrate water in spatial plans. The cases are chosen in three representative locations where water plays an important role in the urban environment, namely the historical city centre, the riverfront and the urban village.

The first pattern represents water in public spaces in the city centre that both pluvial flood mitigation and urban regeneration demands can be combined. By reorganising current

public spaces and water systems without changing land uses and spatial functions, water values can be achieved with contributions to safety, environment, and society. Public space in Guangzhou used to maintain a close relationship with water, in the form of goods loading areas, waterfront squares, canal streets and wetland parks. As the functions of public space become less water-dependent, water has gradually disappeared from people's daily lives. Meanwhile, a lack of recreational public space in the city centre has been notified as an issue concerning liveability. The challenge lies in how to make full use of the existing public space especially green space with water to bring vitality back to the city.

The second pattern is associated with the transformation of the former industrial area along the rear channel of the Pearl River, such as in Haizhu District. Along with the seaward relocation of the deep-water port, redevelopment opportunities can be seized by restructuring industrial brownfields at the riverfront. It is common practice to transform these waterfront brownfields into real estates such as commercial centres and gated communities for high economic profits. As a result, waterfronts are densely occupied with limited space for public activities, sometimes are at the expense of narrowing parts of the river. In some other cases, historical industrial areas are regarded as important cultural heritage. For example, the Taikoo Wharf and the Xinyi Club areas have been transformed into spaces with commercial and cultural functions. Industrial buildings and warehouses are preserved and the interior space has been renovated into bars, restaurants, cinemas or design studios that serve limited social groups. Considering the values of waterfront brownfields for a wide range of public, multifunctional landscapes and public spaces can be created by design that combines waterfront redevelopment schemes with water management strategies. Normally, the industrial land use is featured as wide roads and large open spaces, which offers possibilities to apply water sensitive design solutions. An industrial park for instance with flood buffers by the river, not only can bring safety and environmental values, but also can create recreational spaces for social and cultural activities.

The third pattern refers to water values for urban villages where the authentic rural culture and social structure are linked by water. Taking a retrospective view on the "Liede model", the third pattern is more concerned with the preservation of existing social values that face enormous development pressures. Guangzhou used to have lots of historic water villages and the spatial pattern of which is usually structured by water and surrounding natural landscapes. Within the village, social lives and activities are closely linked with water, such as the organisation of public spaces like ancestral halls in front of ponds. Since the 1990s, these villages have become urban villages under great development pressures. Some of them have been completely demolished for real estate development, such as the former Liede Village along the north bank of the Pearl River (see section 6.2.3). Identified as important cultural heritage, some of these villages have survived and become bases for artists and designers, and tourist

attractions. Although the physical structure of the villages is kept, the social structure and associated values have been completely changed. The revitalisation of the authentic social values of water requires re-positioning and re-profiling of these water villages in a bigger context of spatial development.

§ 7.5 Theoretical and methodological implications

§ 7.5.1 Transferability of knowledge - the “value” concept

This research uses the concept of “water values” as a lens to explore the driving forces of spatial development in a flood-prone delta context where rapid urbanisation is confronted with both natural and social challenges. The value concept provides a unique perspective to understand governance challenges and mechanisms that drive different actions in the complex delta system. The case study of Guangzhou provides an empirical validation of value theory discussed in chapter 2. From a historical perspective, a comprehensive understanding of water values on physical, institutional, hierarchical and temporal dimensions provides important knowledge to link the value concept with spatial development for building consensus in society. Although this research focuses on the empirical study of Guangzhou, the interdisciplinary perspective and the knowledge acquired from the analysis can contribute to a better understanding of the values of water in delta cities in general. Guangzhou’s experience shows radical spatial and value transitions through time and the capacity to adjust the system to new political, social and economic development models. Compared to Western countries, Guangzhou’s experience might provide more practical lessons to urbanising deltas in the world, such as many Asian delta cities, where fast growing population and urbanisation processes are challenging the environmental quality, and the societal diversity needs more adaptive measures to deal with conflicting interests and values. Concerning value transitions, three main characteristics can be concluded based on value theory and empirical studies and their implications are addressed.

First, values are not static, but are perceived with an evolving nature, as responses to the changing conditions of natural dynamics, socio-economic developments, political orientations, and emerging risks. Following the global trend towards value pluralism in policy-making, the existing development of Guangzhou shows the coexistence of

diverse water values in spatial strategies. This consensus is based on the long-term process of value judgement, negotiation and adjustment, which is closely related to the changing social structures and governance approaches. At the beginning of the socialist period, the national government imposed high priority and strict control over the single value of economic productivity in Guangzhou. The negative impact on social and environmental values caused a shift in dominating economic values towards the needs of accommodating plural values several decades later. The devolution of power and responsibility in administration from the state to local governments and actors allows more flexibility in decision-making. This transition provides implications to planning and design for delta cities, that the recognition of plural values and diverse interests involved is important for building consensus among a wide variety of actors.

Second, value conflicts provide a motive force for change. Conflicts occur between different levels of systems and institutions across boundaries. These boundaries can be physical - natural and urban borders; institutional - administrative separation; hierarchical - power division across scales; or temporal - short-term and long-term. It is essential to recognise these boundaries and conflicting values across multiple scales and levels. Understanding the interrelationship between values, particularly the value conflict, is important for evaluating policies and defining development orientations. One of the key implications for the practices of planning and design is to identify “who” values “what”, including both vertical and horizontal relations. At the vertical level, the conflicts between national and local values are essential for creating a synergy across scales. At the horizontal level, consensus building between different institutions can create an interdisciplinary vision that promotes alternatives in decision-making. The understanding of value transitions and their interrelationships across scales can help planners and designers to take into account the qualitative aspect of costs and benefits in terms of flood safety, as well as economic, social and environmental dimensions while assessing the unquantifiable impact of spatial plans and development projects. In the meantime, a long-term vision is required because initial changes in ideology or revolutionary ideas usually take a long process to influence the whole society that then becomes shared values. For instance, the influence of Western values on Guangzhou concerning aesthetics and functionality was not immediate but far-reaching. This lengthy process is featured by constant interactions between traditional and emerging values within the process of negotiation, prioritisation, transformation and adaptation. This understanding is rather important when we discuss the adaptive capacity to deal with future uncertainties when conflict occurs between short-term political interest and its long-term environmental impact. It can help decision makers to develop alternatives and flexibility based on a comprehensive image of the possible consequences, risks and opportunities for future development.

Third, we need to identify the persistence and continuity of values within a society over time, as it represents the core of intrinsic cultures and common interests with a strong adaptive capacity to the changing contexts. In view of this, we need to identify the universal values of delta cities and the intrinsic values for individual society. Delta cities in general are characterised by vulnerable land exposed to flood risks, complex geographic conditions and sensitive ecosystems. But values concerning economic and social aspects vary from delta to delta and place to place due to differences in major risks, political systems, economic models, social structures and cultural roots.

In the current Chinese society, most of the responses to urban issues have been institutionalised and centrally controlled, such as large-scale infrastructures, environmental regulations and land use plans. Although Guangzhou shares many universal values as other mega-cities in the world influenced by global economy and institutional organisation, there are still some unique values that differentiate the city from others. Values in Guangzhou's society are shaped by both internal and external forces. On the one hand, the intrinsic value of Lingnan Culture with open, innovative and practical features lays the cultural foundation and defines social relations. Compared with the political centre (Beijing) and the financial centre (Shanghai) in China, Guangzhou was historically developed through commercialising agricultural products from the delta for foreign trade so that the development of the local economy and social structure is closely linked to the natural systems including climate, delta landscapes, and water systems. On the other hand, externalities act as a motive force to receive new values and integrate them with traditional and indigenous ones. Guangzhou has always been a pioneer city in China to explore innovations of cultures and policies. It is the original place of the "Silk Road on the Sea", the only treaty port in China for 85 years during the imperial era, and also the pilot city influenced by modernisation and Western planning ideas in the 1920s, and benefited from the open-door policy from the 1980s. As a result of these internal and external forces, a great diversity of water cultures coexist in Guangzhou and keep adapting to radical socio-economic transitions.

Contextualisation is particularly important when transferring foreign experiences, policies, practices and technology to local development concerning different prioritising mechanisms. In this regard, the understanding of site-specific conditions in different cases concerning both universal values and particular local values is crucial for generating the dynamics of the delta system. We need to acknowledge different contexts, risks and development needs in order to identify both generality and particularity of values in the development of spatial strategies. Above all, particularity defines the persistence of values within a society; this requires more local wisdom in planning and design through the development of unique cultures, economy and societal connections based on natural dynamics.

§ 7.5.2 Methodological development

The research develops an analytical framework based on morphological studies and value assessments with a focus on the perception of multiple water values in the long-term process of spatial development. The value concept adds a social layer to the analysis of the complex delta system, which explains the social and cultural root of values. By understanding the diversity of values in society, the research connects the link between physical and social complexity, with a touch on the science-policy interface. A better understanding of the spatial transformations of delta cities from the value perspective provides a retrospective and prospective view on the current spatial planning and design strategies and promotes possible integration with cross-cutting fields. Before drawing conclusions on methodological applications, it is important to note that, the analytical framework provides an approach to define and understand the complex relations between water values rather than measuring and comparing them.

Regarding the three fundamental components of the morphological analysis: form, scale, and time, it is essential to develop value-based thinking in a comprehensive framework addressing these three elements. Complementary to the cost-benefit analysis and multi-criteria analysis, this analytical framework uses spatial form as the main evidence to justify the processes of value transition. In this way the spatial relations of values are defined and their interactions are discussed. Concerning the complexity of delta cities, the interdisciplinary perspective contributes to the understanding of diverse values reflected in three key systems including water systems, flood defence systems and urban systems, as well as the mechanisms and dynamics of transitions of different spatial patterns. As indicated in the Dutch layer approach, these key systems (layers) have different dynamics of transformation, so that the impact of spatial interventions on certain values is slower than others. For example, the realisation of the environmental values of water takes longer time than the economic values, which explains the unwillingness of prioritising environmental values in the political agenda. The global development trend towards preparing for unknown future requires consideration of both long-term values (e.g. environmental sustainability and water resilience in response to climate change) and short-term values (e.g. economic productivity, political interest). Thus, it is important to address the time horizon and different dynamics of values so as to develop an adaptive capacity to cope with future uncertainties.

The empirical studies of Guangzhou suggest that the recognition of values have the dimension of scale. Social values are better recognised at the local level. The value of social interaction for instance can be identified through the utilisation of waterfront public spaces. Economical values can be reflected by the land use change such as from

agricultural land to industrial land as well as from natural land to new development areas with housing and financial centres. Environmental values are more associated with long-term geographic changes as well as diking and reclamation activities on the delta scale. Flood safety on the other hand, is connected to spatial patterns at all scales. Spatial changes on different scales can cause value conflicts. For example, the national-level policies and regional infrastructure development can create conflicts between national and local values when a centralised management system is adopted. This may explain why the canal system at the first stage promoted the synergy between safety, economy and society. But this kind of synergy disappeared when regional hydraulic infrastructures were developed for flood protection while some social and economic values were not underlined.

The historical and empirical study provides a scientific basis for the understanding of the water-city interrelationships over scale and time. The analyses not only show the horizontal development in a certain period, but also compare the vertical transitions of a certain area at different development stages. The development priorities and associated values change along with the changing power and responsibility of water management among actors. And the knowledge acquired from history not only indicates how the system worked in the past, but also shows what are the dynamic variables influencing different systems. Complementary to the spatial analysis, some other research methods are used to describe intangible water values, such as facts and figures about water-related economic profiles, environmental changes and social relations; interviews with experts on the institutional divergence over projects; as well as plan and policy reviews showing the differences between political ideologies and the actual values achieved.

§ 7.5.3 Future research

It is important to develop a systematic analytical framework that contributes to bridging the gap between theory and practice for a better understanding of the role of values in spatial development. Scientific data is required to investigate the past and present situations in order to provide transferable knowledge and applicable tools for future spatial development. This research mainly adopts qualitative analysis approaches based on the narratives of historical transformations. A comprehensive framework can be developed in combination with some quantitative analysis approaches, such as the cost-benefit assessment, environmental impact assessment, social impact assessment, and flood risk assessment, etc. In addition, more

comprehensive spatial elements in the morphological framework such as landscape patterns can provide more scientific evidence to support the argument.

Water values are closely related to the diverse interests and conflicts among actors, including multi-level institutions and social groups. The communication gap among these actors increases the complexity in the development of spatial strategies. This thesis focuses on showing the changing spatial patterns as a result of value divergences among actors and their unequal power in decision-making. Therefore, the analytical framework is expected to be developed as an applicable tool in the practice of policy-making, which can be tested with a broad range of actors. Furthermore, it is expected that a systematic understanding of Guangzhou's experiences regarding urban and water challenges and opportunities can provide knowledge and new perspective for spatial development of the city and the delta region, and can further shed light on resolving water related urban issues facing other delta cities in the world.

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Appendix 1 Urban Planning and Water Management Documents

NATIONAL AND DELTA SCALE PLANS	
International Development Scheme - Great Southern Port Plan (1920)	实业计划之南方大港 (1920)
National New Urbanisation Plan 2014-2020	国家新型城镇化规划 2014-2020
13 th "Five-Year Plan" of China 2016-2020	第十三个五年计划 2016-2020
National Technical Guideline for Sponge City Development (2014)	海绵城市建设技术指南 (2014)
Guideline for Promoting Sponge City Development (2015)	关于推进海绵城市建设的指导意见 (2015)
The Outline of the Plan for the Reform and Development of the Pearl River Delta 2008-2020	珠江三角洲地区改革发展规划纲要 2008-2020
The Pearl River Delta Urban-rural Integration Plan 2009-2020	珠江三角洲城乡规划一体化规划 2009-2020
The Greenway Network Master Plan of the Pearl River Delta 2010-2012	珠江三角洲绿道网总体规划纲要 2010-2012
The Pearl River Basin Flood Control Plan 2025	珠江流域防洪规划2025
CITY SCALE PLANS	
Action Plan of Guangzhou Public Works (1929)	广州工务实施计划 (1929)
Draft Summary of Guangzhou Urban Design (1932)	广州市城市设计概要草案 (1932)
Guangzhou Master Plan 2011-2020	广州市总体规划 2011-2020
Guangzhou Land Use Plan 2006-2020	广州市土地利用规划 2006-2020
Guangzhou 2020: Strategic Planning of Urban Development	广州2020：城市总体发展战略
South of Guangzhou New Central Axis Urban Design	广州新中轴线南岸城市设计
Canal System Planning in the City Centre of Guangzhou 2010-2020	广州市中心城区河涌水系规划 2010-2020
Guangzhou Sponge City Special Plan 2016-2030	广州市海绵城市专项规划 2016-2030
Guangzhou Waterfront Overall Plan 2010-2020	广州市水系岸线总体规划 2010-2020
Guangzhou Flood Protection and Waterlogging Drainage Plan 2010-2020	广州市防洪（潮）排涝规划 2010-2020
Overall Environmental Planning of Guangzhou 2014-2030	广州市城市环境总体规划 2014-2030
DISTRICT SCALE PLANS	
Guangzhou Haizhu Eco-city Regulatory Plan	广州市海珠生态城控制性详细规划
Haizhu Stormwater Management Project	海珠雨洪调蓄区工程
Lychee Bay Cultural and Leisure Zone Plan	荔枝湾文化休闲区改造规划
Guangzhou Nansha New District Master Plan 2012-2025	广州南沙新区城市总体规划 2012-2025

Appendix 2 Interview

INTERVIEWS WITH EXPERTS IN GUANGZHOU		
1	Dec 2013	Planner involved in the Greenway Planning of the Pearl River Delta
2	Nov 2014	Planner involved in the Lychee Bay project
3	Dec 2013	Hydraulic engineer, manager of the Haizhu Lake project
4	Nov 2014	Planner, Guangzhou Urban Planning Research Centre, Nansha District
5	Nov 2014	Senior Official, Guangzhou Water Affairs Bureau
6	Dec 2013	Professor of urban planning, South China University of Technology
7	Dec 2013	Senior planner, Guangzhou Urban Planning Bureau
8	Nov 2014	Urban designer involved in the sponge city project in Guangzhou

Interview topics and questions:

1. Flood risk

- Is there any flood risk assessment of Guangzhou and does it guide urban planning and design?
- Is flooding getting mitigated or increased in recent years (city centre and new areas)? Why?
- Is climate change adaptation considered in urban planning and flood risk management?

2. Water projects (Lychee Bay Canal and Lakes)

- Is the approach of creating more water storage in the city feasible and sustainable in terms of balancing investments, environmental sustainability, quality of life and interests of local people?
- Which departments are involved in such projects and how they coordinate regarding different values?

3. The PRD Regional Planning

- How regional planning would affect the development of Guangzhou?
- How to integrate regional resources and development with internal competitiveness?

4. "Sponge City" Programme

- What are the initiative projects that adopt the sponge city concept in Guangzhou?
- Which departments are involved and what are the main challenges?

5. Nansha New District

- What are the impacts of port and urban development on the natural environment of Nansha?
- Is sea level rise considered in the planning of coastal areas and what measures have been taken?

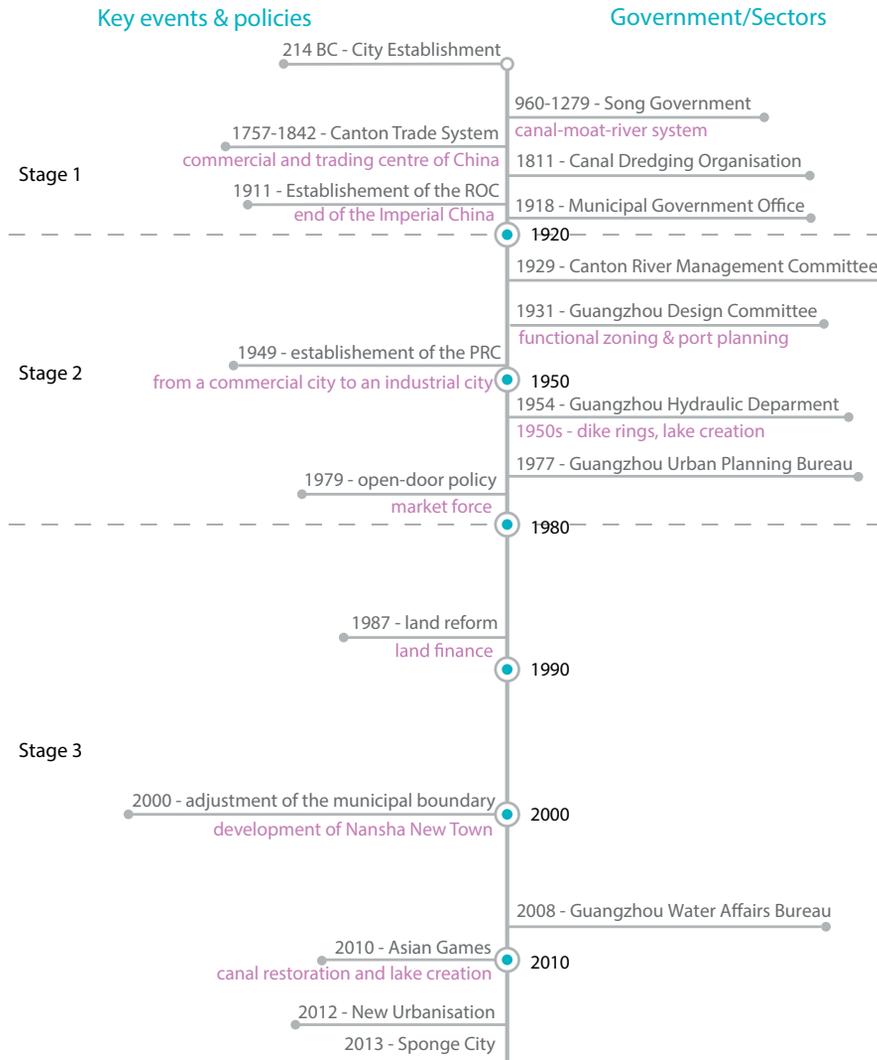
6. Public participation

- To what extent that public values can be reflected in planning through planning publicity?

7. Greenway planning

- Can greenway planning actually contribute to the improvement of the natural environment, recreation, and flood management?

Appendix 3 Timeline of Key Events, Policies and Sectors in Guangzhou



Biography

Yuting Tai was born in Nanjing, China in 1984. She obtained her master degree from Urban Planning and Design at South China University of Technology. During her master period, she developed research interest and insight from the observation of dynamic urban development of Guangzhou in the Pearl River Delta of China as well as through the participation in some planning and design practices. These experiences guided her to start PhD research at the Department of Urbanism, Faculty of Architecture and the Built Environment, TUDelft. The extensive knowledge of the Dutch delta management inspired her to work on this multi-disciplinary topic about water values in delta cities, and the research findings have been disseminated through academic conferences, reports and journal articles.

Besides research, she has actively involved in many academic activities. She has developed adaptive ability to work with people from diverse cultural and disciplinary backgrounds and deal with complex tasks by contributing to the organisation of international conferences (such as ISOCARP), workshops, seminars, research group meetings and volunteer work. During 2014-2015, she was the coordinator of the IDEA League doctoral school on Urban Systems and Sustainability. She also contributed to teaching the MOOC – “Rethink the City”, and giving lectures to master courses and summer schools.

