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VILLAGE IN THE RIVER

Transformation of Riverine Landscapes in Vernacular

Urban Settlements in Jakarta, Indonesia

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MICHAELA FRANCES PRESCOTT

B.Des (LA), MLA, Royal Melbourne Institute of Technology

Born on 24.09.1987

Citizen of Australia and of the United Kingdom

Accepted on the recommendation of

Professor Christophe Girot
Chair of Landcape Architecture
Department of Architecture (D-ARCH),
Swiss Federal Institute of Technology in Zurich

Dr. Rita Padawangi
Senior Research Fellow
Asia Research Institute
National University Singapore in Singapore

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Village in the River

Abstract

To date, the global river amelioration paradigm involves multifunctional infrastructure and urban design approaches that reinforce water sensitive behaviours. However, this approach is challenged by the densely settled urban riverine landscapes of megacities, such as Jakarta. Here, the conflicting triple bottom line pressures of social, environmental (or ecological) and financial performance often dominate decisions. It's important to question the relation between design for disasters, such as flood, and strategic design to benefit a city's future.

This thesis traces the transformation of urban riverine landscapes in Indonesia. It begins by establishing an understanding of the current paradigm through a comparative case study of contemporary sites in Java. This sets the premise for research on the Ciliwung River, which involves a historical study of transformation since the 4th Century (CE), and a detailed fieldwork investigation. Building from Nassauer's principles 'landscape as medium' and 'landscape as method', the research developed an approach to understand the socio-spatial processes within these landscapes, and connect residents' everyday experiences to other actors and processes involved in riverine landscape transformation. These are examined through the architectural devices of cross-sections and maps. This approach allows the research to integrate varied perspectives of landscape transformation, from both communities and government.

On one hand, the study revealed that while there are a variety of spatial relationships to the river that illustrated positive aspects of the river's services and community attitudes, some elements of the urban structure of these communities were contributing to negative environmental behaviour. On the other hand, ecological knowledge regarding the socio-environmental aspects of the urban riverine landscape contributed to the development of tactics that resulted in more resilient communities and landscapes.

As outcomes of the research, the thesis compiles a catalogue of cross-sections that summarise positive examples observed in the field research, and were then ranked based on a range of aspects. Together with the conclusions from the interviews, surveys and site documentation, the dissertation's findings are exemplified by two site-specific design interventions. In these respects, the methods form a basis for reaching mutual understanding between actors, while the outcomes inform more durable and situated design guidelines that can be considered broadly applicable to other Southeast Asian rivers.

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RÉSUMÉ

A ce jour, le paradigme d'amélioration globale des cours d'eau implique des infrastructures multifonctionnelles et des approches de conception urbaine qui renforcent la gestion durable de l'eau (Water Sensitive Urban Design). Cependant, cette approche est remise en cause dans le cas des paysages fluviaux urbains densément peuplés des mégapoles, comme Jakarta. Dans ce cas, les pressions conflictuelles des triples performances que sont l'approche sociale, environnementale (ou écologique) et financière dominent fréquemment les décisions. Il est important de remettre en question la relation entre la conception des catastrophes, comme les inondations, et la conception stratégique au profit de l'avenir d'une ville.

Cette thèse suit la transformation des paysages fluviaux urbains en Indonésie. Elle commence par établir une compréhension du paradigme actuel à travers une étude de cas comparative de sites contemporains sur l'île de Java. Cette étape marque les prémices de la recherche sur le fleuve Ciliwung, qui inclue une étude historique de sa transformation depuis le 4e siècle (ap. J-C), ainsi qu'une enquête de terrain détaillée. En s'appuyant sur les principes de Nassauer « paysage comme moyen » et « paysage comme méthode », la recherche développe une approche pour comprendre les processus socio-spatiaux au sein de ces paysages, et pour connecter l'expérience quotidienne des résidents à d'autres acteurs et processus impliqués dans la transformation fluviale urbaine. Ceux-ci sont examinés à travers un système architectural de coupes transversales et de cartes. Cette approche permet à la recherche d'intégrer des perspectives variées de transformation de paysages, venant à la fois des communautés et du gouvernement.

D'une part, l'étude révèle que, bien qu'il existe une variété de relations spatiales liées au fleuve qui mettent en évidence les aspects positifs des services écosystémiques du fleuve et de l'attitude des communautés, certains éléments de la structure urbaine de ces communautés contribuent à des comportements négatifs sur l'environnement. Cependant, les connaissances écologiques concernant les aspects socio-environnementaux du paysage fluvial urbain ont contribué au développement de stratégies créant des communautés et des paysages plus résistants.

En conclusion, la thèse présente une matrice de coupes transversales qui résume les exemples positifs observés durant la recherche de terrain. De plus, les conclusions des entretiens, des enquêtes et de la documentation des sites ont permis de créer des lignes directrices de plans urbains qui sont illustrées par deux conceptions, chacune associées à un site spécifique. Ainsi, d'une part, les méthodes forment une base pour parvenir à une compréhension mutuelle entre les parties prenantes ; d'autre part, les résultats permettent de façonner des lignes directrices pour un plan urbain spécifique et plus durable qui peuvent largement être appliquées à d'autres fleuves de l'Asie du Sud-Est.

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To my parents.

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1

Riverine Landscape Transformation: Introduction

I open by asserting the problem that the increasingly urban conditions of rivers within Southeast Asia's fast developing cities—specifically Jakarta—, and their governments' approaches to their improvement, sit outside of contemporary global frameworks for riverine improvement. I argue for the need to ground river amelioration in local contexts; and introduce the empirical focus of this thesis, namely a vernacular urban village (kampung) area along the Ciliwung River called 'Kampung Melayu' and 'Bukit Duri', which is situated to the south of the centre of Jakarta. Following an account of the key objectives of this thesis, which are explained in succeeding chapters, I describe the background and organisation of the study.

Figure 1.1.1: Left - View of the Island and the City of Batavia Belonging to the Dutch, for the India Company c. 1740. Source: Daumont Paris, c.1780, public domain/KITLV. Right - Jakarta from the air in 2014. Source: Gurusamy, 2014.

1.1 Background

The relation of urbanisation to water holds a significant position in Indonesia. Indeed, the history of the Southeast Asian region has been moulded by the accessibility afforded by the sea and waterways to a greater degree than other regions of comparable size [72]. Water, not land, is the defining element in the Southeast Asian region, whereby human—water, rather than human—land, relationships are determining [238]. In the first millennium CE, approximately 80% of Javanese settlements were located in close proximity to rivers, and Javanese water systems were managed by and constructed for autonomous villages and communities [118]. Indonesian folklore and ancient inscriptions indicate water system development, including irrigation practice, significantly predates the Hindu period. As well, Indonesian folklore and spiritual traditions have a special reverence for water bodies and rivers and the relationship of settlements to them.

A network of rivers and canals dating back to both colonial and pre-colonial times structures the capital city of Jakarta (Figure 1.1.1). Few of the marshlands and water bodies of the pre-colonial lowlands remain as urbanisation pressure increases, while rivers and canals continue to deteriorate from the encroachment of settlements, and the lack of inadequate infrastructure. These inevitably affect the severity and frequency in flooding, not to mention the increase in environmental degradation and pollution. The governmental elections of Jakarta in 2012 saw the fore fronting of river amelioration projects as key topics of debate, and Joko Widodo, or Jokowi as he is more informally known, was finally elected following his successful community relocation and river amelioration projects in Surakarta. After his election Jokowi visited riverbank settlements along the Ciliwung, and announced plans to widen culverts and continue with plans to dredge the 13 rivers that pass through Jakarta, as well as lakes and dams. Flooding pushed Jakarta into an emergency status from the 17th to the 27th of February 2013, and according to the Jakarta Provincial Disaster Mitigation Agency (BPBD), the flood left 14 people dead, inundated more than 340 neighbourhoods and forced more than 38,000 people to evacuate to higher ground. Assistance was offered by China, and Denmark. This came in addition to a pledge already made by South Korea to help the administration to restore the Ciliwung River—the largest of the 13 rivers running through the capital—as part of the city's mitigation program.

As foreign interest in the plight of the city increases, and technology and money offer solutions, the relation of city and water is changing and acquiring yet a new meaning. Water in the contemporary Indonesian context is often regarded merely from a technical and engineering aspect, with the reflective, symbolic and spatial qualities are frequently sidelined for what are perceived as more 'pressing concerns'. Although riverine amelioration in urban Indonesia has typically focused on normalisation, bank reinforcement, and relocation, it has much to learn from and studies of the socio-cultural and ecological relationships of urban environments and rivers.

This thesis is part of a collaborative research project of the Landscape Ecology module is guided by an integrated approach to the remediation of degraded rivers in Southeast Asia. Taking as an example the Ciliwung River in Jakarta, Indonesia, the team seeks to develop a range of scenarios that consider the river within three scales—catchment, corridor and neighbourhood. Such a multi-scaled perspective provides insights into the possibilities and consequences of future development scenarios.

1.2 Study Area

The research begins with the premise that the spatial design of local scale landscapes can serve to both instigate and support a culture of stewardship toward urban rivers in Indonesia. I examine whether the configuration of particular landscape conditions within historic and existing riverine communities has a correlation with environmental and socio-cultural behaviours. I also examine whether a culture of care, and also aspirations, for the river exist within these communities, which would support the development of such an approach.

In line with this, the research is guided by the following research questions:

1. How is riverine landscape transformation conceptualised in the context of urban settlements in mainland Indonesia?

2. What kind of tactics and behaviours of those producing the built environment—including local communities and governments—emerge within urban riverine neighbourhoods?

3. What is the relation between riverine landscapes, tactics and behaviours, and socio-spatial[1] change? What theoretical and practical (empirical) lessons can be drawn?

These research questions will be revisited to demonstrate their contextual relevance following the literature review (See Ch1, Section 1.3). Henceforth I will flag them within the thesis as RQ1, RQ2, and RQ3.

I explore this hypothesis by reflecting on case studies in Java, Indonesia, with a particular focus on two subdistricts in central Jakarta that lie along the Ciliwung River. I conclude that the amelioration paradigm of rivers in Indonesia must

[1]The term socio-spatial refers to the relationship between people and places. People are constantly modifying and reshaping places, and places are constantly coping with change and influencing their inhabitants (Knox 2005:3)

expand to be responsive to local human communities by using spatial, design oriented approaches. It will therefore be necessary to draw on and interact with knowledge, paradigms and methods from social sciences and landscape architecture (see [176]). This is established through investigation and design at the local landscape scale using: (a) an historical analysis of the growth of Jakarta; and a series of local scale landscape studies (b) Java—to establish the regional case, and (c) Jakarta as the test-site).

As defined by Jackson, landscape refers to both literal settings: real places, and also a conceptual field that examines how humans affect geographic space (1984).

River amelioration is the subject of this thesis because it epitomises the inherent contradictions and potentials of landscapes made by people. Amelioration is to a degree the key term in the phrase. Meaning to make better or more tolerable, amelioration does not have the inferences that other more specific terms from within the field of river improvement have, such as rehabilitation and remediation (See Findlay et al 2008 for a detailed description of these). As such, it does not specify what form the improvements may take, nor who enacts them, which I will later argue are perceived disparately.

I substitute amelioration for transformation when discussing specific changes that are made to riverine landscapes. I consider transformations to be the temporal expression of design action, and following Joan Iverson Nassauer [162] I consider design to mean 'intentional landscape change'. This includes 'change affected by design professions like engineering, landscape architecture and planning; change affected by real estate development or natural resource management; and most importantly, change that stems from the local custom, pragmatic adaptation to circumstances, and unpredictable mobility" [102] of people living their lives' [160].

Vernacular urban settlements are used here to describe those settlements — often described as 'informal' — that are resilient even where politics and planning fail, and sit outside of the purview of state planning or administrative systems (See Prescott [194], and Figure 1.2.1). Following Peter Marris, I argue that the conception of informal is in itself problematic: 'a slum is a slum only in

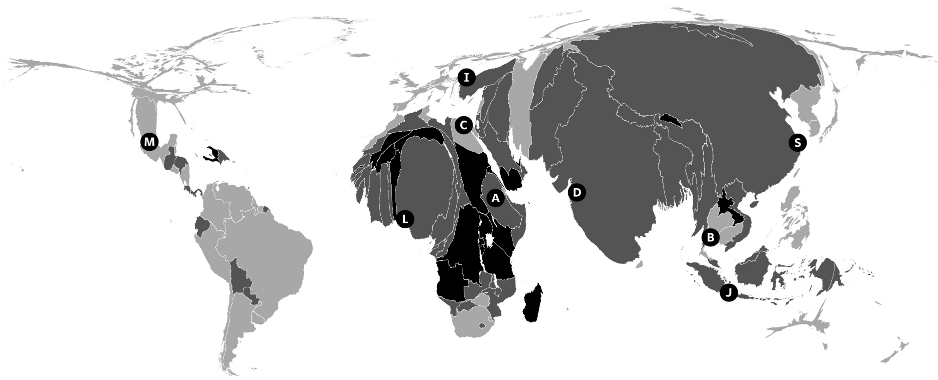


Figure 1.2.1: Map depicting country sizes as determined by urban slum population size. Slum populations are based on datasets from the UN Department of Economic and Social Affairs Statistics Division (UN 2013) and supplemented with data from UN-Habitat (2010). A default 1% of total urban population was used for developed countries, which do not report estimates. Urban population data are from the UN's World Urbanisation Prospects (2012). Map generated by Derek Vollmer, for the Informal Urbanism Gazette [194].

the eyes of someone for whom it is an anomaly – a disruption of the urban norm and relationships that to the observer seem appropriate to his or her own values and perceptions' [137].

1.3 Literature Review

The following section will summarise the exploration of theory and approaches to river amelioration, which I extrapolate to riverine landscape transformation, within the context of vernacular urban settlements. Additionally, it will establish the relevance of the investigation of tactics and behaviours within the thesis. I discuss the concept of the 'appropriateness' or 'relevance' of projects to sites, and how knowledge of the culture and practices of a community group can inform this.

First a general introduction to the theoretical background summarises the main themes. This is followed by a discussion of the scales of research and intervention (ecosystem services and landscape services). Thirdly, I introduce the practical challenges of river amelioration within the regional context of Southeast Asia. Within this I briefly touch on a number of river amelioration projects, which contributed to riverine landscape transformation and discuss how they link back to the main themes (project relevance). Finally, I discuss the challenges for developing an approach, which can contribute to the development of relevant amelioration projects within Indonesia.

1.3.1 Theoretical Underpinnings – Transformation of Riverine Landscapes

The research initially drew on a literature review that examined how riverine landscape transformation has been defined and conceptualised. This review set out to develop an approach to riverine landscape transformation in urban environments by contextualising this concept in urban and landscape discourse, particularly regarding urban informality, and later suggesting key aspects that connect riverine landscapes to socio-spatial processes.

a) The problem of riverine landscape transformation in urban regions

Traditionally environmental problems facing rivers and their urban regions have been understood as biophysical, 'hard' systems, and addressed technically through engineering works in isolation from their social context [101]. While such solutions facilitated improved navigability, land reclamation and flood protection, ultimately these led to larger alterations in environmental processes requiring further 'corrections' and works, along with decreased habitat and reduced capacity for floods and riverbank inhabitants [195]. Over the last two decades, as a result of these environmental consequences, a major paradigm shift has occurred globally. Catchments and water systems are now acknowledged as socially constructed entities [101], and a shift has taken place wherein humans are acknowledged as components of ecosystems [183]. This has led to emphasis in the literature on 'effective governance based on principles of equity, efficiency and diverse knowledge integration', which are now seen as similarly important to technological solutions [86]. Additionally, understanding and managing landscape change to achieve and protect ecosystem services has been recognised as requiring not only science but ecological design, which aims to synthetically achieve ecological, social and economic goals [163, 183].

River amelioration research has called for an ecosystem service approach. Such an approach understands the benefits to human societies that natural ecosystems provide [183], and encourages society to understand and request these benefits [265, 281]. Although efforts in river amelioration in developing nations still favour engineering solutions as a means to an end, a paradigm shift in institutional management that accounts for local perspectives is initialising. Wagner observed that local communities often have high-level views on the direction of restoration activities based on knowledge and life experiences [267], with perceptions that are 'based on a range of personal, historical, social, cultural and economic factors, as well as on characteristics of the proposed change' [96]. As such, Pahl-Wostl et al conclude that understanding belief systems, human attitudes and collective behaviours may be perceived as an integral part of project durability and instigating a process of cultural adaptation [182].

b) Shifting down scales, from ecosystem services to landscape services

Fisher defines an ecosystem service as the aspects of ecosystems used (actively or passively) to produce human well being [71]. Current emphasis within this field utilises environmental and economic sciences in mapping and economic valuation of services and typically considers the regional scale. Researchers such as Hermann and Antrop acknowledge landscape as a socio-ecological system (Figure 1.5.1 - Left), in which humans benefit from changes made to the physical landscape [11, 92]. Following on from this, Wagner et al, Termorshuizen and Opdam recommend that a further shift down scales is necessary on the understanding that the local scale where people make concrete decisions about landscape change is increasingly relevant [175, 251, 267].

From the standpoint of human experience, Termorshuizen and Opdam [251]

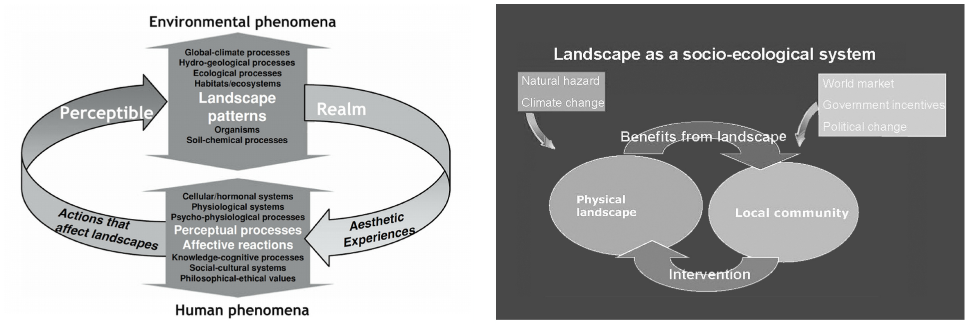


Figure 1.3.1: Left - Landscape patterns are the basis for what people directly perceive about environmental phenomena of all scales, and human experience of landscapes prompts human actions to change landscapes. Redrawn from [267]. Right - Redrawn from [175].

recommend the adoption of the term 'landscape services'. They propose that landscape services should be determined in a community process of selecting ecological functions that the community values. As such, the emphasis shifts to landscape as result of human-nature interaction and its spatially explicit pattern. Wagner et al [267] also concluded that the 'perceptible realm'—the scale of environmental phenomena where landscape patterns are perceived (experienced) by humans—is decisive for landscape change (Figure 1.5.1 - Right). This landscape scale links the everyday experiences of residents with other environmental phenomena that are not directly perceived. The perceptible realm is where humans enact intentional landscape change, described by Nassauer[159] as a 'design' action.

1.3.2 Riverine landscape transformation within vernacular urban settlements in Asia

a) Challenges for the design and implementation of urban water- and river front transformation projects within the region

Not all countries within the region have adopted the adaptive, multifunctional infrastructure and urban design approaches reinforcing water sensitive behaviours, which are emphasised within the new paradigm. Vernacular settlement patterns within urban riverine landscapes play a role in this, challenging the potential of river transformations. Furthermore, the density of these cities—which greatly surpasses that of their European counterparts—presents its own challenges. Meanwhile decisions are often dominated by conflicting triple bottom line pressures (economic, social and environmental) [70]. While the matter is multifaceted it appears that projects in Asia conducted for 'emergency' action—or under short time frames—, and often those funded by foreign sources, have lesser emphasis on holistic transformation and are focused instead on immediacy and engineering. As examples of this claim I provide the Siem Reap River in Cambodia (See Figure 1.3.2), and the Ciliwung River in Indonesia, the latter of which is the focus of this thesis.

On one hand, in the light of some situations where an immediate or emergency response is required, it is perceivable that a strategy more heavily weighted toward one aspect might be expedient. On the other hand, if the water landscape is seen as being integral to social and cultural development, then a multi-disciplinary approach in which culture and landscape are highlighted within a spatial investigation has merit. Additionally, when improvements are discussed and planned it is important to note that the seemingly most expedient solution may have the *most negative* and *most long-lasting* impacts on the spatial structure, ecology, and socio-cultural development of the city.

b) Lessons from riverine landscape transformations in the region

While numerous exemplary projects of urban waterfront regeneration and river amelioration exist within the European and American contexts, the densely settled and quickly developing cities of Asia are yet to catch up.

However, as cities within the region experience increasing pressure from urbanisation and its related processes, spaces and neighbourhoods that have not been capitalised upon which might offer solutions to urban problems come into

Figure 1.3.2: The Siem Reap River in Siem Reap, Cambodia, which was historically significant for the Angkorian complex, has been subject to transformation using foreign funding. The vernacular settlements along the river's edge (Left) have been cleared to an area outside the city centre, and the main road has been established as a clear demarcation of the river edge. The riverbanks have been re-graded (Right). Source: Author's fieldwork (2012).

the public eye. Such cases include Bangkok [131, 282], Manila [178], and Ho Chi Minh [225] and Jakarta. Communities within these neighbourhoods often have rich cultural heritages spanning several generations[2]. Some examples in practice, which can elicit some lessons, are the Yongning River Park (China), Bishan Park (Singapore), Cheongyecheon Stream (South Korea), Bang-Bua Canal (Thailand) and Pasig River (Phillipines) (See Figure 1.3.3). These projects' attributes are classified into physical and social aspects, and serve to illustrate the present paradigm of river improvement within Asia and Southeast Asia.

Physical aspects

Projects such as the Yongning River Park (completed in 2004), and Bishan Park (completed in 2012) provide state-of-the-art examples of ecologically driven remediation approaches to urban rivers—which had previously been canalised and/or culverted—within the Asian context.

The Yongning River Park in Taizhou, China, (Turenscape, constructed

[2] As such, I deliberately make the decision to use 'vernacular' rather than 'informal' to describe the urban settlements of such sites—including that selected for this research project (see Ch1, Section 1.2).

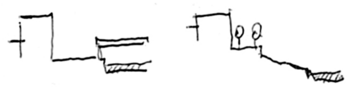
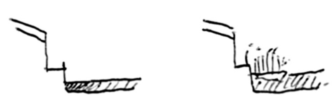
Case	Completed (Year)	Diagram of waterfront treatment Before (left) & After (right)	Description of changes
Yong Ying River Park Taizhou, China	2004		Re-naturalised river edge and facilitated public access to the waterfront.
Bishan Park (Kallang River) Seoul, Singapore	2012		Re-naturalised river with capacity for storm water buffering (flood control). Facilitated public access throughout the park.
Cheonggyecheon Stream, Seoul, South Korea	2005		Re-daylighting of culverted river. Continuous public access and recreation spaces are facilitated along a stepped waterfront.
Bang-Bua Canal Bangkok, Thailand			Inwards densification results in cleared waterfront facilitating continuous access along the canal. Water transport is reinstated and used for garbage collection.
Pasig River Manila, Philippines	2009		Degraded river edges are cleared of garbage and revegetated, and walkways bring residents to the waterfront.
			Floating vegetated rafts serve to filter the water and create the impression of a green river-edge.

Figure 1.3.3: Relationship of waterfront and the water body before and after improvements.

Figure 1.3.4: Yongying River Park in Taizhou, China, (Left) before the removal of a concrete embankment (Right) regrading process required to restore riparian edges. Source: Water Urbanisms East [57].

2002-2004) entailed the removal of a concrete embankment and riparian edges to be restored (Figure 1.3.4). The works introduce public access, which serves to 'animate and soften the edge of the land-water interface', and riparian edges to recreate natural habitats[286]. The regrading process required for the construction of these edges is illustrated in the in-progress photograph.

Bishan Park in Singapore (Atelier Dreiseitl, constructed 2009-2012) re-naturalised a 2.7 kilometre stretch of the Kallang River, which was previously contained within a drainage channel (Figure 1.3.5). The natural drainage system had been converted to a concrete drainage channel during the 1970s as part of a national scheme to alleviate flooding. The re-naturalisation used a more holistic set of solutions to the challenges of inclement weather and urbanisation which Singapore faces. The park becomes a floodplain during heavy rains, which has increased the carrying capacity by approximately 40%. The case illustrates collaboration by the national water agency, Public Utilities Board (PUB), and the National Parks Board. The project is one of many conducted under the PUB Active, Beautiful and Clean Waters (ABC Waters) program (est. 2006). Other institutes involved in water issues in Singapore include the Institute of Water Policy (IWP) at the Lee Kuan Yew School of Public Policy (est. 2008).

The Cheonggyecheon Stream in Seoul, South Korea (constructed 2000-2005) in comparison faced higher spatial limitations than the two previous cases. While

Figure 1.3.5: Bishan Park, Singapore (Left) Before the removal of the concrete drainage channel (Right) After the channel was naturalised. Source: Ramboll Studio Dreiseitl.

historically the Cheonggyecheon was a culturally significant river, development of the city saw the river culverted and concealed beneath a 12-lane highway (Figure 1.3.6). Under a government funded, multi-partner project (including Cheonggyecheon Restoration Centre, Seoul Development Institute, Cheonggyecheon Restoration Citizens Committee, and Seoul Metropolitan Government) a 5.8-kilometre segment of the waterway was redirected and day-lighted to create a new streambed with landscaped banks. The stream restoration has three distinct zones: the first is focused on a series of historical bridges; the second provides a recreation area with artwork, maps and a long walkway with seating; and the third combines natural ecologies such as well as ecological conservation areas with industrial relics such as the former highway supports [204]. The river improvement provides flood protection for up to a 200-year flood event.

While the Cheonggyecheon Stream, Bishan Park and Yongying River Park projects required significant reallocation of land and monetary backing, necessitate support from ministries and institutes; examples from Thailand and the Philippines while more modest in appearance demonstrate the possibilities for incremental changes within densely settled urban areas.

In the case of the Bang Bua Canal in Bangkok, Thailand, where settlements extend to the edge of waterways, setbacks have served to reorient the urban fabric toward the water and create access along the canal. This demonstrates that

Figure 1.3.6: Re-daylighting the Cheongyecheong Stream in Seoul, South Korea (Left) The highway over the culverted Cheongyecheong, before the re-daylighting; (Right) After the re-daylighting. Source: [233]

incremental physical alterations to adjacent urban areas can be a mechanism for improving waterways. Through a process of negotiation and inward densification, residential land was transformed into public open spaces facing the river and community facilities (See Figure 1.3.7).

In the case of the Pasig River and its tributaries in Manila, Philippines, encroachment and pollution (including garbage disposal) have contributed to the poor condition that is observed today.

Kapit Bisig Para Sa Ilog Pasig (KBPIP)—literally meaning 'linking arms for the river'—is a river rehabilitation project launched by the ABS-CBN Foundation in February 2009 (See Figure 1.3.8). Taking a tributary-by-tributary approach, the project targets particular spatial adjacencies, which contribute to a tributary's deterioration. Strategies have included: relocation, renovation, dredging, traps for solid waste, material recovery for recycling, and regular clean up. Local materials such as coconut fibres are used to stabilize banks and filter water. The project aims to rehabilitate Pasig River and its tributaries to a state wherein it can sustain aquatic life, accommodate secondary contact sports and may be used for industrial processes.

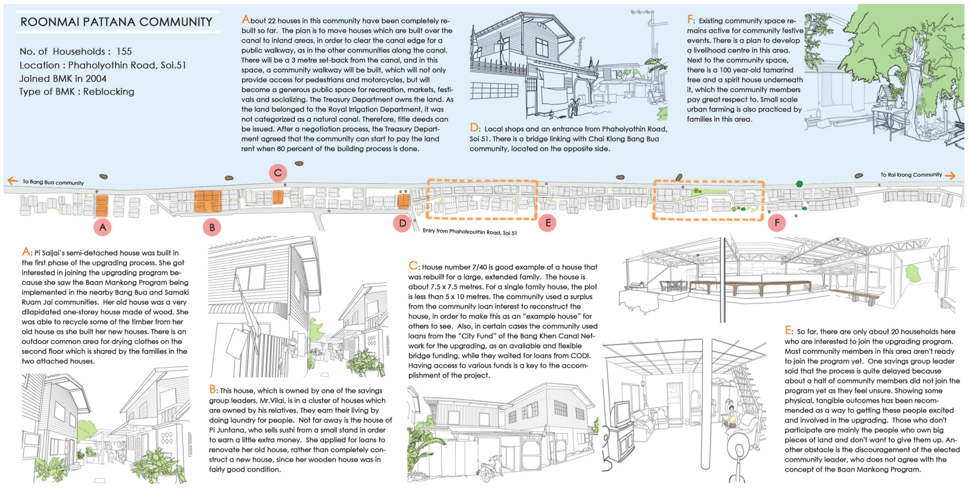


Figure 1.3.7: Baan Mankong project which was implemented in Bangkok, Thailand along waterways such as the Bang Bua canal involved the negotiation amongst stakeholders of land along the waterway. Newly designed spaces served to increase accessibility and amenity, and alter the perception of the waterway. Source: Interactive Bang Bua Canal Guidebook, ACHR 2011.

Figure 1.3.8: Estero de Paco in Manila, Phillipines before and after (2012) rehabilitation works by the Pasig River Rehabilitation Commission (PRRC). Source: ABS-CPN Foundation, Faizza Tanggol.

Socio-cultural aspects

Three different perspectives on community/constituents are expressed within the cases described: (1) communities as end-users or beneficiaries of improvement projects; (2) communities as drivers for improvement; and (3) communities as participants in improvement.

1) Communities as beneficiaries

Within the Yongying River Park, Bishan Park, and the Cheonggyecheon Stream projects communities were considered primarily as end-users or beneficiaries. As such, these projects involved limited community consultation and focused on providing opportunities for communities post implementation.

In the case of Yongying River Park in Taizhou, the designers proposed the reintegration of the river with daily life, seeking opportunities for cultural heritage protection and recreation. This involved provisioning space for human activities within the park, and specifically at the river edge within floating gardens. Provided for within the park are: bicycle paths, fishing areas, sports fields, resting areas, viewing areas, a skate park, and an event field.

In the case of Bishan Park, Singapore, the designers engaged for the project observed that simply being able to access the water, and experience its 'natural rhythms and beauty', can profoundly affect a community's perception and sense of stewardship of its surrounding environment [22]. Key within the project's objectives were establishing connections between the two neighbourhoods living on either side of the river, and providing amenities—such as playgrounds, fitness areas, open green spaces, and restaurants.

In the case of Cheonggyecheon Stream, Seoul, the stream was envisaged as a park in the centre of the city with recreation areas, waterfront decks and stepping-stones; designed using environmentally friendly materials, with artwork and maps on walls along the river corridor. The Cheonggyecheon Restoration Citizens' Committee helped to gauge public opinion, communicating the projects goals through information sessions and conveying concerns.

2) Communities as drivers

In the case of the Tsumida River Restoration in Japan, small NGOs and communities have been important drivers in river improvement in Japan since the 1960s. Since these groups have limited financial and technical resources they have engaged with scientists and local authorities to stimulate projects. Japan has a long history of river restoration that dates back to the beginning of the 20th century. However, it was only prioritised after the 1970s following an intense economic boom, paralleled by severe water pollution. Rapid economic growth slowed from the 1970's and rivers—as remaining open space for amenities and recreation—came into the spotlight again. Shin-sui, 'playing with water', parks and playgrounds were established along waterways and contributed to bringing nature conservation and restoration back into the public eye [156]. The number of restoration projects undertaken in Japan as part of the 'Nature-oriented River Works' initiative has been on the increase since the 1990's.

3) Communities as participants

In the case of the Bang-Bua Canal in Bangkok, a participatory approach was taken incorporating a public hearing, savings group, surveying and planning, design with architect and focus group-discussion, and implementation — including construction and management.

In the case of the Pasig River in Manila the coming together of different sectors has been integral to facilitating river rehabilitation. Youth, corporations, armed forces, non-profit organisations, people's organizations and local government units and agencies are engaged in the project to revive the historically important Pasig River. Private organisations and institutions provide funding, meanwhile local government units and government agencies provide manpower, logistics, and enforcement of environmental regulations. Finally, within KBPIP's River Warrior component organisations and individuals provide manpower and support in river clean-up campaigns, and act as environmental stewards.

As a result, I conclude that the current paradigm is focused on the creation of adaptive, multifunctional water- and riverfronts, and urban design approaches reinforcing water sensitive behaviours. The examples raised illustrate recurring trends of opening up the waterfront to the public—including increased access and recreational spaces, and the development of community facilities—, integration of ecological interfaces—including vegetation and filtration systems. Often within more densely settled urban areas the role of community and non-governmental organisations became integral to facilitating spatial and socio-cultural changes. Tahir et al[248], suggest that '... external assistance becomes developmental if it is based on shared decision by community, not when external agency decides value, action, or how people should behave, then provides staff, equipment, programs'. This indicates significantly that within the Asian context the neighbourhood, or community, can be important when facilitating improvement projects. From reflection across these projects it also appears that spatial changes that facilitated access to the waterfront have served to positively influence community perceptions of, and stewardship toward, their surrounding environment.

1.3.3 Integrating social and spatial research into urban river transformation

a) General overview of both spatial and qualitative studies—where and why is there a need for further research?

In the last two decades growing concern over the reductionism of planning, and urban fragmentation, has called for the integration of the physical landscape with human dimensions through designs that connect communities and environments [12, 125]. However, a review of the literature reveals that research on the processes affecting urban riverine landscapes rarely integrates biophysical changes to landscapes and social conditions, despite research in a range of fields calling for the integration of social factors.

Writing on the topics of ecological function and cultural perception—now two-decades ago—, Nassauer[158] raises the challenge of perceiving ecological quality, which tends to look 'messy' and is therefore problematic for those who imagine and construct new landscapes to improve ecological quality. Nassauer claims applied landscape ecology is essentially a design problem, and cites as key challenges: differences in the scientific and cultural concepts of ecology, and the cultural concept of nature; and the difference between function and appearance. The difference in the conception of landscapes by different actors (e.g. wetlands versus swamps), leads to challenges in communication and design.

Palmer et al[183] call for research frameworks that explicitly incorporate humans in ecosystems, arguing that socio-ecological research needs to address the tension between human needs and ecosystem needs. Meanwhile Nassauer [159] argues that landscape change instigated by professionals should become vernacular, meaning, informed by the actions of local stakeholders and thus more resilient to future transformations. Ecology, she argues, (growing from knowledge that integrates science and practice—design) is necessary to produce landscapes that synthesise apparently distinct societal and environmental functions and anticipate the future (ie. are resilient). Pahl-Wostl et al [181] recommend, among others, that the recognition of mutual dependencies and interactions, and the identification of barriers for change and possible solutions to overcome them can be important tools in the design and maintenance of multifunctional riverine landscapes. Meanwhile, Deming et al[60] conclude from their review of existing literature that that public welfare is promoted by landscape architecture by enhancing human communities through awareness and stewardship of natural environments [60].

Therefore, it is important to understand to what degree current research methods integrate spatial and social aspects—which would affect the integration of diverse perspectives—and where the challenges in this lie. The following parts discuss the literature on spatial and social studies within landscape architecture, architecture, and planning research. The search has been limited to research on riverine and urban landscape types.

Despite the presence of articles in the literature on urban improvement in Indonesia since the 1980s, research has only recently turned to discussing more specifically approaches to the physical transformation of rivers and their interface with surrounding settlements. The increasing prevalence of research conducted on topics surrounding these issues over the past decade illustrates the relevance of the enquiry. Findings from previous studies that address riverfront improvement within urban areas in Indonesia have focused various socio-cultural and spatial aspects. For this review the research has been largely limited to English language literature. However, searches were also completed using Indonesian keywords, which revealed that discussion on the topic was also increasing within the Indonesian language literature. A number of pertinent documents did exist and were thus translated.

b) Spatial studies

Pertaining to spatial features of riverfront transformation studies have considered: 1) ecosystem services [219, 263]; 2) behaviour within-, attitudes toward-, and spatial implications of riverside settlements; 3) neighbourhood-based improvement [23, 245, 285]; 4) neighbourhood resilience to flooding [62, 93, 138, 278]; and 5) urban-upgrading, renewal and renovation, versus relocation [120, 230, 244, 245].

Systematic and deductive assessments of landscape change have become common over recent decades and typically focus on land cover and/or land use characteristics [267]. Based on the scale of the assessment and the time-span under study these assessments generally engage well-established models of landscape change [19], for example, through satellite coverage for use in landscape metrics application (example: Lausch [123], and aerial and ground-based imagery to establish prior conditions. Geographic Information Systems (GIS) are commonly used to measure land cover and land use characteristics in comparative studies. The technology and its measures enable the measurement of spatio-temporal landscape changes, and the visualisation of changes using maps. Van Eetvelde and Antrop[260] found aerial photos and census data on their own were insufficient to understand landscape change, and recommended combining these with data from interviews and oral histories for a greater level of insight. Reviewed research acknowledged that information produced using this method of assessment might not be consistent with the perceptions and experiences of residents. Furthermore, palmer et al [183] observes that 'the way that landscape planners, designers and managers classify the landscape and its elements may not adequately represent the way residents think about it'. For example, Wagner et al [267] found that local resident's expectations and baselines for comparison of landscape change differed, and that stakeholders may not necessarily perceive spatial changes identified by the GIS assessment.

Human-scale studies of densely settled landscapes and urban areas typically involve two- and three-dimensional spatial methods of spatial analyses [24, 253]. Prominski et al[195] constructed a set of design tools and a catalogue of design strategies from a review of built designs for urban river spaces. Nillesen [166] described method to test the spatial impact of different flood-risk interventions at different locations to discern where interventions are most required from a spatial perspective. Both toolkits were targeted at supporting interdisciplinary approaches between landscape architects, ecologists, architects, urban planners, and engineers that has been called for in the literature [148].

Research on waterfronts in the larger geographic context has been increasing over the past decade. Studies have addressed transformation and development in Malaysian cities such as Kuala Lumpur [26, 121, 224], Penang [6], Kuching [98], and nearby Singapore [4, 98]. Using a spatial framework Latip et al [121] derive conceptual cross-sections of the waterfront to illustrate the shifts in configuration along the Klang and Gombak rivers in Kuala Lumpur, Malaysia, They discuss the relationship between river condition, attitudes, design, and waterfront development. Pertinent to the study of vernacular landscapes, Yong [284] used a combination of participant observation, informal dialogues and diagrams to investigate the relationship between behaviour and the configuration of exterior spaces to study a traditional village in Huizhou, China. Beattie[24] similarly combined ethnographic research with spatial studies including plans and drawings in a study of courtyard houses in Calcutta, India. While all three examples give insights on how spatial frameworks may contribute to this research; however, the latter two studies begin to touch on potential integrations of spatial research tools from architecture and landscape architecture being integrated with those of the social sciences.

c) Socio-cultural studies

Research on landscape change therefore supports the need to take on approaches integrating social studies with biophysical studies. Social studies offer insights into the human—nature relationship by bringing to light everyday interactions, and their integration within landscape studies is not new [25, 274]. Meanwhile, using qualitative methods of social analysis can reduce the oversimplification of resident values during public involvement [33]. Through the registration of people's observations of a landscape, its meaning to them, and changes that they make to it, scientists, designers and policy-makers may reach synthetic conclusions that are helpful in enacting change [159, 251].

Gobster et al[80], similarly studying a river corridor, examined stakeholder perceptions using focus groups and interviews. Their study revealed that the awareness of residents was spatially bound, and often limited to their own neighbourhood and their observations were primarily regarding visual-indicators such as the 'clarity of the water'. Stewart[236] and later Atwell[14]used ethnographic techniques and interviews, coupled with photo elicitation, to understand the meanings connected to landscape features as a strategy to integrate community-based values into planning processes.

The integration of spatial analysis within social studies is largely limited to the photographing and mapping of information. Geostatistical techniques such as indicator kriging, which maps the probability that a given threshold value was exceeded at a particular location, may be used to analyse geo-tagged quantitative and qualitative information producing probability maps (example: [265]Vollmer et al, in press). However, if presented as the final representation these risk oversimplifying other three-dimensional aspects of intentional landscape change revealed within the data.

Other researchers observe that disparate perceptions of a landscape, its functions, and changes, may exist amongst groups with diverse languages and cultures—such as design and science, science and society, policymakers and local stakeholders [267]; [161]; [132]. Additionally, Luz[132] and Heimlich and Anderson[88] highlight that the communication of environmental knowledge between such groups is not always effective. Similarly, Deming observes that there may be differences between what researchers and clients identify as social and cultural benefits, which we would extend to include the perceptions of communities and governments[59].

Meanwhile, studies regarding the socio-cultural aspects of riverfront improvement in Indonesia have broached topics such as: 1) integration of local knowledge for the development of locally-sensitive approaches [228];[220]; [285]; 2) participation and social capital [100]; [198]; [242]; [106]; 3) community stewardship [275]; and 4) collective activity within improvement programs [245].

Within literature examined on Indonesia, the relationship between the physical aspect of river transformation, or 'improvement' as it is commonly known, and the socio-cultural aspect are scarcely addressed in relation to each other. The most useful example was an Indonesian language paper by Setiawan[222] on the environmental perception, physical environment, and behaviour of children living in a riverside urban village in Yogyakarta. Setiawan uses a sequence of annotated cross-section drawings to illustrate the correlation between different types of children's play and their riverside context. Most publications focused either on single cases (eg. refs), and/or considered broader issues of river improvement (eg. refs). Thus, there appears to be a lack of understanding of these matters within the context of other river transformation cases.

1.3.4 Limitations and Potentials

Following this review of literature and projects on the topics of riverine landscape transformation, scales of intervention, and research methods, I identify the following challenges:

1. *Synthesising disparate perceptions of landscapes*
   Firstly, challenges synthesising the diverse perspectives and experiences of a landscape are not resolved within the current approaches. This is further complicated by:

   (a) Lack of integration between research that results from spatial- and socio-cultural research;

   (b) Differing perceptions of transformations from various actors;

   (c) Intangibility of socio-spatial knowledge of communities;

2. *Contextualising riverine landscape transformation at the local landscape scale*

   (a) Such a downshift requires the coupling of appropriate spatial representation and social feedback from the community;

   (b) Need to recognise mutual dependencies and interactions, barriers for change and possible solutions to overcome them;

   (c) Need to link the experiential dimension of landscape with other environmental phenomena;

Thus, identifying the synthesis of socio-spatial information and perspectives as a key challenge, I propose the concept of 'landscape as medium', initiated by Nassauer [159], to: a) synthesise diverse perceptions landscapes; and b) contextualise transformations at the local landscape scale. This is discussed within the context of landscape in Chapter 2, and the approach and methods that I develop are described therein. The approach and methods seek to extend from Wagner et al's [267] study and to demonstrate a practical application of Nassauer's concept.

Learning from this review, I recommend a combined spatial and socio-cultural approach to waterfront and river improvement that engages local communities. I develop a comparative study that focuses on the spatial and sociocultural implications of riverine landscape transformations along riverfronts at the local landscape scale. Building from the literature review, the research project takes the following questions:

1. How is riverine landscape improvement conceptualised in the context of urban settlements in mainland Indonesia?
2. What kind of tactics and behaviours of those producing the built environment—including local communities and governments—emerge within urban riverine neighbourhoods?
3. What is the relation between riverine landscapes, tactics and behaviours, and socio-spatial[3] change? What theoretical and practical (empirical) lessons can be drawn?

Considering the acknowledged discrepancy between individuals' perceptions of landscapes, it appears an approach that incorporates the local landscape scale is necessary. While the limited availability of spatial representation of the local landscape, in particular that of complex, densely settled sites, has often been cited as a hindrance to the progression of design for such sites [265]; spatial acquisition technologies (such as image- and range-based modelling), which are increasingly democratised, are applied to visualise and digitally reconstruct site-scale landscapes for the purpose of analysis, discussion and design [167, 201].

An understanding of **tactics and behaviours** of actors within riverine landscapes (including residents and local governments) is viewed as being integral to the development of relevant amelioration approaches. Relevant or appropriate approaches are here defined as those which are informed by the knowledge and life experiences of communities and are durable. Durability of projects is viewed to be influenced by 1) positive community perception of proposed change [267]; and 2) appropriateness of project to site, in a

[3]The term socio-spatial refers to the relationship between people and places. People are constantly modifying and reshaping places, and places are constantly coping with change and influencing their inhabitants (Knox 2005:3)

socio-spatial sense, which facilitates both resilience to changing conditions (such as flood), and cultural adaptation and stewardship [60, 182]. I foreground the landscape scale which serves to link the landscape experience of humans (perceptible realm)—including changes—with other environmental phenomena (See Figure 1.5.1 - Right).

The first two research questions, concerning the **conceptualisation of riverine landscape transformation in urban settlements** and **the tactics and behaviours of those living within and affecting riverine settlements**, have been addressed in four ways: first, through an extensive literature review in the fields of landscape architecture, urban planning, sociology, geography and environmental disciplines. This informed the overall research design, including the planning and implementation of the fieldwork. Second, through a one-week ethnographic field study of riverine settlements within Java, Indonesia. Third, through a historical study of the transformation of Jakarta. And finally, through a series of one- to two-week long ethnographic field studies of an urban riverine neighbourhood in Jakarta which were conducted over a three-year period. Primary and secondary information from the second, third, and fourth components was analysed using a landscape as medium approach.

1.4 Research Design

As is shown by the initial literature review and the questions guiding this research, it is necessary to develop a research methodology capable of addressing: firstly, the spatial aspects of urban riverine transformation; and secondly, the socio-cultural and environmental aspects which influence the manner in which transformations play out at the local scale. Resultantly a simultaneously inductive and deductive approach is deployed, aiming to construct knowledge based on the analysis of data collected through both qualitative and quantitative fieldwork, and literature review (see Chapter 2).

This research engages a more exploratory or episodic quality. In this case I do not rely upon a sole overarching conceptual framework across the entire project.

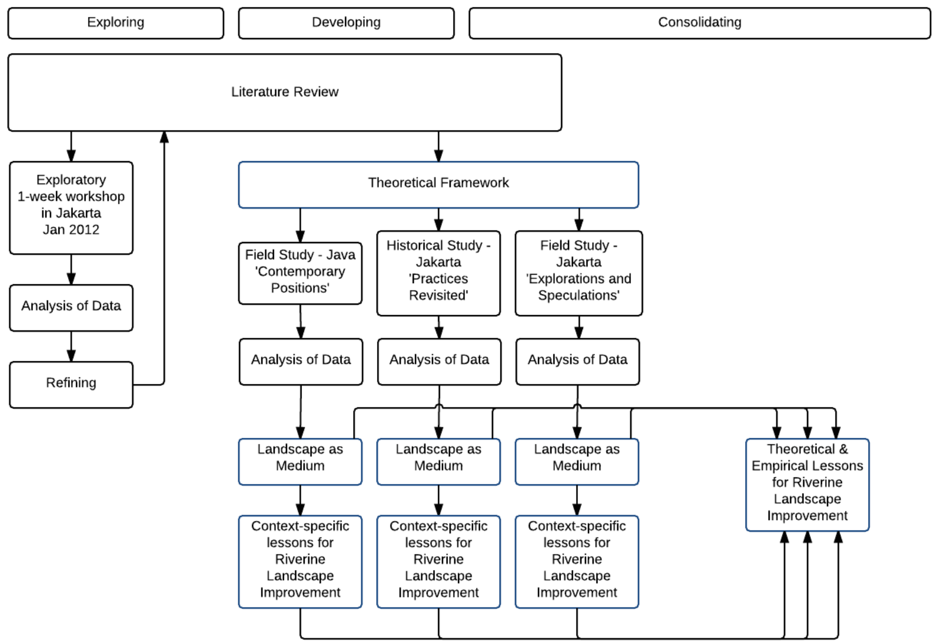


Figure 1.4.1: Diagram illustrating the research design, processes and outcomes.

This said, the project builds upon a range of conceptual frameworks from more subjective systems of enquiry including design, and review of precedents to objective social science research frameworks[4]. The research therefore is designed through a mixed methods approach using a primary case study, which is contextualised against a series of minor case studies, to explore the socio-spatial dynamics of riverine landscape transformation at the local landscape scale (Figure 1.4.1).

[4]As discussed by Michael Joroff and Stanley Morse, "A proposed framework for the emerging field of architectural research," in J. Snyder (ed.), Architectural Research (New York: Van Nostrand Reinhold, 1984), 15-28.

1.4.1 Strategy

a) Initial Literature Review

Riverine landscape transformation has been explored within the discourse of many disciplines, including landscape architecture, urban planning and sociology. Despite this, the relationship between the spatial and sociocultural aspects of riverine landscape transformations has been largely overlooked. Hence, the literature review attempted to explore both the past and current theoretical and methodological approaches toward riverine landscape change. This literature review in turn, informed the methodological approach to the fieldwork.

b) Exploratory workshop – Ciliwung transect

The Landscape Ecology team workshop facilitated my first contact with the Ciliwung River. Throughout the course of one-week the team took a transect approach to understanding the river, travelling from the river mouth in Old Batavia to the upstream reaches passing through a village called Ciawi. Through this time, I focused upon grasping a general impression of the river, which would later be more specifically targeted. A transect was taken from sea to slope, and also walked within the downstream neighbourhoods close to the geographic centre of Jakarta. This exploratory workshop enabled me to test such methods, and as well provided necessary 'ins' or points of contact with the neighbourhoods and other grass-roots organisations and ministries focused on this context.

c) Refining the theoretical framework – towards a 'landscape as medium' approach

As a result of the first exploratory workshop and further literature review, the 'landscape medium' theory was initiated as a theoretical and methodological tool to analyse the data collected (see Chapter 2). I proposed the use of the 'landscape as medium' to illustrate and analyse the diverse perspectives on riverine landscape transformation according to the actors, objects, processes and spaces identified through the fieldwork. The aim of this approach is to record narratives describing the transformation of the riverine landscape.

Step 1 – Consolidation of methods, tracing riverine landscape transformation through actors, processes and spaces

The methodology for the following months of fieldwork was shaped by 1) the initial literature review; 2) the intuitions gained from the exploratory workshop; and 3) the introduction of landscape as medium as an approach to the study of riverine landscape transformation. As the literature review identified (See Chapter 1.3), our understanding of local environments, the actions leading to particular conditions, and the potentials for improvement can be enhanced through integrating various research approaches. Based upon this, the methodology pointed toward a mixed-methods, case study approach. Within architectural research it has been recognised that research that combines strategies forms an important and necessary frontline within the discipline. Mixed-methodology research strategies have the potential to maximise strengths and to minimise the weaknesses of each sampled research design [83].

Step 2 – Applying the landscape as medium approach in the context of mainland Indonesia

The methods employed at this stage are described in detail in Chapter 2, and were based mainly on interviews stemming from convivial interactions, observation and mapping. I made use of methods of a participatory nature, which allowed residents to reflect on their experiences of the site over a period of time.

Contemporary Positions - Comparative case study of riverine landscape transformation in Java, Indonesia

The first study took a comparative approach in the development of a perspective on the characteristics of riverine landscape transformation in urban areas of Java, Indonesia (See Chapter 3). The selected cases demonstrated transformations undertaken for the sake of improvement by residents and other actors. In contrast to the densely settled mega-city of Jakarta, where development pressures leave little space for change, these urban areas have greater flexibility for a range of spatial and socio-cultural outcomes. This study seeks to understand the approaches and interventions of the actors and investigate the potentials that arise from each location's site conditions.

Therefore, a set of cross-sectional and pictorial diagrams emerge from this study (See Chapter 2), documenting the spatial aspects of riverine landscape transformation and become the beginnings of a typological analysis of riverine landscape transformations which is further developed in Chapters 5 and 6.

Historical overview of riverine landscape transformation in Jakarta, Indonesia

The second study takes an interpretive-historical approach to the study of the Ciliwung River in Jakarta, Indonesia (See Chapter 4). Firstly, it initiates the primary case study (Chapter 5), locating it within the context of the region's development. Secondly, it aims to explore the evolving attitudes and behaviours relative to the riverine landscape in Jakarta, and the belief systems that shape this, as was called for by Pahl-Wostl et al [182] within the literature review (See Chapter 1.3).

A set of maps documenting the city's development along the Ciliwung River, along with photographs of river—human relationships provides insights to the transformations of the riverine landscape.

Riverine landscape transformation at the local landscape scale in Jakarta, Indonesia

The third study is based on informal urban settlements along the Ciliwung River in the districts of Kampung Melayu and Bukit Duri. While Chapter 4 provided the historical context of the development, revealing the long history of the settlements within these riverside districts; Chapter 5 develops an ethnographic approach (see Chapter 2 for a detailed description of this), using the landscape as medium for understanding the tactics and behaviours relating to riverine landscape transformation within the present day. The spatial aspects of these transformations add to the typological analysis of riverine landscape transformations initiated in Chapter 3.

d) Additional Information on partnerships and sources

Internal and external collaboration

Research in the field has indicated the benefits of working within a multidisciplinary project structure (See also Chapter 1.3, Literature Review). As such, this research seeks to determine an integrated feedback loop that crosses the hydrological cycle, working through a number of methodologies and scales. The integration of this research within the framework of the Singapore ETH Centre (SEC) Module VII: Landscape Ecology seeks to establish this sounding board and relational loop from the outset. The benefits of this team structure have been obvious from early stages, as the team have worked to define the broader project goals. This interface was built on and expanded during this research, empowering holistic understanding of both the local and regional context, problematic and opportunities, as well as presenting further opportunities for reciprocity, collaboration and dissemination.

In the pursuit of regionally specific material affiliations were sought with a number of institutes including: National University of Singapore (NUS); Lee Kuan Yew School of Public Policy (LKYSPP) and Asia Research Institute (ARI); Institute of Southeast Asian Studies (ISEAS); École Française D'Extrême-Orient (EFEO) Jakarta; along with the University of Indonesia (UI) and Bogor Agricultural University (IPB). Through these sources a number of personal relationships were fostered for the purposes of knowledge sharing and also to aid in the development of region-appropriate research methodologies. Additionally, Design Research Studios (conducted by the Chair of Landscape Architecture at the ETH Zurich with the Department of Landscape Architecture at the National University of Singapore (NUS)) accrued field data, producing site maps and 2- and 3D cartography, which was important in the research.

Collaborations with local non-governmental organisations such as Ciliwung Merdeka and Komunitas Peduli Ciliwung were sought to provide invaluable local

Country	Library/Archive	Access
Indonesia	- École Française D'Extrême-Orient, Jakarta	- Physical
Singapore	- The National Library	- Physical
	- Central Library, National University of Singapore	- Physical
	- The Institute of Southeast Asian Studies	- Physical
The Netherlands	- KITLV	- Online
	- Atlas of Mutual Heritage	- Online
	- Tropen Museum	- Online

Figure 1.4.2: Libraries and archives used by the author.

context to the work. In particular, the involvement of Ciliwung Merdeka offered valuable insights as a result of their prolonged involvement in Bukit Duri and Kampung Melayu and facilitated involvement with the communities with whom I worked.

Libraries and archival sources

Research for this thesis involved work in a number of libraries and archives both physically, and through the use of online databases (Figure 1.4.2). While all chapters drew on library and archival work to some degree, majority of the research for Chapter 4 entailed this. All textual sources were in English, excepting a number of policy documents and archaeological books, which were only published in Indonesian. Some English translations of Indonesian, Dutch and Portuguese texts were also referred to.

Ethical considerations

Researchers working in social environments have a responsibility to ensure the privacy of those involved. As Jennifer Mason acknowledges, 'the rich and detailed character of much qualitative research can mean intimate engagement with the public and private lives of individuals' [140]. Martin Beattie emphasises:

'Whether research is done on people or whether it is done with them there is the possibility that their lives could be affected in some way through the fact of them having

participated… There is a duty on researchers, therefore, to work in such a way that minimises the prospect of their research having an adverse effect on those who are involved'. [24]

Denscombe describes the political, commercial and personal consequences that research may have on participants and states that in good practice researchers should avoid publishing reports that identify individuals by name or role. Equally, he acknowledges that this contrary to the need of researchers to publish details of their methods of data collection for purposes of others within the research community verifying their work [61]. While participants may be anonymised to a degree (through the use of pseudonyms), 'the better the identities of those involved are disguised the more difficult it becomes to check the validity of the data' [61]. Additionally, I would add that the use of geospatial information, maps, and photographs within architectural and landscape analysis makes ensuring the complete anonymity of those involved challenging.

As such, following the example of [24], during all interviews and visits in Bukit Duri and Kampung Melayu my assistants and I would outline the following information to participants:

- Who I was and where I was from;
- The purpose of the study;
- The basis for which the participant had been selected to take part (e.g. resident within a particular neighbourhood, living directly along the river);
- What the participation entailed (e.g. being interviewed, surveyed, photographed);
- The time and effort needed by those whose collaboration was being sought;
- The purpose for which the data would be used.

Research confidentiality might be considered an important issue amongst three groups of participants approached in the fieldwork: the households, the community leaders, and the district leaders. Ethical considerations pertaining to confidentiality are particularly important within this case study as neighbourhoods are implicated within relocation projects which were under consideration by the government at the time this research was conceived. As such, efforts were made to preserve participant confidentiality when dealing with spatial and personal information.

As mentioned earlier, ensuring anonymity amongst all participants was impossible. In the case of the households their houses and home-gardens were photographed and geo-located in-situ. For the community- and district-leaders, through identifying them as such and keeping them distinct for purpose of comparison complete anonymity is difficult. As such while I have marked the households which are referred to in the text alphabetically, I have retained other identifying characteristics, as complete removal would have meant the loss of significant data.

Another limitation to participant confidentiality was local networks and neighbourhood structure. These were generally very strong within the neighbourhoods under study. I often found that households either required, or were reassured by, us having communicated with or sought approval from community leaders before they took part. I attribute this largely to the sensitivity of these sites given the changing political parties over the course of our research, along with the tenuous nature of land tenure in the face of government plans for river improvement. Additionally, the closely-knit nature of these communities—in the face of dense living conditions, long occupancy, and recurrent flooding—meant that little occurred that was not commented on by the residents. While my research assistants and I always sought to introduce ourselves to community leaders before beginning research in a neighbourhood, it was not uncommon to be approached by them or directed to them first. We often found that they might have already heard of the research from other community leaders and residents nearby.

1.5 Thesis Structure

This chapter has introduced the reader to the subject of this thesis, particularly in its focus on understanding the challenge of river improvement within Southeast Asia, and subsequently its focus on exploring how tactics and behaviours emerge within these circumstances. To this purpose, the chapter offered an overview of literature addressing riverine landscapes as the subject, informal urban settlements as the proposed scenario (or site), and transformation as a subject that relates riverine landscapes and tactics and behaviour to socio-spatial change.

The preliminary findings suggest firstly, the need to change the Indonesian paradigm of water management—through offering context sensitive approaches for urban river corridors. Second, the need to address the link between 'changing the environment' and 'changing behaviour' within spatial scenarios. Nonetheless, the literature review also revealed the need to approach riverine landscapes with a methodological approach that addresses the complexity of their socio-spatial processes, while also facilitating a relation between the local landscape scale and urban improvements within river basins, connecting the resident's everyday experience to other actors and processes[5].

Chapter 2 introduces the reader to the landscape as medium theory as the proposed methodological approach to a) present the riverine landscape within a common platform (for communication between residents and actors), b) to approach the complexity and trans-scalar nature of processes in informal urban settlements, and c) to explore the emerging tactics and behaviours of transformations in a critical way. Firstly, a literature review introduces how landscape as medium has been applied within landscape architectural studies. Secondly, I introduce the methodological approach of this research building from the conceptual framework proposed in the first part. First, it outlines the proposed (social science & landscape architectural) methods to capture everyday experiences of riverine landscapes within the informal urban settlement, and

[5]This concept of interconnection between residents, actors and processes is brought forward in relationship to scarcity in the built environment by Nunez-Ferrera [171].

second it outlines how diagrams (including cross-sections and typological studies) can be used to represent the data and analyse linkages. The outcome of this chapter is a methodological template which will be applied to the case studies in subsequent chapters.

The following **Chapters 3, 4, and 5** largely concern 'researching' the socio-cultural and ecological narratives of the rivers in mainland Indonesia. Following the framework devised by Shannon and de Meulder within their Water Urbanisms series [226], the chapters discuss contemporary (3 - Contemporary Positions), historic (4 - Practices Revisited), and projective (5 - Explorations and Speculations) aspects of the topic at hand. Chapter 3 mainly analyses historic texts and documents, while chapters 5 and 6 investigate specific places and communities. Chapter 3 reviews a selection of river improvement projects at the local scale in mainland Java to understand how spatial reconfigurations have affected human—water, or community—river, relationships. Essentially, chapter 4 gives a broad 'urban history' of the Ciliwung River; meanwhile chapter 5 seeks to uncover the local dialogues on the river, communities, open space and vegetation within the two subdistricts of Bukit Duri and Kampung Melayu.

In **Chapter 3**, Contemporary Positions, in contrast to the trajectory of decline and the improvement paradigm demonstrated in chapter four, I make a comparative study of three other rivers in Indonesia generated from active field survey, which demonstrate different approaches to rivers within varied urban and sub-urban environments. I consider the degree to which responses appear to be reflective of local contexts, and to which they limit or change community—river interactions. And I attempt to understand how a spatial and socio-cultural approach might be useful in contextualising riverine improvements to the local landscape scale.

In **Chapter 4**, Practices Revisited, I investigate precolonial, colonial and postcolonial practices and attitudes to the water, with the Ciliwung River in Jakarta providing a central focus. A historical analysis of the cultural, ecological, and hydrological traces is conducted using the historical transformation of Jakarta and its rivers as a framework. In this context I ask 1) to what degree have the historical transformations of the region re-shaped the human—water relationship? And, 2) what are key signifiers of the relationship of the city to its rivers?

In **Chapter 5**, Explorations and Speculations, I focus on a past and present-day sense of place, found within riverine neighbourhoods along the Ciliwung River, and more specifically in the subdistricts of Bukit Duri and Kampung Melayu. Investigating case studies located in two transects taken across the river corridor I highlight the human and daily scales of interaction between the river and its peoples. I show how the fluctuation (from normal to extreme) of the river affects the spatial organisation of the riverine landscape and environmental behaviour of its communities. I explore three questions: 1) what knowledge surrounding the local landscape and its cultural values is embodied within the site? 2) How has this changed over the time in which the landscape was settled? 3) What is the baseline for landscape and urban improvement, based on the existing condition?

Finally, **Chapter 6** will revisit the initial findings and discuss the key lessons relevant to the riverine landscape for local communities, practitioners and policy makers. The chapter will also contemplate the relevance of a landscape as medium approach for the study of riverine landscapes, drawing the limitations of this approach and suggestions for further research. The chapter will finish with a note on the relevance of this study for understanding similar issues within the region.

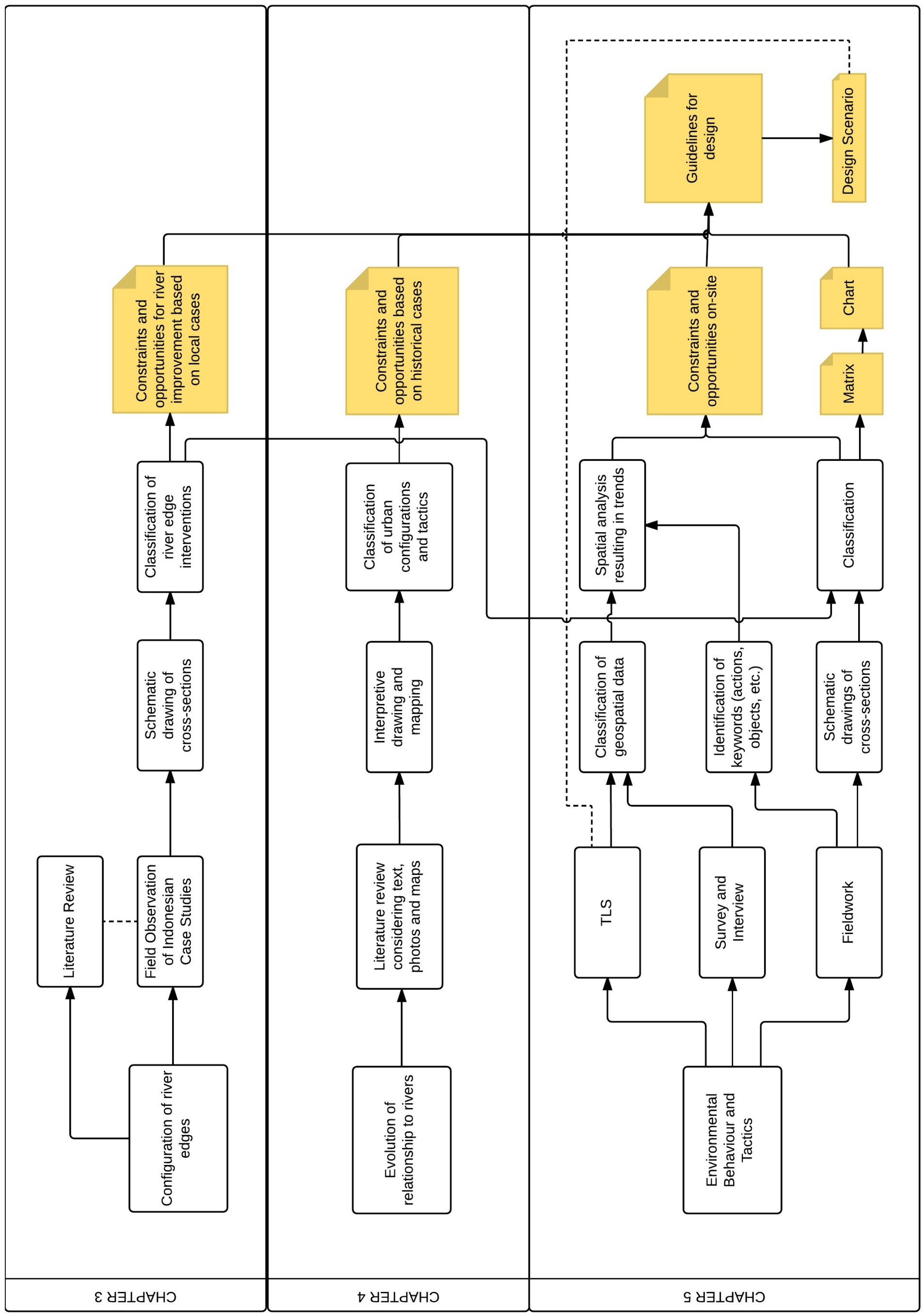


Figure 1.5.1: Overview of thesis

Landscapes are visible evidence of the integral natural and cultural processes that produce and change dynamic environments.

Joan Iverson Nassauer, 2012

2
Landscape as Medium and Method

This chapter aims to introduce the landscape as medium and method theory as the overall approach to understanding riverine landscape transformation. Following which, it draws a conceptual analytical framework that informs the methodological approach to this work.

The literature review within the preceding chapter focused on the conceptual exploration of riverine landscapes and their transformation by humans. From this analysis, the landscape emerged as a medium for the synthesis of diverse perspectives and knowledge. Based on the literature review, in order to understand the conceptualisation of riverine landscape transformation in the context of vernacular urban settlements in mainland Indonesia (RQ 1), the need arises to identify different aspects of transformations and understand their relation to spatial production (RQ2).

In the context of this research, it is the premise that the analysis of the constitution of riverine landscapes in the specific context of vernacular urban settlements, can lead to:

1. a better understanding of how riverine landscapes are created through specific spatial patterns, social practices and strategies; and

2. that the understanding of their transformation and potentials can offer a better view of what forces come into play in order to either, reinforce a condition or facilitate change to happen.

Vernacular urban settlements are often located in high-risk areas such as low-lying lands and riverbanks, which are particularly susceptible to extreme weather conditions [212]. In the midst of this, integrated, versatile and often resilient strategies are a common feature (and in some cases part of the vernacular spatial language) and shape the way that the built environment is produced. Therefore, based on the preceding chapter, I can ascertain that these processes exist. However, there is little discussion in the literature on how these processes shape the riverine landscape and the individual and collective social practices that arise under these conditions. Furthermore, from this marrying of social and spatial concepts, the ultimate aim is to understand how the relation between riverine landscape transformation and vernacular urban settlements can offer a better understanding of socio-spatial change.

In order to demonstrate how a landscape as medium and method approach may offer us the conceptual and methodological tools to understand the transformation and potentials of riverine landscapes, the chapter is divided into two parts. The first part focuses on **understanding landscape as an ecological and socio-cultural narrative.** Firstly, the chapter will address the connections between the landscape as medium and method approach and the exploration of cultural, or vernacular, landscape in geography, landscape architectural and urban studies. It is largely this literary discourse that brought about Nassauer's approach. Following this, I will introduce the landscape as medium and method theory as based on the writings of Nassauer [159, 160]. I will conclude the first part by discussing the limitations and potentials of the approach in relation to the research questions and subject matter. In this I will discuss various examples of other research, which could be conceived as operating within a landscape as medium and method approach, and where this project treads differently.

The second part will address the methodological approach to understanding the constitution of riverine landscapes within vernacular urban settlements — **landscape as a medium and a method for synthesis.** It will do so based on the theoretical premises outlined in Part 1 (Ch2, Section 1 and Section 2), and also the preceding chapter (Ch1). The second part comprises two sections; elaborating from the Research Design, which was described earlier (See Ch1 Section 1.4). The first section will address the research methods. Meanwhile, the second section will discuss the analytical methods, which lead to the development of an understanding of RQ1 and RQ2, followed by construction of guidelines and recommendations for affecting riverine landscape transformation (RQ3).

2.1 Understanding Landscape as an Ecological and Socio-cultural Narrative

2.1.1 Landscape in geography, landscape architectural and urban studies

a) The cultural landscape

The anthropology of landscapes concerns the interaction between people and places, and the production and reproduction of social life in and through landscape to create particular ways of thinking and being [191]. Landscapes have been described as palimpsests, revealing traces of their earlier form as a result of their inherent temporality [210]. Within an anthropomorphic viewpoint landscape is understood as a constructed entity—intervened in by humans. This 'cultural landscape', as it is termed by geographers, can provide the foundations for a diverse array of social and ecological knowledge. And as Pierce Lewis observed, 'all human landscape has cultural meaning, no matter how ordinary that landscape may be' [124]. Specific places, such as but not limited to public, civil or religious sites, form a critical component of a social knowledge that links the past to the present.

Following the 1950's the term 'cultural landscape' gained momentum across disciplines, highlighting the increase in the significance of the built environment [84]. The literature on understanding the cultural landscape and discerning landscape meaning has emerged from a number of areas, including traditional geomorphology and plant ecology [270], geography [102, 214], landscape architecture (such as [232, 258]). Geographer Carl Sauer classically defined the cultural landscape as being '... fashioned from the natural landscape by a cultural group. Culture is the agent, the natural area is the medium, and cultural landscape is the result' [214].

b) Vernacular landscapes and landscape transformation

Four decades ago, John Brinckerhoff Jackson identified vernacular landscapes as the product of 'local custom, pragmatic adaptation to circumstances and unpredictable mobility' [102]. He declared that humans make all landscapes, not only those that are recognisable as designed. This concept is well accepted in the landscape architecture discourse [158, 162, 232], and was described earlier within the literature review (See also Chapter 1, Sections 1.2 and 1.3).

c) Discerning multiple landscape meanings

Understanding the cultural landscape and discerning landscape meaning is essential to intervening within a landscape. In the eyes of cultural geographers—from over a century of studies—the meaning of ordinary landscapes is held in setting, dwelling and use; in addition to the designer's intention [258]. Following on from Motloch, I distinguish two types of meaning drawn by individuals from landscapes: first, perceptual meanings from the perceived physiognomies of landscapes; and second, associational meanings relative to the individuals' experiences [152]. These two classifications sit closely adjacent to Gobster et al's [81] explanation of the relationship between perception, experience and intervention, which I described earlier (Chapter 1.3, Figure 1.5.1).

Perceptual Meanings

In the first case, landscape is seen a signifier which reveals past and present conditions [124]. Landscape has been described by geographers Pierce K. Lewis as a 'clue to culture' [124], and by Denis Cosgrove as a 'cultural product' [53]. While landscapes can be seen to represent 'point-in-time expressions of ecological, technical and cultural influences' [152]; at the same time they grow and change, and have a chronology [102]. On the one hand, landscapes have been observed to be 'readable', both historically [144] and more recently [97]. Lewis was quite prescriptive in this, ascribing seven rules for reading the landscape, suggesting questions to ask, and how findings might be assessed [124].

Indeed, the narrative quality of landscape has been well developed within landscape architectural discourse over the past two-decades [50, 53, 192, 232]. Landscape Architect Ann Whiston Spirn [232] describes the dialogues that occur between builders and place as, 'storylines that connect a place and its dwellers'. Humans, however she notes, are not the sole authors of the landscape, their co-authors include other living things and phenomena (floods, volcanoes, rain, plants and animals). The constant re-writing of landscapes and the complexity of their narratives means that they are 'more difficult to read than books', and—as Lewis observes—the way to read a landscape is not always clear [124].

'Sometimes a landscape seems to be less a setting for the life of its inhabitants than a curtain behind which their struggles, achievements and accidents take place. For those who, with the inhabitants, are behind the curtains, landmarks are no longer geographic but also biographical and personal' Denis Cosgrove, 1984[53].

Associational Meanings

This leads into the second case, in which I refer to the subjectivity of an individual's perception of a particular landscape based on his or her own direct and indirect experiences of that landscape. Indeed, Nassauer [158] observes that even the perception of the most primary elements of a landscape—such as vegetation and water—is contingent on cultural interpretation. Again, this may be brought back to discussions of the difference in perception of various actors in a landscape, from residents to planners, to designers, which was raised earlier. As Winchester observes, an interpretive approach recognises that landscapes are understood in different ways by people, and that there are many layers of meaning within one landscape [279].

Historically, Lynch[133], and cultural geographers Meinig[144] and Jackson[102] have highlighted the perceptions of ordinary people as important. For example, in his seminal The Image Of The City (1960), Lynch highlighted as important both the city as an entity, *and* the perceptions of ordinary people of their own city's places and spaces. He argued that a city's clarity, or legibility,—the ease with which its parts may be recognised and organised into a coherent pattern—is dependent upon this. Similarly, Jackson viewed the actions of individuals within a particular physical territory, and how they use objects within that territory, as critical for understanding that space [114]. Finally, Meinig famously listed ten—though he acknowledged there were more—different ways of seeing a landscape: nature, habitat, artefact, system, problem, wealth, ideology, history, place, and aesthetic [144]. He posited that:

'Even though we gather together and look in the same direction at the same instant we will not—we cannot—see the same landscape. We may certainly agree that we all see the same elements—houses, roads, trees, hills—in terms of such denotations as number, form, dimension and colour, but such facts take on meaning only through association; they must be fitted together according to some coherent body of ideas' D.W. Meinig, 1979[144].

Based on this partiality which is well recognised in the literature, I agree with Murphy [153] and Nassauer [158] that it is necessary that I understand culturally different ways of comprehending the environment, in order to appropriately intervene.

2.1.2 An Introduction to Landscape as Medium and Method

'Landscape' defines both real places, and also a conceptual field that examines how humans affect geographic space [102]. Following Jackson, this thesis grounds itself from both the analytical/perceptual and experiential/associational aspects of landscape. Additionally, I follow Nassauer, in claiming that it is the 'pairing of the experiential and analytical in landscape which enables it to be a catalyst for synthesis in science and for insight in urban ecological design' [159]. Nassauer proposes landscape as a method and medium for the ecological design of cities. She first raised the concept in a 2012 paper published in Landscape and Urban Planning. The concept was further extrapolated in 2013 in Resilience, Ecology and Urban Design: Linking Theory and Practice for Sustainable Cities published by Springer.

Nassauer[160] gives two laws of landscape function, and two related landscape principles, to illustrate how landscape may be used to synthesise science and ecological design (Figure 2.1.1). The two laws make the obvious statement that 1) landscapes integrate environmental processes; and 2) that landscapes are visible. The two subsequent principles explain how landscape characteristics can be used to effect sustainability, which I equate to durability within the context of this work (see Ch1) (Figure 2.1.2).

1. 'The Landscape Medium principle demonstrates that the process of designing a shared landscape can synthesise disparate perceptions of a landscape and its functions'.

2. 'The Landscape Method principle pragmatically employs the imaginative artifice of design to produce potential innovations that anticipate the future'.

Law 1 - Integration of Environmental Processes	Law 2 - Common Experience of Visible Characteristics
Different environmental processes operate in and through the same landscape, and each landscape inherently integrates these processes	*Landscapes are visible in everyday experience and can be made visible in spatial representations. This makes it possible for different people to have the same experience of visible characteristics of a given landscape*

Figure 2.1.1: Laws of landscape function as described by Nassauer [160], drawn by the Author.

I follow Nassauer's explanatory structure to provide a brief illustration of the pertinence of the Laws and Principles, following which I discuss limitations and potentials of the use of the landscape as medium and method approach.

2.1.3 Landscapes and Integration of Environmental Processes (Landscape Law 1)

Local and global environmental challenges in the twenty-first century may be addressed through field investigation, which was demonstrated to prove scientific insight by nineteenth century naturalists and geographers. A focus on landscape provides an approach to integrating methods and deductions from diverse specialised sciences. The law contributes to finding beneficial synergies and avoiding unintended effects of landscape change. A consequence of this law is that: landscapes function at nested scales. This is well-acknowledged in the literature on landscape ecology (e.g. Allen [8], and [9]) recommendation of always thinking up- and down- one scale to the subject of primary interest remains a good strategy for testing the relationship between environmental processes and landscapes at different scales.

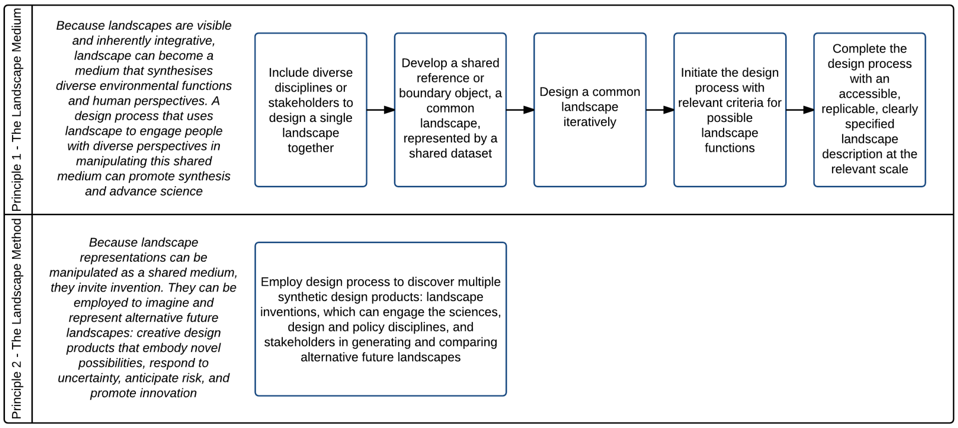


Figure 2.1.2: Landscape Principles as described by Nassauer [160], drawn by the Author.

2.1.4 Visible Landscapes and Common Experiences (Landscape Law 2)

'Landscapes are visible evidence of the integral natural and cultural processes that produce and change dynamic environments' J.I. Nassauer, 2013[160].

Nassauer's second law stresses that the visibility of landscapes means that different people can highlight the characteristics they notice and what these convey to them. The meaning of these characteristics and how they are valued is dependent on context. The complexity of meanings and values ascribed to landscapes has been thoroughly explored, both in landscape architecture (e.g. Spirn[232] and Treib[258]), and preceding this in geography (e.g. Lynch[133], Meinig[144], and Jackson[102]). The law determines that our ability to describe and compare the meanings and values of visible characteristics of landscapes means that we can synthesise the perceptions of individuals and groups.

Like Gobster and Westphal[80], Nassauer differentiates between landscape appearance and landscape pattern. On the one hand, she writes that landscape appearance may be understood as a direct linkage between 'what landscapes mean and how they look', a part of everyday life, or it may be understood as evidence of the 'integral natural and cultural processes that produce and change dynamic environments' [160]. Landscape patterns, on the other hand, are the basis for what people directly perceive about environmental phenomena of all scales; human experience of the landscape prompts action to change landscapes. The scale at which humans intentionally intervene to change landscapes defines a scale of *vernacular design*.

Despite 'seeing' the landscape through different disciplinary or experiential frameworks [96, 144, 267], members of these diverse groups can point to the same locations or relevant characteristics in a landscape—or in a spatial representation of the landscape—and describe what they see there. The landscape is therefore used as a boundary object (see Star[234]), acting as a material or organisational structure that allows different people—who are not in agreement—to discuss perspectives regarding the properties of the landscape, which are more-or-less well understood by the participants.

2.1.5 The Landscape Medium for Synthesis (Principle 1)

Using the concept of the Landscape Medium, Nassauer proposes that through the use of the landscape as a reference object 'different views can be exchanged and that a design process can move that exchange toward synthesis in relation to some question or problem' [159]. Key to this approach described is the use of a transdisciplinary design process, which includes five steps (See also 2.1.2):

1. Include diverse disciplines or stakeholders to design a single landscape together;

2. Develop a shared reference or boundary object, a common landscape, represented by a shared dataset;

3. Design a common landscape iteratively;

4. Initiate the design process with relevant criteria for possible landscape functions;

5. Complete the design process with an accessible, replicable, clearly specified landscape description at the relevant scale;

Include diverse disciplines or stakeholders to design a single landscape together

Since a given landscape can only take one pattern at a time, Nassauer offers the landscape design process as a means to rectify 'differences, incomplete understandings, misunderstandings, and synergies amongst diverse disciplines' or diverse stakeholders' conceptions and values' [159]. It extends a way for science to involve local landscape knowledge and the societal values that often propel urban landscape change. Designing landscapes with diverse participants can promote mutual learning and resolve differences within the setting of the designated landscape, as well as engagement.

Develop a shared reference or boundary object, a common landscape, represented by a shared dataset

Cooperation between the jurisdictions of science and landscape can be facilitated through the use of a common landscape as a boundary object.

Design a common landscape iteratively

This design process may simply involve the selection of the location and boundaries of a place, relevant characteristics of a place or landscape type. For example: the selection, construction, or representation of a place in shared field experiences, images and datasets. The landscape medium attracts iterative redesign, as participants critically scrutinise ensuing landscape patterns and compositions, and share their diverse viewpoints on what they observe.

Initiate the design process with relevant criteria for possible landscape functions

Having diverse participants agree on a single landscape pattern forces them to consider how they can resolve the combination of functions that they were, and were not, aware of. Thus, the emergent common landscape may integrate various ecosystem services and societal values that would customarily be at odds with each other, or might not occur in the same place.

Complete the design process with an accessible, replicable, clearly specified landscape description at the relevant scale

Once the landscape is designed, a cohesive set of representations, datasets, images, and maps can be presented to disciplines, professions and stakeholders. While it is not necessary that all data is shared, a foundation of common data helps to 'promote synthesis, ensure meaningful integrated assessments and adaptive management of a landscape, and set up potential use of the landscape method to generate alternative futures' [159]. Each alternative is represented by a shared dataset. Meanwhile, each alternative can reveal different concerns and values of participants, and scrutiny and assessment of alternatives can indicate common ground.

The outcomes can be 'landscapes that are generalisable patterns, applicable to many different places of a particular type, or designs that are specific to a place. The key to making design useful in this way is to use design of generalisable patterns to link scientific knowledge of environmental or societal processes with design proposals to change specific places' [159]. Resultantly, science knowledge can affect local landscape change, and local knowledge can enlighten future pattern rules and science questions.

2.1.6 The Landscape Method and Invention (Principle 2)

One step further, the landscape method anticipates the future marrying science to creativity, nurturing innovation and effective adaptation to changing environmental phenomena. It is fundamentally a creative process, encouraging transdiciplinary experimentation and openness toward different understandings of landscape change, design or policy throughout an iterative design process. The result may be numerous design products, alternative landscape futures (landscape inventions), and a mechanism for engaging the participants in generating and comparing landscapes, and affecting landscape change.

2.1.7 Limitations and Potentials of a Landscape as Medium Approach: Towards a conceptual and methodical analytical framework

Based on the critical assessment of 1) vernacular, or cultural, landscapes in geography, landscape architectural, and urban studies theory, and 2) Nassauer's landscape as medium and method approach; this section will draw the conceptual and practical challenges of the application of the approach to the understanding of riverine landscape transformation in vernacular urban settlements. These considerations will be taken into account in the development of the following section.

I identify that the concepts within Nassauer's laws provide a potential vantage point on resolving challenges identified within the literature review in chapter 1, along with the points raised in the preceding sections of chapter 2. To recap, the literature review identified these challenges as: a) synthesising disparate perceptions; and, b) contextualising transformations at the local landscape scale.

a) Synthesising disparate perceptions

The landscape as medium and method approach is conceived as a potential answer to the challenge of identifying landscape meaning. A medium and method that incites participants to perceive and influence the same landscape can bring experts from diverse disciplines and stakeholders with diverse experiences to comprehend the landscape as part of a system that includes numerous distinctive visible and invisible processes.

Both Termorhuizen and Opdam[251] and Nassauer[158] posit that the capacity of scientists, designers and policy-makers to develop an awareness of what landscapes mean and how they look to people may result in synthetic conclusions which are useful in affecting change. Furthermore, invisible ecosystem function ought to be represented for human experience if human beings are to maintain ecological quality.

Visual methods and techniques

Landscape Architect James Corner describes the landscape as 'a text that is open to interpretation and transformation… [and] a highly situated phenomenon in terms of space, time and tradition and exists as both the ground and geography of our heritage and change' [50]. In the frame of landscape transformation, Nassauer [158] suggests that to affect the pervasive landscape pattern it is necessary for designers to know 'the everyday language for making and interpreting landscapes'. Resultantly, she observes, the essential visibility of landscapes is 'the basis for a powerfully practical analytical and synthetic device for bringing ecological insight'.

Pertaining to the first aspect of landscape meanings, perceptual meanings, following Krase [114] I propose that, given the rapid transformation of riverine landscapes within urban environments, **there is clearly a value in visual methods and techniques to document landscape conditions.**

Pertaining to the second, associational meanings, following Nassauer [158] **I propose that to penetrate everyday acts of landscape transformation, and ultimately to realise innovative landscape structure, landscape architects need to work from vernacular culture.** While Lynch[133] offered cues, such as visual and non-visual sensations, to structure and identify the environment; Nassauer offers cues to human care, such as neatness and tended nature, as one mechanism for landscape architects to enter vernacular culture[158]. She cautions against constructing a too coarse filter for characteristics of landscapes, which may not meet the perceptions of local residents. For example, in the case of the vernacular urban landscapes of Indonesia 'care' may not look neat as it does within Singapore (the location from which this research was based). While cues may vary between regions and ethnic groups, ultimately these cues express care of the landscape.

Geographer Edward Relph[202] similarly comments on the challenge of understanding the lives, problems and places of others:

'Genius loci cannot be designed to order. It has to evolve, to be allowed to happen, to grow and change from the direct efforts of those who live and work in places and care about them… No matter how sophisticated technical knowledge may be, the understanding of others' lives and problems will always be partial. Just as outsiders cannot feel their pain, so they cannot experience their sense of place.' Edward Relph, 1993[202].

Landscape architects, architects, planners and social scientists *ought* to develop a sensitivity to a places' attributes, and following this initiate and direct what Relph terms 'locally committed developments' [202]. A balancing of local considerations with broader social and ecological concerns is necessary to this approach. And while the approach must be different in each situation, the underlying acknowledgement is that places—as the context of human lives—through their various transformations are to some degree themselves alive.

b) Contextualising transformations at the local landscape scale (Nested scales of landscapes)

From the literature I draw from the example of Wagner's [267] study of the now-defunct Clear Lake, in the American Midwest. This provides an example of how an approach integrating social and spatial information and methods might take shape at a regional scale. They paired an analysis of landscape change over a 60-year timeframe using GIS and aerial photography in conjunction with stakeholder interviews. They found that local resident's expectations and baselines for comparison of landscape change differed, and that most stakeholders did not perceive spatial changes identified by the GIS assessment.

This highlights the necessity of such a study being brought down to the local landscape scale, coupling appropriate spatial representation and social feedback from the community.

As mentioned earlier in the thesis (see Ch1), the research undertaken by others within the landscape ecology team constitutes the steps up- and down- which are necessary to understand the landscape holistically, and to nest the local landscape scale enquiry.

c) Potential

Thus, I suggest that landscape architects can use a landscape as medium and method approach to address the challenges of synthesising diverse perspectives and experiences of a landscape—which are not resolved by current approaches. Through using the riverine landscape as a shared reference, and synthesising knowledge within a shared dataset I can approach the challenges of synthesising disparate perceptions of landscapes through: a) integrating research that results from spatial and socio-cultural research; b) synthesising the differing perceptions of transformations from various actors; and c) harnessing the intangible socio-spatial knowledge of communities. Additionally, the approach may be used to contextualise riverine landscape transformations at the local landscape scale through: a) serving to couple spatial representation and social feedback from the community; b) facilitating the recognition of mutual dependencies and interactions, barriers for change, and possible solutions to overcome them; and c) linking the experiential dimension of landscape with other environmental phenomena.

Resultantly, in the following section I will detail the exploratory and analytical research methods that I employ within the investigation to address these.

2.2 Landscape as Medium and Method for Synthesis

2.2.1 Understanding the conceptualisation of riverine landscape transformation in the vernacular urban settlement

Building from the Research Design, which was described earlier (See Ch1), this section will first address the exploratory research methods, followed by the analytical research methods. These lead to the development of an understanding of RQ1 and RQ2, which is later followed by construction of guidelines and recommendations for affecting riverine landscape transformation (RQ3).

The conditions found along the Ciliwung on preliminary research in Jakarta were unalike from my own earlier experiences, and I quickly realised that the urban theory of my academic upbringing was inadequate in interpreting a river with such different cultural origins and reference points to my own. This has spurred three key influences on the investigation: firstly, it provoked an ethnographic method of research; secondly, it highlighted the importance of locally sourced knowledge from Indonesia and Southeast Asia; and thirdly, it triggered an interest in more personal, intimate and embodied writing — both in terms of enabling reflexivity and opening the research to understanding of others who have not yet come into contact with the site and its particularities.

Anthropology, and indeed ethnography, is well-suited to frame a study of water and the manner in which water is understood and used in a variety of social settings [15, 87]. Perspectives on water use stemming from agriculture are common, with Wittfogel's hydrological theory of the rise of the state, a social science work, being a usual reference [280]. The agricultural provisioning of water has been widely studied, with significant texts in archaeology [215, 216] and social anthropology [34, 47, 76, 109, 119, 209]. Lansing's study of Balinese water systems, and the complex intertwining of religious ritual and water provisioning for agricultural is an important ethnographic study to date. Water's significance stretches into the urban domain as well [246, 247]. In Indonesia, rapid urbanisation has forced a change in relationships to water, with communities whose lives were once centred on water shifting as development introduces new infrastructure [189]. Ethnographies on Indonesia and embedded relationships to water so far focus on rural sites, and a lack of studies on dense urban areas has been observed. The distinctive features of the Indonesian condition suggest that a focused study on the topic is warranted, and is in fact necessary for developing new positions and answers to contemporary landscape challenges.

Premising regionally grounded knowledge is noted by Alatas as a key method of escaping the Euro-centricism of knowledge [5]. This is important, not only for the ethnographic research itself, but also in moving beyond research in the field of river improvement which is confined to temperate climates—and cities undergoing planned urban process—seemingly ill equipped and inappropriate in considering the Southeast Asian condition (i.e. Prominski et al [195]). Studies on both the everyday relationship to water in Indonesia, as well responses to the annual influx of water during flood are key to the development of a base for this study [18, 138, 266].

2.2.2 Capturing narratives of riverine landscape transformation in the vernacular urban settlement

'Landscapes shift and so do the specifics that determine their qualities. Landscape architecture demands a creative synthesis of imagination, human movement, and natural processes over time—of the landscape object and the human subject' Simon Schama, 1996[217].

Previously, this thesis discussed the ways in which landscape has been theorised or addressed in geography, landscape architecture and urban studies research. Relevant lessons emerged from this, in particular, the need to avoid making assumptions about landscape conditions which may lead to transformations that are not appropriate or durable. Instead, it is critical to understand the often complex, temporal and intangible mechanisms behind the everyday riverine landscapes and their transformation within vernacular urban settlements. This is especially useful in this exploratory study, as the findings from the literature review revealed, there was little research which integrated social and spatial research on landscapes, particularly at a local landscape scale.

On the one hand, dealing with landscape transformation dealing with everyday phenomena related to riverine landscape transformation is profoundly linked to methods used in social science, and requires a methodology that allows for an understanding of the daily—even routine, and indeed ordinary—events. One which can examine them in detail and analyse their nature, revealing their relevance for the conception of new theories and empirical approaches.

On the other hand, I observe that the sole use of mainstream qualitative and quantitative methods such as surveys and interviews (among others), may result in the perpetuation of disparity if a mechanism for shared reference is not developed. In the beginning, acts of stewardship and transformations may not be clear or apparent to a researcher, and—at the beginning of this project—a first-time visitor to a vernacular settlement in Indonesia; and this has the potential to lead to misinterpretations and aspects being overlooked, or the construction of knowledge based on preconceptions of what riverine landscape transformation and cues to care are.

For this purpose, this research attempted to build knowledge around everyday experiences of riverine landscapes, as voiced by the residents themselves. To make this possible, primary methods were of a social science nature, with a focus on fieldwork and data gathering from within the neighbourhoods under study. I follow a method of case-study based design research, which is a well-established research approach within architecture and related fields, and comprises an empirical enquiry that investigates a phenomenon or setting within its real-life context [83, 283].

Within the investigation I employ a number of different methods, characterised largely by a household survey, interview, observation and a spatial study, which employs terrestrial laser scanning. This is framed by a grounded theory approach, in which I take the phenomena of environmental behaviour, within this urban neighbourhood and examine it through a process of data collection, coding, conceptualisation, categorisation, leading toward the development of guidelines for improvement. I consider this grounded theory approach in-line with Lewis' [124] proposal of a method of 'looking, reading and thinking, and then looking and reading again' to reveal order within the landscape, and raise new questions, leading towards projective recommendations.

The ensuing part explains the different methods utilised during the research undertaken on riverine landscape transformation in mainland Indonesia.

2.2.3 Information collection

This section takes a focus on the methods of data collection, leading into the development of an understanding of how the spatial structure of the river landscape can be transformed to facilitate behavioural change.

The project used a range of quantitatively and qualitatively driven methods, including: household surveys; semi-structured interviews; transect walks; participatory social maps; and participant observation. A terrestrial laser scanner was used to collect spatial information at the local landscape scale; meanwhile an aerial survey was used to capture spatial information at the subdistrict scale.

2.2.4 Literature Study

Interpretive-historical research

Taking into account the nature of this thesis and its weight on both the contemporary state of riverine neighbourhoods in Jakarta and their histories, an interpretive-historical strategy was used [83] within chapter 4. Interpretive-historical strategies and qualitative strategies are complementary, however the former are focused on historic phenomena while the latter are focused on contemporary phenomena. Interpretive-historical research deals largely with documents and material artefacts, as opposed to the human focus of qualitative research. The complementary nature of the two methods was the reason an interpretive-historical strategy was chosen for this thesis. It was believed that a study of present-day environments might benefit from an analysis of historical documents.

Building from Jackson's [102] two recommendations — 1) '... we can only start to understand the contemporary landscape by knowing what we have rejected and what we have retained from the past'; and 2) to 'try to discover when some of its characteristics first made their appearance, rather than to dwell on the disappearance of the old'. — a key phase of my research has been to trace the evolution of these riverine landscapes, looking for evidence of changes in the human-environment relationship. This has been attempted on the one hand through a literature study, and on the other hand through social-science research including interviews with long-time residents of the site. The research undertaken in the literature review included the acquisition of photographs and map (considered visual evidence of spatial/physical transformations), along with text-based reviews. The sources of this information were various libraries and online databases (See Ch1). Chapter 4 comprises the bulk of the interpretive-historical research, however some elements of this research have been drawn into other sections also.

2.2.5 Fieldwork

Detailed fieldwork was viewed as a mechanism for producing material evidence, with the landscape providing visible evidence of temporal facets of human culture and landscape transformation. For the field research, social-science research, the emphasis in information collection will be on time spent on site. Key impressions of the transformation of the riverine landscape and the interventions of those affecting the landscape at various scales are understood to be only perceivable through spatial and temporal observation.

Due to the distinct environmental and climactic conditions that characterise mainland Indonesia, the chosen sites change markedly throughout the year, both in usage or programming, proximity to the river etc. Preliminary fieldwork conducted throughout 2012 indicated the importance of taking a multi-phased

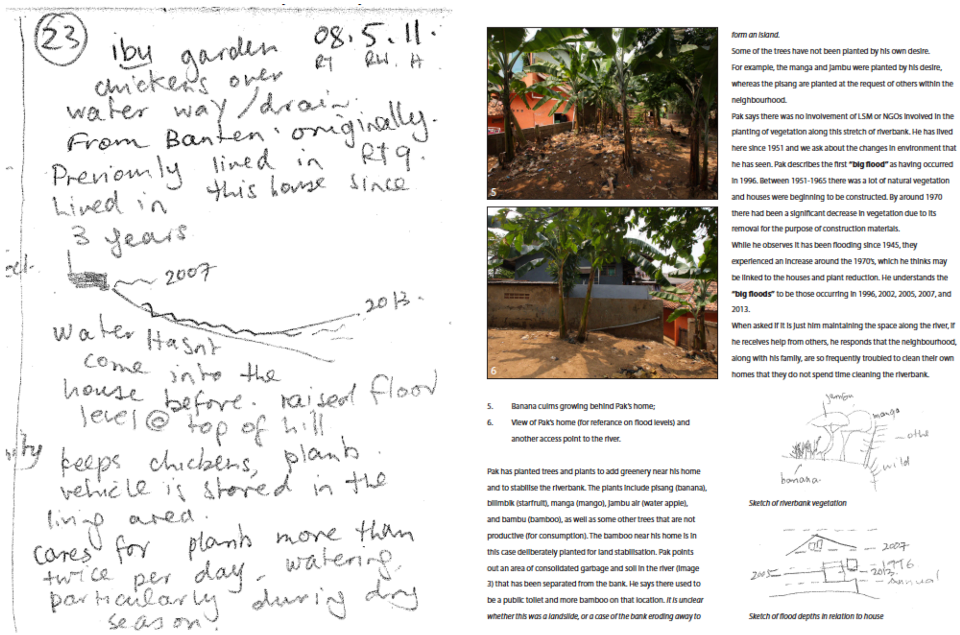


Figure 2.2.1: Sample of notes from fieldwork, Left – example of hand-written notes taken in-situ; Right – example of synthesised notes including photographic and sketched material, and notes from both my own and my research assistants' observations.

approach; and as a result sites were observed through both the wet and dry periods of the seasonal fluctuation of the river, giving a true indication of the spatial interaction between the community and the river.

Over the course of the four-years of the research, numerous fieldwork trips were made. Each trip was of around seven-days in duration. Each trip had a distinct purpose and was planned in advance. During the fieldwork sketches and observations, including notes from interviews were made in notebooks (See Figure 2.2.1) and mappings were created using hand-located and geotagged locations on maps and aerial photographs. For ease of access to internet, storage of tools and equipment, I stayed near the neighbourhoods, and travelled to the site daily using the local bus service (angkot).

2.2.6 Socio-cultural approaches: Discovering the social context of riverine landscape transformation

It was my intention not to force or impose my own perceptions of what might be the primary influences of riverine landscape transformation within the context of what were to an outsider seemingly 'informal' and poorly managed settlements. For this purpose, I involved residents living within the river corridor to understand their interaction with domestic and riverine vegetation, including intentional landscape changes (design actions) that they enact within the riverine landscape. As such, I employed a community participation method [239] to examine the social context and uncover landscape experiences of the communities. The method stems from social inductive research and produces descriptive results [115].

In my research I utilised a household survey—for supplementary quantitative results to understand larger trends within the study area of the main case study—, along with structured and semi-structured interviews, sketches and observations.

Local university students who had spent extended periods (often living in households) within these communities during their thesis projects and members of local NGO's were instrumental in the research; facilitating interviews, conducting household surveys, compiling summary notes, and reviewing the analysis. Their involvement as reviewers served to ensure the trustworthiness of the study [267], and builds reflexivity.

a) Social Sciences

I use concepts and methods from social science to ground my research on space. Whilst the significance of the general concept of space is part of a continuing intellectual discourse, and the importance of locality as a principle in structuring local relations has long been stressed, Durkheim (together with Mauss) was the first to deliberately bring the concept of 'social space' into sociological theory [135, 151, 231].

'People everywhere face the reality of space and time, but how they cope with them

is a cultural variable, evident in language classification, technology and ideology; and because members of different cultures structure the same physical phenomena through different perspectives and techniques, we cannot assume that they have a concept of space equivalent to our own' Hilda Kuper, 1972[**?**]

The relativity of the notion of space is now well accepted. With globalisation Bohannan's vivid caricature of a clear oppositional notion of space no longer exists, where the Western is separated from the non-Western, instead spatial perception is multi-layered and processual, with physicality, society, culture, and time each playing into the way that societies understand space.

Of potential interest for the landscape architect, Evans-Pritchard discerned physical, ecological and structural space, with 'the physical being the most concrete and measurable, the ecological being "a relationship between communities defined in terms of density and distribution,"' and with reference to natural resources, and the structural 'as the relations between groups of persons in a social system expressed in terms of values' [117].

Indeed, social scientists and landscape architects share a common task, that of seeking to understand these different temporal and spatial concepts. Both do this through the understanding of site. In Architecture and field/work, 2010, Ewing et al [68], acknowledge an 'ethnographic turn' in the artistic thought and practice of the architectural discourse. The text examines the cross-disciplinary borrowing of architecture, in its (re)understanding of and approach to fieldwork. In fact, tracing the development of both landscape architecture and architecture, fieldwork is understood as an enduring methodological feature. When considering that the projects of such star-architects as Rem Koolhaas and foundational figures as William Holly Whyte employ largely ethnographic techniques it appears the broader understanding of the origins of these methods and concepts should be imparted for, 'understanding differences in habit pertinent to different habitual ends may nurture future dialogues and exchanges which inform reinvigorated habitual routines and innovative practices' [68]. It is toward this end that I seek to integrate these methods.

Architect Martin Beattie describes the emphasis ethnography places on 'the immersion of the researcher in a particular cultural context and the attempt to ascertain how those living in that context interpret their situation' [24]. In this sense, the ethnographer can never remove their influence from the ethnography. As mentioned earlier, the involvement of local research assistants and NGOs as reviewers of the research helped to build reflexivity and trustworthiness.

b) Observations and mappings

A distinctive aspect of this study is its reliance on overt (participant) observation as a key form of information collection. I attempted to capture and re-present the field setting. Photography and sketches, including maps, were used to study and frame the events and interactions of residents within the urban riverine landscape (Figure 2.2.1). The river was considered both the stage and a protagonist within unfolding events. Understanding that participant observation is subject to different circumstances within each site, based on spatial conditions, programmatic adjacencies etc., the same techniques and methods were applied to allow for a level of comparison.

Data gathering techniques for participant observation included:

- Drawings such as plans and cross-sections, including physical features and dimensions, which may be used as bases for the discussion of temporal changes;
- Spatial Use Maps indicating adjacent programs and active and temporal programs within the site;
- Photography employed to visually depict the transformation of the site. Photographs from successive visits to the site are compared and contrasted to understand changes to the environment as a result of human intervention and phenomena such as flooding. Additionally, photographs are used as evidence of transformations;

- Participant Involvement was explored as a method of information gathering for the purpose of creating a shared landscape. This is approached through household survey, semi-structured interviews, and transect walks;

- Finally, the making of field notes will be critical throughout to record, reflect upon and confirm observations, assumptions and conclusions.

Documentation and observation of sites was focused upon the observation of physical traces of use and behaviour. This is a way of undertaking Environment-Behaviour (E-B) research. Zeisel[288] describes the following categories of traces particularly appropriate for E-B observations: 'by-products of use, adaptations for use, displays of self, and public messages'. He observes:'The first category represents remnants of what people do *in* an environment, and the others of what people do *to* it. This way of looking is aimed at increasing our ability to intervene through design and make settings better suited to what people actually do'.

Insofar as this thesis, the Zeisel's first category defines 'behaviour', and his second category — most specifically adaptations for use, or in this case living within a riverine landscape — 'tactics'. These were further identified using surveys and interviews.

Field records of vegetation, proximal to key spaces established earlier and near interviewed households, were made to establish an ethno-botanical (the relationship that exists between people and plants) profile of the river within Kampung Melayu—Bukit Duri (See Figure 2.2.2). Through an understanding of the range of vegetation within the site, its distribution, uses and performance (such as shade, food or medicinal source, and material source), a palette of plants was assembled for use within design studies. Research on the historical prevalence of species throughout the vicinity, as well as on existing ethno-botanical studies was seen to complement the research. Particular attention was paid to use of vegetation for bank stabilisation and consolidation,

Figure 2.2.2: In-depth interview with long-term resident on the evolution of the relationship between the river, vegetation, and the community.

for its specific relevance to riverine landscape transformation.

c) Household survey (applied within the main case study)

As I have mentioned, I utilised a household survey to provide supplementary quantitative results to understand larger trends within the study area of the main case study at Kampung Melayu and Bukit Duri in Jakarta. A deliberate sample of participants from the study area was drawn. These participants represented three stakeholder groups: households, neighbourhood leaders, and district leaders of local communities. Location within the study area and neighbourhood, perceived activity within the river corridor, length of tenure in the region, and role within the community, were among the factors influencing participant selection within the stakeholder groups.

Household surveys within Bukit Duri RW 12 (n=57) were conducted over a six-week period in 2014, meanwhile surveys within Kampung Melayu RW 2 (n=49) were conducted over one-week period in October 2013. Further surveys (n=53) within Kampung Melayu subdistrict conducted during these periods provided context to the research but were not used within the comparison statistics. The sample was stratified using the community unit (RW) and neighbourhood (RT) to ensure adequate geographic coverage for spatial analysis using GIS. Households were selected at random by the surveyor walking along the streets and alleys within the neighbourhood. A sample size of 5 households per neighbourhood was used for extrapolation and surveyors attempted to distribute surveys spatially (selecting households closer to- and further away from- the river within each neighbourhood).

The household survey, conducted using a tablet computer, provided us with a basic understanding of resident—environment interactions within the subdistrict. Each respondent household location was marked using geo-coordinates and manually located on a map. The density of the settlement meant that geo-coordinates were not always accurate, so the manual mapping of households allowed us to crosscheck during processing. Photographs were used to document locations and landscape characteristics commented on by respondents. The surveys sampled information on common-use space, vegetation, and river use, which were seen to reveal cultural motivations of the urban condition.

d) Semi-structured interview

While the surveys brought forward statistical relationships within the larger study site, semi-structured interviews provided a method of procuring information specific to local contexts. Additionally, these enabled me to continue to assimilate information as it was gathered during interactions with the community and during fieldwork. While most often these interviews continued on from conversations that occurred within the household survey, some were also the product of introductions from community members and friendly interactions during fieldwork. A set of interview questions was formulated specifically for community leaders, which helped us to engage them in discussions on topics such as spatial planning, and maintenance of shared spaces. This social sciences approach was adopted to help me perceive the landscape from the perspective of my research subjects. Additionally, I believed it would help us to understand and synthesise the quantitative and qualitative data that I collected.

To allow the interviews to progress without distraction—many of these interviews were made with people that I only met with once or twice and strong relationships were not formed—I did not make audio recordings of the interviews. As such, detailed transcripts of interviews were not retained. Instead, notes were written in English (by myself) and in Indonesian by the local university students who acted as my assistants. The Indonesian notes were later translated, used for cross-checking, and synthesised with the English notes before the analysis was begun (See Figure 2.2.3). Grounded theory method was then used to analyse the qualitative information and to identify patterns and form hypotheses [44, 213]. This is described further later in the chapter.

Figure 2.2.3: Residents of Kampung Melayu and Bukit Duri participating in household surveys and semi-structured interviews.

Transect walks

Within landscape architecture, Brett Milligan asserts that it is generally perceived that 'an urban transect has the most research and application value as a method of interpreting and intervening in the city when it's multilayered, openly adaptive (both in relationship to the environments in which it is applied and to its own embedded methodologies), and expressive of spatial and physical qualities'[150]. A transect is a cut or path through part of the environment showing a range of different habitats [41]. It may be used to describe landscape characteristics, and also an experience—or journey—through a landscape.

Transect walks were undertaken within the case study sites following a route along the main street of the neighbourhood, and alleys that ran perpendicular to this and the river (Figures 2.2.4 and 2.2.5). The participants included collaborators from the NGO, community leaders and residents. Convivial interactions with the residents provided opportunities to ask questions and identify features along the path taken [54, 136, 173]. This facilitated the recording of the social-environmental conditions of the study area, such as gradual changes in land use, terrain, and materiality. The transect walks enabled communication with neighbourhood groups who are often unable to read conventional and professionally-used landscape representations such as plans, aerial photographs, and sections. Additionally, these walks provided information on a variety of

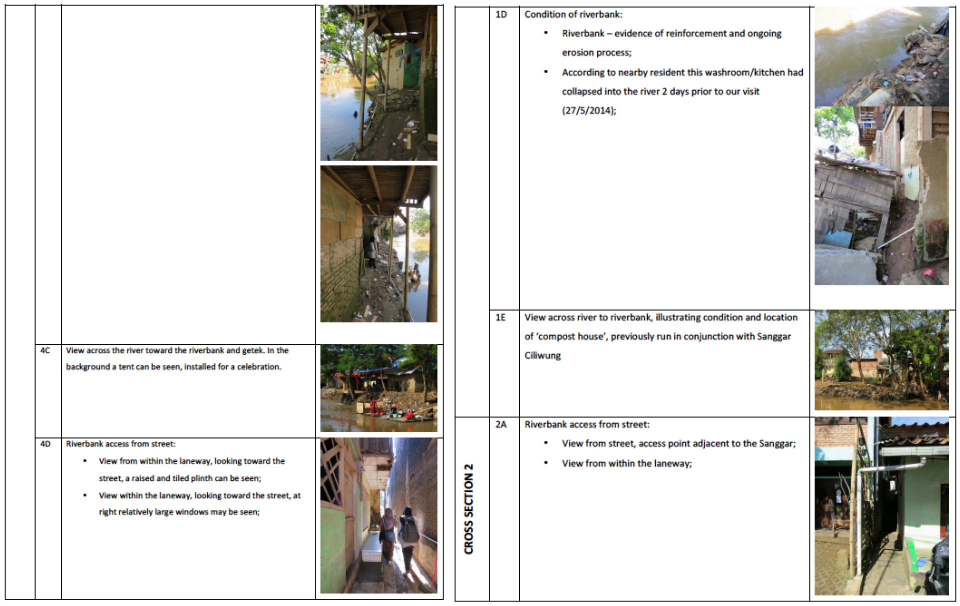


Figure 2.2.4: Notes from transect walk in Bukit Duri involving participation of NGO collaborators, community leaders and residents.

spatial conditions as I deliberately sought to investigate the differences between areas within the neighbourhood that were closer to- and further from the river.

2.2.7 Environmental/Spatial approaches: Ascertaining the spatial context of riverine landscape transformation

Detailed spatial studies including precise measurement and documentation of spaces and surfaces (including riverbanks) within the Kampung were undertaken. Studies sought to understand and establish a variety of spatial types, and their daily transformations through photography, and diagramming. Classification schemes including inventory, and typology were assembled from the field research to understand the socio-cultural relationship of the neighbourhood to the river.

Figure 2.2.5: Map of transect walk in Bukit Duri, including transects/cross-sections studied in detail, along which I selected participants for in-depth interviews to collect local narratives of riverine landscape transformation.

a) Image- and range-based modelling

I mobilised the use of image- and range-based modelling approaches to digitally construct the sites namely, in Bukit Duri and Kampung Pulo (Figure 2.2.6). Models were created and manipulated by Yazid Ninsalam (TLS and SfM) and Ervine Lin (DEM), both of FCL. The Bukit Duri model was generated by a range-based modelling approach where a FARO Focus 3D terrestrial laser scanner (TLS) was used at a resolution of 6mm for a distance of 10m. 33 scans were taken at an interval of 20-metres and registered using Autodesk ReCap Pro. The terrestrial scanning for this model was completed during the same expedition as the Bukit Duri transect walk. A collaborator from the NGO was involved in the scanning.

Concurrently, the Kampung Pulo site was reconstructed using an image-based modelling approach, namely structure-from-motion (SfM). These images were acquired using an Olympus PEN E-P3 digital camera with a resolution of 4032 x 3024 pixels, which was post-processed in Visual SfM and CMPMVS. Both image- and range-based models were digitally manifested as point clouds which were co-registered with a 1-metre resolution digital elevation model (DEM) from an unmanned aerial vehicle (UAV) in an earlier campaign. The point clouds, with spatial (XYZ) and colour (RGB) information were subsequently cropped into a 100-metre by 30-metre region of interest. Cross-sectional elevations were cut along the chosen site in Autodesk Revit and provided baseline spatial information for the subsequent study.

2.2.8 Information processing

The gathered information was analysed using grounded theory method, and spatial and statistical analysis.

Qualitative Analysis

Grounded Theory

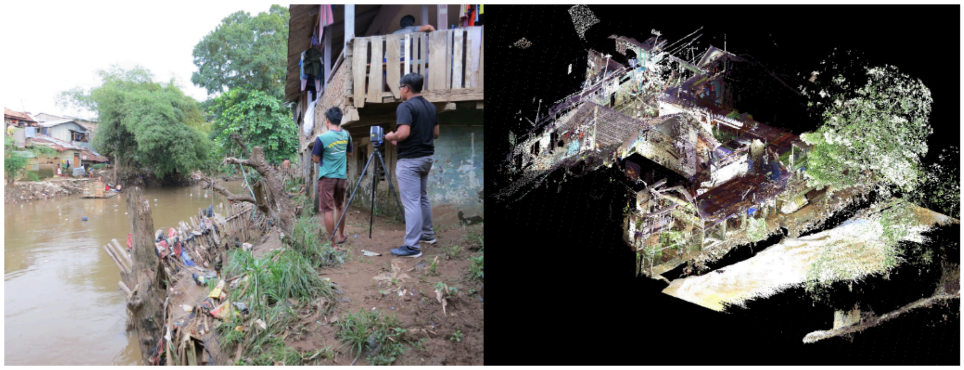


Figure 2.2.6: Left - Capturing the Bukit Duri site model using the terrestrial laser scanner with the help of the NGO collaborator; Right - Sample of the Bukit Duri site model. Source: [193]

I specify grounded theory as an appropriate mechanism to build theory regarding everyday experiences of riverine landscapes, as voiced by the residents themselves. Thus, the analysis process followed a grounded theory approach.

Grounded theory principles were developed by sociologists Barney Glaser and Anselm Strauss in the late 1960s and the 1970s [83]. Through this approach they sought to progress the then-norms of research from descriptive studies to explanatory theoretical frameworks. Charmaz [44] provides a comprehensive overview of a grounded theory process (Figure 2.2.7), in which a researcher slowly refines their knowledge of a topic through a repetitive process of observation, data collection, transcription, coding (data analysis), and classification, which leads to the development of a theory. This approach was followed within the research project.

The information sources, which were synthesised using the grounded theory method, included notes from interviews, transect walks and surveys, along with artefactual/site documentation and observational notes which were recorded through notes, plan and sectional sketches, and photographs. To synthesise this varied and voluminous information, and derive conclusions or theory, I coded and categorised information on the examined phenomena (Figure 2.2.8). While the use of interview notes rather than transcripts meant that the volume of text to code was reduced, this was still a time intensive process. Early initial coding of the first set of interviews and surveys from Bukit Duri and Kampung Melayu lead to the the revision of the survey with a section on the role of religious organisations removed prior to the second phase of interviews and surveys.

While there are a number of computer programs available for use with qualitative data that can facilitate data storage and management, coding, interpretation and display, following discussion with my co-advisor I elected to undertake this manually. This allowed for the development of visual displays of the synthesised information, in the form of sections, exemplary visual images and diagrams.

To ensure that the meanings found in the qualitative data were valid, repeatable and right (e.g. Miles[149], in Groat and Wang [83]), I reviewed these with the Indonesian research assistants, and with members of a local NGO who had a deep familiarity with the site. Additionally, I coupled information derived from the qualitative study with a quantitative and spatial analysis to clarify patterns found within the distribution of information, and provide explanations for outliers, surprises and extreme cases.

Spatial Analysis

Following the example of William Whyte, I use correlational research strategies to reveal the reasons for particular conditions within the urban landscape, and to suggest guidelines for design [83]. On one hand I analyse the survey data to understand spatial patterns relative to proximity to the river. On the other hand, I use cross-sections and transects to synthesise between perspectives of the riverine landscape and to construct a typological analysis of riverine landscape relationships in mainland Indonesia.

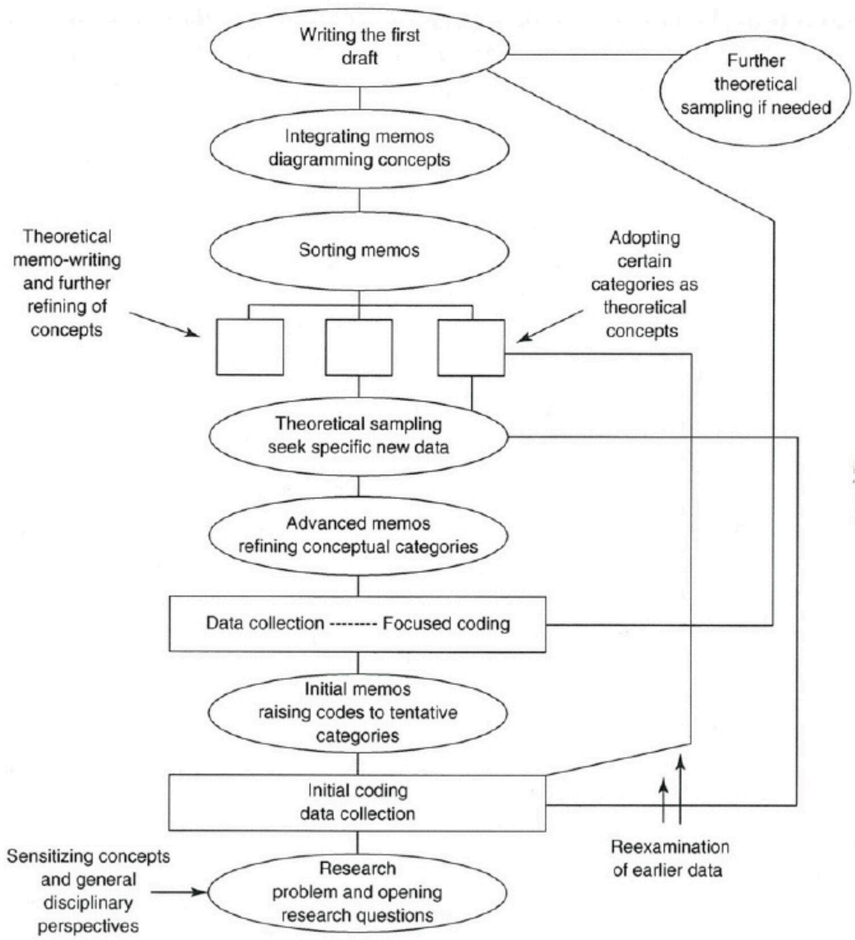


Figure 2.2.7: The grounded theory process as described by Charmaz [44]

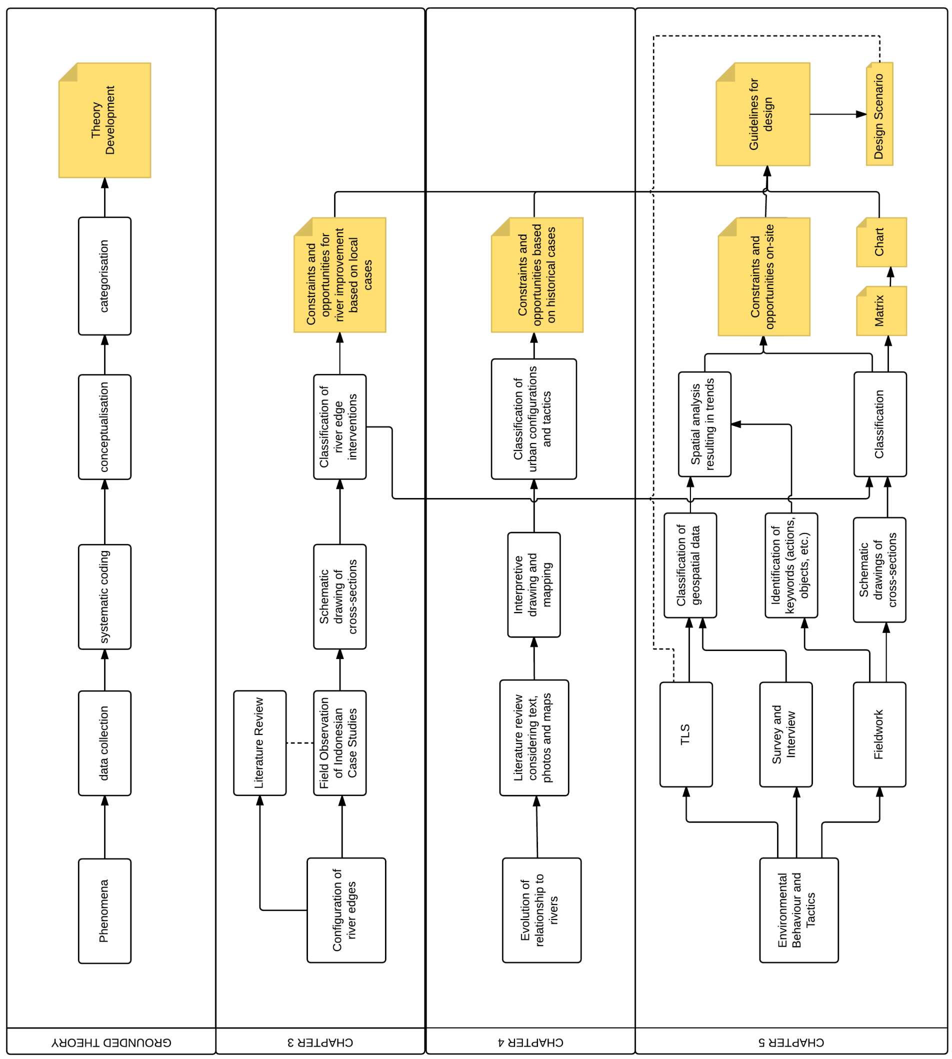


Figure 2.2.8: Based on Charmaz [44] I developed the process illustrated for investigating the phenomena of environmental behaviour (relationship between residents and vegetation) in urban riverine settlements.

a) Analysis of Survey Data (see Chapter 5)

I sought to identify trends and outliers within the information gathered from the household surveys in Kampung Melayu and Bukit Duri. First, the results of the descriptive surveys are presented as basic lists and tables, with a numerical summary of the replies in each category.

Second, a series of probability—or cumulative sample distribution—maps were generated. These were created in ArcMap (ESRI) using the 'Indicator Kriging' tool in the Geostatistical Analyst toolkit. Through the interpolation of indicator (0 or 1) variables (collected in the household surveys) I was able to generate probabilities that a critical value was exceeded or not at each location in the study area. The maps are useful in understanding how proximity to the river factors into the distribution of vegetation, and human-environment behaviour, particularly when coupled with the qualitative data collected within interviews and field observations. Additionally, these helped to identify patterns in the information, which were useful in understanding to whether the information derived from the interviews was either representative or outlier behaviours.

b) Cross-sections, transects and typological analysis of riverine landscapes

Cross-sections and transects Previously I raised the use of transects as an experiential mechanism for studying landscapes. In biology and ecology transects are used to study the symbiotic elements that contribute to habitats [41]. Using Abdul Latip et al's sectional analysis of river-edge relationships in Kuala Lumpur as an example[121], this design research examines historic and existing examples of river-edge relationships within urban areas in Indonesia, using typological techniques. The research seeks to use this cross-sectional and transect approach to understand riverine landscape transformation. Another seminal example of this approach is that of Patrick Geddes, a biologist, sociologist and urban planner who was interested in the relationship between life and its environment. Geddes used a section cut to illustrate the interrelation between

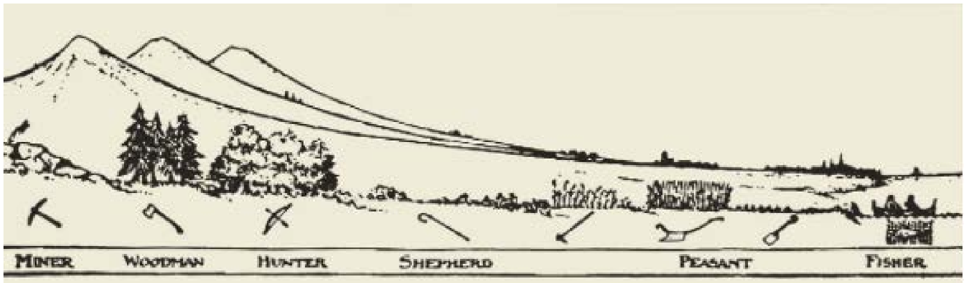


Figure 2.2.9: Patrick Geddes' 'Valley Section' used a section cut at the regional scale to illustrate the interrelation between settlement, culture and landscape. (Source: http://www.dpz.com/uploads/Books/DRAFT20140701-A_General_Theory_of_Urbanism.pdf, Accessed 13 November 2015)

settlement, culture and landscape within a valley (Figure 2.2.9). Alice and Peter Smithson followed later considering house types and their context, building off Geddes' work. They used Geddes' Valley Section to devise a range of house types to suit different communities; the hamlet, the village, the town and the city (Figure 2.2.10). I favour Geddes' approach over that of Ian McHarg coming half a century later in 1969, because of its association of natural conditions with human presence. Contrastingly, McHarg's analytical/operational system failed to integrate the human habitat—relegating it only to those areas where the natural system was less valuable [41]. This follows on from earlier where I previously determined this human element as being essential to my approach.

Typological studies Landscape architect M.E. Deming defines typology as a 'taxonomic classification scheme applied comprehensively to entire categories of built form, relative to cultural values and practices'. She observes, that through a process of '... identifying and describing (diagramming) specific qualities and characteristics ... the researcher [can] identify patterns of association that relate design elements hierarchically across scales'[60].

Typological studies have been used in urban planning and architecture, and in preservation of vernacular landscapes and practices since the 1950s. I acknowledge one such example of this within the topic of riverine

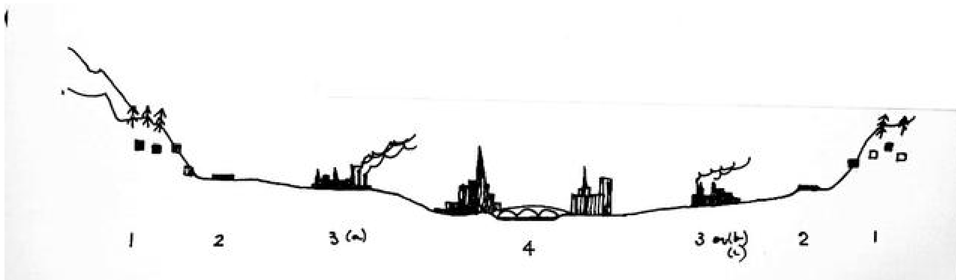


Figure 2.2.10: Alison and Peter Smithson, Sketch for the 'scales of association' from Patrick Geddes' Valley section from the 'Draft Framework 3' guidelines for CIAM 10, 1954. (Source: http://www.fig-projects.com/?p=515, Accessed 13 November 2015).

transformation: River. Space. Design[195]. The text provides an overview of river amelioration techniques within European projects, and develops a typological classification of these. However, this text's relevance is limited for Indonesian, and indeed Southeast Asian sites, as it is sited within European landscape knowledge.

Firstly, this section and transect approach was used to document and analyse the conditions recorded in the the hand-drawn cross-sections (in the case of Chapters 3, 4 & 5), along with the 3D terrestrial scan, which was broken down into a series of 2D detailed views, transects and cross-sections (see Chapter 5). This approach was key to synthesising information gathered during the interviews, surveys and transect walks, as it visually represented the landscape in such a way that it could be described and discussed by various actors/site experts. The information contained within these views, transects and cross-sections was classified according to the codes identified by the site experts.

Secondly, this research seeks to go one step further than that of Abdul Latip et al, by conducting a systematic study of the types of river-edge relationships observed within mainland Indonesia. The river edge relationships documented within the study were gathered together, coded and classified, creating a typological study which was based upon the local condition.

All industrial nations one day hit an environmental turning-point, an event that dramatises to the population the ecological consequences of growth.

The Economist, 2012

3

Contemporary Positions

3.1 River improvement in Indonesia

While the condition of rivers has long been of concern in Indonesia (see Chapter 1), there has been limited documentation and comparison of river improvement projects specific to spatial and socio-cultural factors. There is an increasing need for practical examples of such work in the literature. This chapter describes a practical application of a comparative analysis of qualitative factors in river improvement in mainland Indonesia (Java). Two main features in the framework are: the integration of physical and socio-cultural considerations in the assessment; and the use of cross-sectional illustrations (Figure **??**). Although the study is concerned with the Java region, the overall methodology is transferable to any region in Indonesia or internationally.

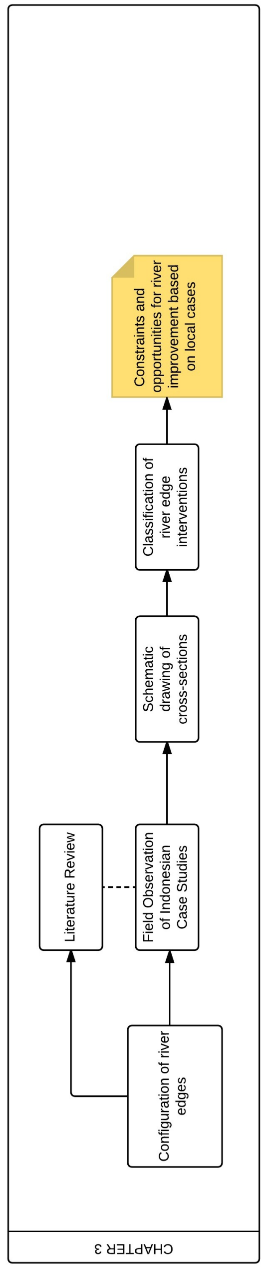


Figure 3.1.1: Overview of Chapter 3.

3.2 Understanding the Indonesian approach to urban rivers

3.2.1 Environmental turning points and ecological consequences of growth

The past decades of immense demographic and economic growth within Asia have seen the region's rivers heavily compromised. Similarly to the rivers of the rest of the world—such as London's Thames, and Paris's Seine—Asia's rivers have buffered adjacent settlements by collecting and carrying waste [57]. The materials used in daily life have transformed (from organic to inorganic) and increased exponentially outweighing the capacity of rivers with the volume of waste and contaminants. Cities across Asia are reaching what The Economist has termed *environmental turning-points* [66] as the impacts of these patterns are revealed through events which illustrate the extreme environmental degradation that has been sustained [57, 130]. Events such as the discovery of 16,000 pig carcasses in a tributary of the Huangpu River in Shanghai, China in March 2013 [57, 134] and the increasingly severe flood events—such as 2007—affecting Jakarta over the last two-decades provide region-specific examples of these over recent years. These developing nations—such as China and Indonesia—are repeating a pattern established by others including Britain, America, and Japan: 'develop now, clean up later' [66, 156].

Lakes and rivers in Indonesia, particularly within densely populated areas, are heavily polluted as they serve as dumping grounds for liquid industrial waste, solid waste, and sewage [129]. Patterns of negative-environmental behaviour, which have established over longer periods, are less easy to break. There are still numerous examples of damaged ecosystems and pressured rivers within urban areas in Asia (See Figure 3.2.1). Environmental pollution in Java was not seen as problematic until the mid 1970s. A jingle originating in Eastern Java [130], recalls the habitual nature of environmental pollution which saw rivers used as a dumping ground for rubbish and industrial waste:

'When the guest is here, roll out the mat,

Figure 3.2.1: A river in Surakarta, or Solo as it is familiarly known, is coloured red by the dyes of the Batik industry which discharge their wastewater into it. Source: Author's fieldwork 2012.

When the mat is torn, patch it with sticky rice,
When the rice cake has gone bad, give it to the dog,
When the dog is dead, throw it into the river,
When the river is flooding, leave the dog on the bank.'

Research evidence demonstrates that informal areas in developing countries are often located in high-risk areas such as low-lying lands and riverbanks, which are particularly susceptible to extreme weather conditions [212]. More than 24 rivers and streams cross the city of Jakarta alone, and—according to a survey undertaken in 1990—there are some five-thousand major rivers in Indonesia, and some 66-thousand tributaries [240]. It is therefore significant that riverfront transformations within this geographical context are studied and reflected on, for the continued advancement of future transformations.

3.2.2 Riverine landscape transformation in Indonesia

Riverside settlement is not a new concern throughout Indonesia and, despite the inclusion of guidelines for the preservation of the river edge — or borderline (sempadan) — in regulations for some decades already, it has been observed that in practice regulations have not been upheld consistently [116]. Riverside settlements and their close proximity to the river margin have been addressed since the mid-1980s through urban upgrading programs such as the Kampung Improvement Program (KIP). However, the programs implemented within riverside areas were 'not riverside habitat-specific', but were instead common amongst kampung programs. Yossi and Sajor suggest that this may have contributed to the lack of success in resolving key issues pertaining to deteriorated condition such as environmental awareness, empowerment, and sanitation facility upgrading [285]. Moreover, improvements to settlements have not often stretched to include transformations to the river edge or waterfront area.

Policies on rivers — such as GR 38/2011 [185] — do not mention the characterisation of the river border and promote functional, though not necessarily multifunctional river corridors, which are presently promoted within the literature [82]. For a brief review of legislation, policies and programs that have affected the transformation of the Indonesian riverine landscape within urban areas, refer to Yossi and Sajor [285]. They indicate the coherence of policies across national, provincial and municipal levels as being a primary challenge in the future development of rivers and their waterfronts in Indonesian cities. They suggest that river management—within this era of decentralisation—requires 'local-river specific planning' rather than a national regulation that generalises the characteristics of all rivers. Furthermore, they propose collaboration and coordination between different government authorities and external stakeholders (donor foundations and research institutions) to ensure successful urban river management.

The aim of this chapter is therefore to present a spatially explicit methodology examining the spatial reconfiguration of riverine landscapes in Indonesia as a result of human intervention and implemented policies. This includes the following objectives. Thus far, I have 1) demonstrated the potential for integrating physical, or spatial, and sociocultural factors in the assessment of urban riverfront improvement, using cross-sectional analysis. Following this I will 2) establish a set of comparable case studies of riverine landscape transformation in mainland Indonesia; and 3) develop of a framework of analysis for improvements to densely settled riverine landscapes pertaining to socio-cultural and spatial factors. Next, I formulate a discussion in which I consider the 4) sociocultural and spatial measures implemented within riverfronts and their implications. And finally, I reflect on recommendations for the future spatial reconfiguration of riverine landscapes in Indonesia.

3.3 Approach to the comparative study

3.3.1 Study area and conceptual framework

a) Case Studies

The study takes a set of comparative case studies for the purpose of understanding the remediation potential and challenges brought forward in mainland Indonesia. Empirical evidence is drawn from five urban riverine case studies in Java, Indonesia (see Figure 3.3.1, and Figures 3.3.2 and 3.3.3). The case studies selected include rivers in Central-, West-, and East Java: the Code and Winongo (Yogyakarta); the Ciliwung (Jakarta); the Cikapundung (Bandung); and the Bengawan Solo (Surakarta).

The rivers under study are primarily short rivers, less than 50-kilometres in length—excepting the Bengawan Solo, and pass through densely settled, urban and sub-urban areas. In the case of the Bengawan Solo, the portion studied is that which passes through the urban and sub-urban areas of Surakarta, a segment around 15-kilometres in length. Sites in both the urban and sub-urban reaches of the river were visited for each case, which served to familiarise us with the

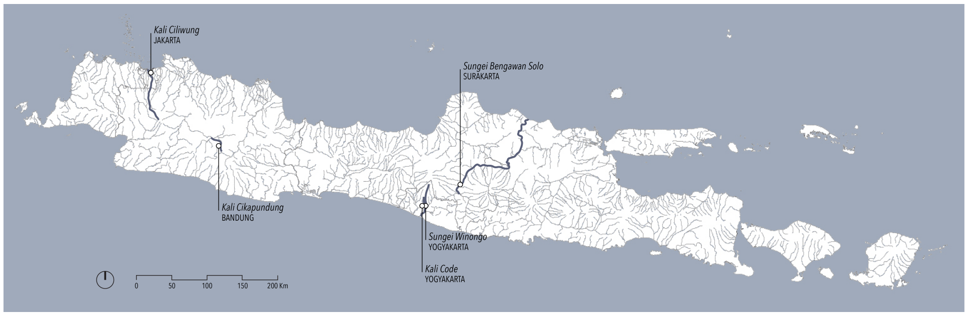


Figure 3.3.1: Map of comparative case study illustrates selected river rivers in Java (see 2-4), in comparison to the location of the Ciliwung River (see 1).

challenges particular to each river. Each river passes through a number of districts and/or subdistricts.

b) Local landscape scale

In this study I used the concepts of the local landscape landscape services. Landscape services is used to contextualise ecosystem services to the local landscape scale [251]. The literature review section of this thesis provides more detail in this regard. In brief, following [251] I take 'landscape services' as a specification of ecosystem services in light of landscape development involving local actors. 'Landscape' may be directly 'associated with people's local environment, with the place for which they feel responsible, and with distinct spatial elements that they can change to improve the ecological, social, and economic value'.

While [251] use a structure-function-value chain of knowledge, [92] build from [56] to establish five primary services for the local landscape scale: regulation; habitat; provision; information; and carrier. Moving into a landscape architectural socio-spatial consideration of landscape services, I compare the services of particular riverfront landscape configurations. Rather than projecting

Figure 3.3.2: Maps of the urban—river relationship in Bandung (top), Yogyakarta (middle), and Surakarta (bottom). Source: Open Street Map.

	Variables	Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta		Bengawan Solo River, Surakarta
Overview characteristics	River length (kilometres)	33.5 km	12 km	17km		15 km passes through Surakarta (total length 540 km)
	Watershed size	145.93km2	N/A	40.06 km2		16,100 km2
	Population pressure (Size of city/urban region)	2.7 million	3.2 million	3.2 million		600,000
	Districts crossed	9 sub-districts	6	N/A		20
Case studies	Case study settlement(s)	1. Lembang, Cicendo, Sumur Bandung & Andir.	2. Kampung Dukuh	3. Kampung Code	4. Tegal Panggung	5. Pucang Sawit & Kg. Sewu
	Land classification (for case studies)	Urban, sub-urban	Sub-urban	Urban	Urban	Sub-urban
	Width of riverbed	10 m	15 m	10 m	15 m	50 m
	Width of flood plain	N/A	N/A	N/A	N/A	~250 m
	Length of river passing through case study settlement	(multiple sites)	900 m	120 m	300 m	500 m

Figure 3.3.3: Comparative statistics of the case-studies.

onto the sites, I use a grounded theory approach to discern the services relevant to the context at hand (see Ch3 and Ch2 for further information on this approach).

c) Case study and typological research on riverine landscapes

Case studies are regarded as particularly appropriate for landscape architectural research, since the discipline's focus is 'typically complex, multidimensional and embedded in a wider context, and [is] thus hard to separate into discrete factors' [60].The value of the case study method for landscape architecture is highlighted by [74], who compiled a report for the Landscape Architecture Foundation identifying an extensive set of components that case studies ought to include in order to contribute to the discipline. The case study method has been observed to have significant value when used cumulatively and comparatively to develop theory [60, 74].

A recent and pertinent example of such a study is Prominski et al's River. Space. Design. Planning Strategies, Methods and Projects for Urban Rivers [195]. The book is divided into two volumes, and offers built examples of design strategies that combine flood protection and navigation with stream and the amenities of public space. The first volume defines strategies for riverside design using European projects as examples, and is divided into two chapters: Fundamentals, and the Design Catalogue. Fundamentals describes the basic hydrological principles—giving a general understanding of river dynamics—and serves to identify what the authors term: process limits, the critical constraints of design strategies which are described within the following Design Catalogue. These tools and measures are extracted from the best-practice case studies of the second volume. The second volume, the Project Catalogue, comprises forty-five case studies which are documented through photographs; simple plans and sections; and interpretive diagrams, which serve to illustrate the river dynamics working within particular design strategies.

However, the book appears limited by its Euro-centricity, which I have recognised has been similarly critiqued historically in the realm of social sciences (see Ch2, 'Landscape as a Medium and Method'). The nature of riverine landscapes in Indonesia—and indeed Southeast Asia—as described in earlier sections of this thesis (see Ch1 and Ch3), means that the application of some of these approaches may be constrained by their specific urban context. Additionally, the book rarely compares directly between strategies and tools, particularly when discussing specific case studies.

3.3.2 Overall methodology

The overall methodological framework (see Figure 3.3.4) is based on data availability and the spatial scale of the local landscape. The river selection was established using geographical region and landscape architectural typologies (riverfront settlements in urban areas) as organising characteristics. This was informed by the case study method for landscape architecture described by Francis [74].

The research applied a qualitative approach, combined with grounded theory—using deduction, verification and induction—to offer insights, enhance

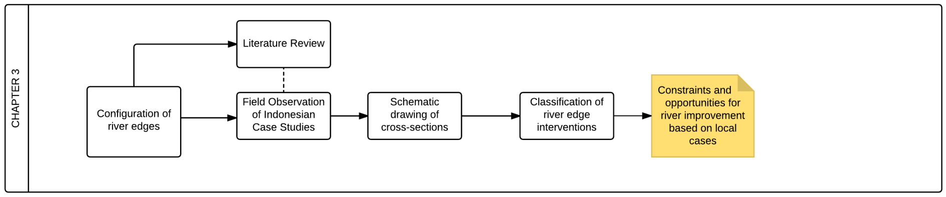


Figure 3.3.4: Diagram of research methodology applied for Ch3.

understanding and provide a meaningful guide to future action. The selection of multiple sites for comparison allows observation, data collection and data structuring to take place in an iterative process, thus, allowing a theory regarding the spatial configuration of urban riverfronts to emerge from the data. This theory will then be taken and considered within the design of the final case study of the Ciliwung River, Jakarta.

The fieldwork and reviewed details considered: the rivers' physical environment, including spatial relationships of the river edge, settlement and ecology; and the socio-cultural aspects, including community and organisation, recreation and access. Landscape data recorded in the field were then translated into socio-spatial indicators—or traces [288]—and linked to the related spatial types [195] and the landscape services they provided. The socio-spatial indicators influencing the selection of spaces for discussion included: access, crossing, open space, river usage, spatial structure (including orientation, and building type).

a) Spatial approaches to the transformation of riverine landscapes

The spatial approaches are classified partially using [195] Design Catalogue for urban rivers, which is broken down into process spaces, design strategies and design tools. The framework established by Prominski et al is viewed as a starting point for identifying specific changes to river edges. However, in contrast to Prominski et al's approach which separated case studies for individual analysis, I use a compare and contrast approach to reveal differences between sites.

Throughout this chapter I seek to understand to what degree Prominski et al's catalogue can be useful for this design research project, focused upon the Indonesian context.

b) Environment and behaviour research methods

I build off the fundamental idea in landscape development that people are part of the landscape and that landscapes are changed for their benefit (See Chapter 1, Section 1.3.1) [11, 92]. And, from [288] the following questions are useful for framing our enquiry: 'How do environments create opportunities for people? Where do people and their surroundings impinge on each other? Where do they limit each other? How do people use the environment as means to an end? And to what ends? What design skills do people have? How do they manipulate their surroundings? How do people change environments to meet their needs? What takes place in particular settings?'. It is important to note that Zeisel's definition of 'design' aligns to that of [162], meaning 'intentional landscape change' (See Chapter 1, Section 1.2).

Methods from environment and behaviour research were used to observe physical traces of human activities and changes made to surroundings. Of interest are changes made to surroundings for the purpose of the physical improvement of the riverfront, and as a result or reaction to the improvement of the waterfront. Environmental behaviour is affected by physical traces such as barriers, walls, orientation and objects, and, as such these elements have informed the structuring of our results.

Recording devices such as annotated diagrams, drawings, and photographs, allow for speedy and easy record-making and provide a glut of information for review and analysis [288]. Thus, analysing the combined physical trace and interview data I am able to realise what effect particular physical transformations have had, both on communities' relationship to the river and on the condition of the river itself.

3.4 Results and Discussion of Sociocultural and Environmental Aspects Affecting Riverine Landscapes

Common to each of these projects I have identified a series of sociocultural and spatial measures that have been taken (Figures 3.4.1 and 3.4.2). These include:

Sociocultural measures

- Empowerment, facilitated through neighbourhood involvement throughout the upgrading process;
- Respect for environment, facilitated through activities, programs, and groups;

Spatial measures

- Physical improvements, such as reorienting the neighbourhoods toward the river;
- Facilities, such as public spaces.

Generally the measures implemented at the sites selected were found to be consistent with UN-Habitat's principles of participatory slum upgrading [259] (see Figure 3.4.3, these are outlined in blue where relevant within Figure 3.4.2), which could thus be perceived as a baseline for improvements to riverside settlements. However, as observed earlier such efforts do not focus on changes to riverside habitats specifically (See Section 3.1). Thus, the discussion is focused on how such sociocultural and spatial changes have affected the activities occurring along the waterfront—which are seen as indicators [288]. Furthermore, the potential range of landscape transformations within a situation are affected by the physical environment (Figure 3.4.4): including types of adjacencies—such as settlements, agriculture, industry, and forestry or vegetation—, and bank conditions.

The discussion is structured in two parts. First, I discuss the socio-cultural aspects of measures that have been taken, comparing and contrasting examples

Variables			Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta (Kampung Code)	Kali Code, Yogyakarta (Tegal Panggung)	Bengawan Solo River, Surakarta
River improvement / management	Involvement	Neighbourhood	•	•	•		
		NGO	•	•	•		
		Institution					
		Regional/ municipal government		•		•	•
	Socio-cultural	Community Empowerment			•		•
		Respect for environment	•	•	•		•
	Spatial	Orientation	•	•	•	•	
		Access / preserve edge / set-back	•	•	•	•	•
		Infrastructure/ Facilities			•	•	

Figure 3.4.1: Summary of range of parties involved in selected case studies, and actions taken to improve riverside settlements broken down into socio-cultural and spatial factors.

from each site. Following which, I discuss the physical, or spatial, measures that have been taken. Again, examples from each case study are compared and contrasted.

3.4.1 Sociocultural aspects

Specific to riverine vernacular settlements, socio-cultural aspects of landscape transformations included: the empowerment and involvement of communities; respect for environment (including stewardship, green infrastructure and environmental campaigns); socio-economic activities; and recreation and access to the river.

Figure 3.4.5 details the types of activities or transformations that these entail, and prevalence within neighbourhoods included in the case study. While tenure

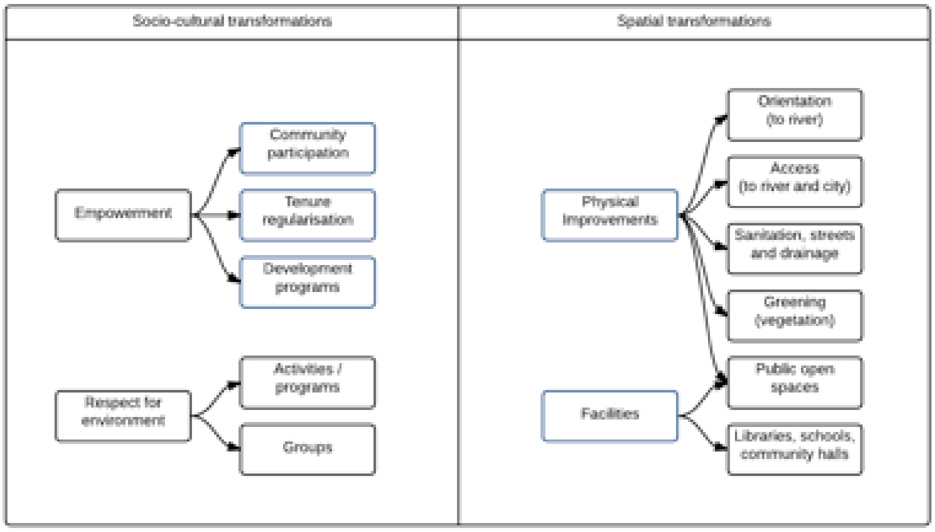


Figure 3.4.2: Summary of actions taken to improve riverside settlements broken down into sociocultural and spatial factors. These correspond to some degree to UN-Habitat's principles of 'participatory slum upgrading' (see below).

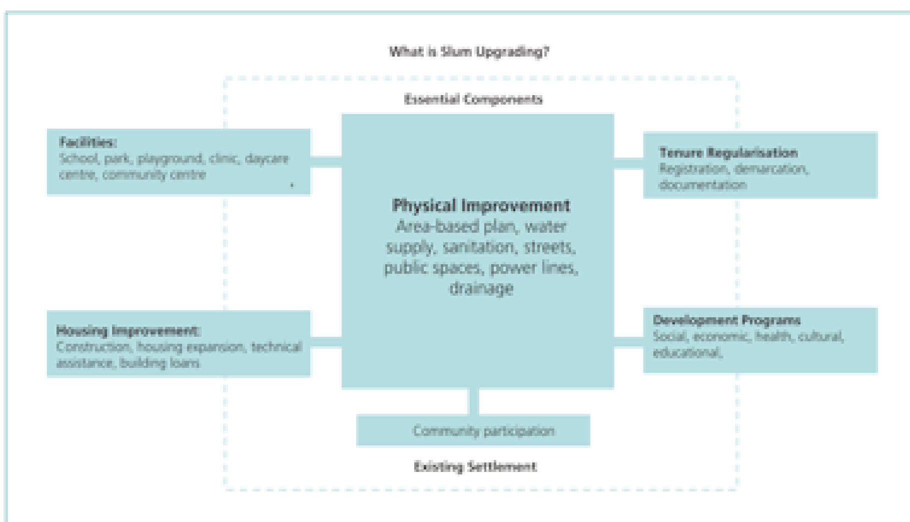


Figure 3.4.3: UN-Habitat's principles of 'participatory slum upgrading' [259]

Physical environment	Variables		Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta (Kampung Code)	Kali Code, Yogyakarta (Tegal Panggung)	Bengawan Solo River, Surakarta
River-edge relationships	Adjacencies	Low-rise residential (<4 floors)	•	•	•	•	•
		Mid-rise residential (>4 floors)				•	
		Agriculture	•	•			•
		Industry		•			•
		Forestry/ Dense Vegetation	•	•			
	Bank conditions	Steep vegetated	•	•			•
		Steep reinforced		•	•		•
		Moderate vegetated	•				
		Moderate reinforced	•			•	
		Flat vegetated					
		Flat reinforced	•	•			
	Channel	Rectangular channel	•	•	•	•	
		Trapezoidal channel					•
	Walls and barriers	Embankment					•
		Half wall	•	•	•	•	
		Full wall	•				

Figure 3.4.4: Aspects of the physical environment shaping river-edge relationships

	Variables		Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta (Kampung Code)	Kali Code, Yogyakarta (Tegal Panggung)	Bengawan Solo River, Surakarta
Socio-cultural aspects	Empowerment/ involvement	Neighbourhood driven improvement	•	•	•	•	
		Involvement of communities in design generation			•	•	
		Involvement of communities in relocation process					•
		Involvement of communities in maintenance	•	•	•	N/A	N/A
	Respect for environment	Environmental stewardship	•	•	•	•	•
		Green infrastructure	•	•		•	•
		Environmental campaigns	•	•			•
	Socio-economic and domestic activities	Within river	•	•	•	•	
		Along riverbank		•	•		
	Recreation & access to river	Pedestrian access (along river)	•	•	•	•	•
		Vehicular access (along river)					
		Facilitated access to the river (at-grade)	•	•			
		Community facilities and spaces (adjacent to river)		•	•		•

Figure 3.4.5: Socio-cultural aspects of riverine landscape transformation

regularisation and development programs were components of some of these case study improvements, these will not be discussed in detail as they are not the focus of this review and have been discussed within the literature already (see Appendix for some details). Socio-economic and domestic activities while not being directly relatable to improvement strategies in these case studies, were observed to transform the riverine landscape in a variety of ways and are thus included within the analysis. I acknowledge that while all activities are influenced by both sociocultural and spatial factors, recreation and access is largely defined by spatial factors and as such while I include it in this table, I describe it in detail later on.

a) Programs and activities relating to the river and riverside spaces

Empowerment and involvement of communities

Consistent with the observations on river improvement in the extended region (see Ch1), positive exemplars of riverine neighbourhood improvement programs in Indonesia are often focussed upon community-based management. This reflects a development paradigm which is 'people-centred, participatory, empowering, and sustainable; placing emphasis on local autonomy in the decision-making, self-reliance, direct participation, and social learning' [248]. Examples such as Kampung Code (and Stren Kali Surabaya) illustrate the success of neighbourhood-driven improvement, sustained by the mutual support of residents. This involvement took several forms, including:

- Neighbourhood-driven improvement - whereby physical actions indicate readiness and mutual support from residents willing to improve the look of the village and take on a position of stewards of their environment (Bandung; Yogyakarta – Kampung Code, Sungai Winongo);

- Involvement of communities in design generation - whereby communities propose spatial improvements based on their understanding of the local landscape (Yogyakarta – Kampung Code, Tegal Panggung);

- Involvement of communities in relocation process - whereby communities are involved in decisions about their place of residence and made aware of benefits of landscape changes (Surakarta);

- Involvement of communities in maintenance (Bandung; Yogyakarta – Kampung Code, Tegal Panggung).

  Community involvement in larger physical restructuring of urban areas adjacent to rivers establishes a sense of ownership and stewardship, which results in a sense of responsibility toward the ongoing maintenance and care of a site. Ultimately, this may serve to ensure the larger success of improvement projects. As in the case of Surakarta, making local situations visible through tools such as mapping makes assistance/future visioning from others more targeted and relevant.

Respect for environment - Stewardship, green infrastructure, and environmental campaigns

Environmental stewardship was revealed through physical signs of care and ownership [158] throughout the case studies. While some neighbourhoods had clearly defined environmental programs and campaigns, in others stewardship was evidenced mainly at the household level. Although often this was supported collectively and visible at the neighbourhood scale. Consistently, the case studies in Yogyakarta, Surakarta, and Bandung revealed that neighbourhoods had an interest in green-infrastructure and environmental campaigns. Meanwhile, the involvement of NGOs and environmental groups was observed as an important factor.

In Bandung environmental groups implemented greening programs to improve neighbourhoods directly along the river, as well as the river corridor itself. (Figure 3.4.6). For example, in the reaches of the river passing through the city centre an NGO encourages neighbourhoods to participate in greening campaigns, and brighten up narrow walkways and large walls with painted murals. Meanwhile in the upstream area another NGO has implemented a biofilter using *Vetiver sp.* to filter the domestic wastewater of a nearby village, and a third works with volunteers to revegetate the river edges, as well as educate. In Yogyakarta municipal schemes for river improvement are disseminated through education programs within riverside communities, in terms of individual behaviour (such as garbage disposal - Figure 3.4.7) and in terms of physical measures that can be taken within neighbourhoods (such as biopori - Figure 3.4.7). In Surakarta following devastating floods in 2007, the relocation of 1500 families from an area adjacent to the river [218] made way for a public park, urban forest, and floodplain. The local administration perceives the urban forest's ongoing maintenance as the responsibility of the city, and as an important step toward the city taking stewardship of- and feeling a sense of ownership of the park. Cleaning and maintenance events have been held since its completion involving the military, NGO's and the public. A variety of cultural events have been arranged by the municipality to enhance the city's relationship with the river (such as the annual Getek, or raft, parade).

The case study neighbourhoods along the Code and Winongo rivers of Yogyakarta provide valuable examples of neighbourhood-based improvements. Kampung Code illustrates the value of 'bottom up' and self-sustaining neighbourhood improvement, whereby the community continue to maintain their environment and adapt to environmental changes. Household greening in the form of home gardens (pekarangan) was observed in both formal and informal expressions in Bandung and Yogyakarta (Figure 3.4.8). In some neighbourhoods, where there was less space available for homegardens, space was found for potted plants along the riverfront. In Kampung Dukuh along the Winongo while the physical alterations and reinforcements to the river edge (gabions and rock-walls) are fairly new, the domestic elements that are already appearing along the riverfront (pot-plants, canopies, seating elements) illustrate the physical

Figure 3.4.6: Environmental groups focused on rehabilitation of the river-banks and neighbourhood greening are active in both the neighbourhoods in the upstream and urban reaches of the Cikapundung, Bandung. Author's field-work, 2012.

signs of the residents' care and ownership (Figure 3.4.8). The attitude of stewardship that these communities take is demonstrated through their continued maintenance of the riverfront.

3.4.2 b) Use of the river and riverside spaces

Socioeconomic and domestic use

While in the urban sites the opportunities for adapted uses and transformations of the riverfront spaces were limited, thus limiting opportunities for human activity; in the sub-urban sites the sociocultural significance of the river was still clearly evident. Daily uses of riverfront areas included economic, domestic, and recreational functions. The Cikapundung, Winongo and Code rivers all bore evidence of socio-economic and domestic activities occurring within, and/or alongside the river. These included use of the river edges for fruiting- or edible vegetation, fish- and bird keeping, and the harvesting of sand for use

Figure 3.4.7: Left, a sign in a park along the Winongo River, Yogyakarta, reads ‘I swear, I’ll be embarrassed should my river be filled with trash’. Right, Biopori have been drilled through hard surfaces in a riverside neighbourhood to increase permeability. Author’s fieldwork, 2012.

Figure 3.4.8: Home gardens, either formal or informal, are physical signs of care and ownership of the riverfront environment. Author’s fieldwork, 2012.

in construction. In the case of the sand harvesting, fine-grained naturally occurring sediment washed down the river was being incrementally collected. While in a natural system this might be viewed as destructive, within such a dense urban environment the harvesting of sediments can be viewed as a positive contribution to the maintenance of the functionality of the river channel.

Recreation and access to the river

For discussion of recreational use see: 'Open space - parks and playgrounds'.

3.4.3 Spatial aspects

Specific to riverine vernacular settlements, spatial aspects of landscape transformations included the re-orientation of settlements towards the river—including promoting the visibility of the river from the settlement, and the establishment of access ways, to facilitate access along the river and between the river and the city. Figure 3.4.9 details the types of activities or transformations that these entail, and prevalence within neighbourhoods included in the case study.

a) Access

Continuous walkway along river

Continuous walkways were observed to have been implemented along the river amongst four of the case-study settlements which were located in urban and sub-urban areas of Yogyakarta and Bandung (Figure 3.4.10). These walkways were largely constructed from stone and concrete, and edged with walls. Excepting in the steep riverbank area of Tegal Panggung

	Variables		Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta (Kampung Code)	Kali Code, Yogyakarta (Tegal Panggung)	Bengawan Solo River, Surakarta
Spatial Aspects	Orientation (toward river)		•	•	•	•	
	Access	Continuous walkway (along the river)	•	•	•	•	•
		Facilitated at-grade access	•	•	•	•	•
		Across the river (bridges)					
	Expansions	Foreshores (within river)	•	•	•	•	•
		Open spaces	•	•	•	•	•
	Walls and barriers	Embankment					•
		Wall (half)	•	•	•	•	
		Wall (full)	•				

Figure 3.4.9: Spatial aspects of riverine landscape transformation

(Figure 3.4.10 d.), houses and apartments were oriented toward the walkway—which served to provide them with improved access—and thus the river.

Facilitated at-grade access to river Facilitated at-grade access to the river was observed in only two of the case study settlements, the Cikapundung and the Winongo (Figure 3.4.11). In the former case no immediate benefit was visible, however in the latter case the river-access served to allow a nearby resident access to a foreshore formed by sedimentation along the river edge. This area was then planted with fruiting- and edible vegetation species.

Despite there only being two situations where river access was deliberately provided this was not the only instance where such behaviour was observed (see also 'Informal foreshores'), and this is described also in the following section.

Connections across the river (bridges)

Pedestrian connections such as bridges between riverside neighbourhoods (on opposite sides of the river) were only observed in two of the case study settlements, the Cikapundung and the Winongo (Figure 3.4.12). In both examples the bridges were observed to be functional. While the sturdy steel and concrete bridge in downtown Bandung provided access for pedestrians and motorcyclists; the narrow steel and timber crossing between sub-urban riverside neighbourhoods in Yogyakarta was also used for recreational activities such as fishing and socialising by men and boys.

b) Expansions

Informal foreshores (sedimentation)

Informal foreshores, forming from naturally occurring sedimentation along the river corridor, were observed to often be adapted by local residents for various socio-economic and domestic functions. Amongst four of the case-study settlements which were located in urban and sub-urban areas of Yogyakarta and Bandung (Figure 3.4.13) residents were observed to have accessed the river corridor for a variety of purposes. All of these areas were seasonally exposed.

Along the Cikapundung River a man was observed harvesting sand from a foreshore that had been colonised by grasses (Figure 3.4.13 a.). Meanwhile along the Winongo River, adjacent to a staircase providing river access, a resident has cultivated a variety of edible and fruiting plants (such as Carica Papaya) for domestic consumption (Figure 3.4.13 b.). In Kampung Code on the Code River a larger foreshore area—evidently there for some time because of the permanence of its adaptation—has a rectangular concrete fishpond, and banana culms (*Musa sp.*) among others (Figure 3.4.13 c.). In the neighbourhood of Tegal Panggung ducks are accommodated in bamboo pens and roam free on a foreshore area, which is limited by the river edge and the river (Figure 3.4.13 d.).

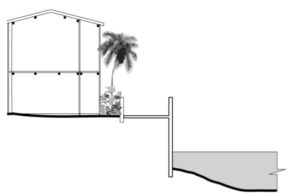
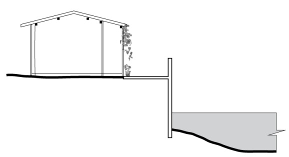
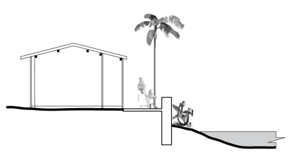
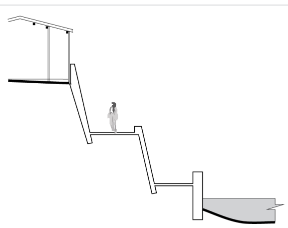
Continuous Walkway			
W	Schematic cross-section	Photo	Description
Cikapundung			Material: Concrete Function: Provide access along the river and orientate toward the river
Winongo (Kampung Dukuh)			Material: Concrete and unit paver Function: Provide access along the river and orientate toward the river
Kali Code (Kampung Code)			Material: Concrete and earth Function: Provide access along the river and orientate toward the river
Kali Code (Tegal Panggung)			Material: Concrete Function: Provide access along the river and orientate toward the river

Figure 3.4.10: Cross sections and photographs illustrating continuous walkways along the river within the case study sites.

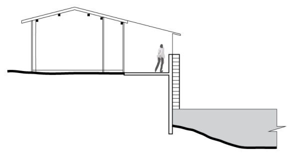
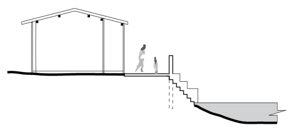
At-grade access			
A	Schematic cross-section	Photo	Description
Cikapundung			Type: Parallel staircase Function: Provides access over the wall into the river corridor
Winongo (Kampung Dukuh)			Type: Perpendicular staircase Function: Provides access from the neighbourhood into the river corridor, to both the water and domesticated foreshore areas

Figure 3.4.11: Cross sections and photographs illustrating facilitated at-grade access to river within the case study sites.

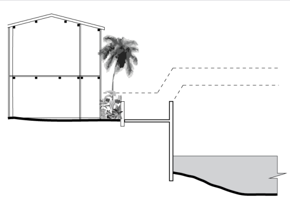
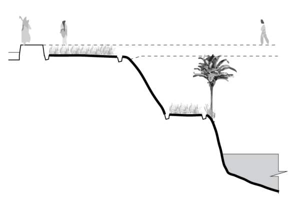
Connection across the river (Bridges)			
B	Schematic cross-section	Photo	Description
Cikapundung			Type: Pedestrian bridge Function: Provides access for pedestrians and motorcyclists between two urban neighbourhoods
Winongo (Kampung Dukuh)			Type: Pedestrian bridge Function: Provides access for pedestrians between two suburban neighbourhoods

Figure 3.4.12: Cross sections and photographs illustrating connections across the river (bridges) within the case study sites.

These adaptive uses of foreshore areas provide tangible evidence of the socio-cultural value of the river within the everyday lives of riverside communities.

Open space - parks and playgrounds

Amongst the case studies open spaces along the riverside were provided in various forms. Amongst the three case studies from Yogyakarta open spaces were observed along the river, implemented with varying success. In the case of the sub-urban case study along the Winongo River a neighbourhood playground has been outfitted with children's play equipment, brightly painted planters, and paved open space (Figure 3.4.14). The sub-urban setting facilitates a green, vegetated outlook.

Comparatively, open spaces along the Code River face greater limitations as its banks are significantly steeper and the urban area is more densely settled and less permeable due to prevalence of hard surfaces such as concrete and asphalt. Despite this an open space directly at the river's edge in Kampung Code is a lively and well-used (Figure 3.4.14). It buffers domestic activities (such as clothes drying), which are constrained within the dense neighbourhood, and provides space for children to play. Additionally, activities such as fish- and bird keeping whose profits provide additional income as well as being used within the home take place within and adjacent to the space. In the neighbourhood of Tegal Panggung steep terrain limits open space provision with only walkways accommodated. On the opposite side of the river at Suryatmanjan an apartment block (rumah susun) has been configured with open space below the block, and directly adjacent to the river. Compared to the apartments at Tegal Panggung this space is relatively unused by the residents and less lively as a result (Figure 3.4.15 L.). It appears that ground-floor activation—such as the residential ground floor at Tegal panggung—is important in facilitating

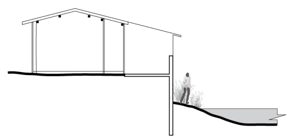
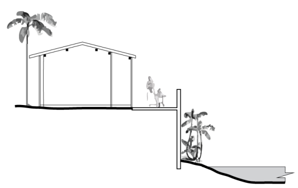
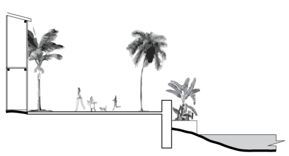
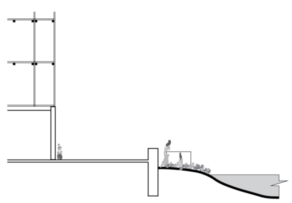
Foreshores			
F	Schematic cross-section	Photo	Description
Cikapundung			Type: Natural foreshore (sedimentation) Material: Sand Function: Collected for sandbags
Winongo (Kampung Dukuh)			Type: Natural foreshore (sedimentation) Material: Sand Function: Planted with productive vegetation that is used for domestic consumption
Kali Code (Kampung Code)			Type: Natural foreshore (sedimentation) Material: Sand Function: Planted with productive vegetation that is used for domestic consumption, used for animal rearing and fish keeping
Kali Code (Tegal Panggung)			Type: Natural foreshore (sedimentation) Material: Sand Function: Used for animal rearing (ducks)

Figure 3.4.13: Cross sections and photographs illustrating foreshores within the case study sites.

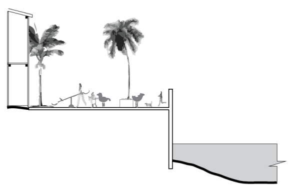
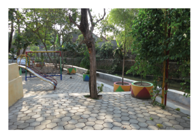
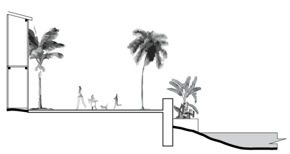
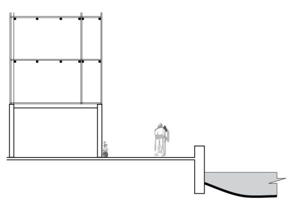
Open Space			
OS	Schematic cross-section	Photo	Description
Cikapundung			Type: Gathering area Facilities: Timber pavilion and sitting area Function: Used for recreation and environmental activities
Winongo (Kampung Dukuh)			Type: Playground Facilities: Children's play equipment, seating and ornamental planting Function: Used for recreation
Kali Code (Kampung Code)			Type: Multi-purpose space Facilities: - Function: Used for children's play, domestic tasks and animal keeping
Kali Code (Tegal Panggung)			Type: Multi-purpose space Facilities: - Function: Vehicle parking
Bengawan Solo			Type: Multi-purpose space Children's play equipment, seating and ornamental planting Function: Used for recreation and animal rearing

Figure 3.4.14: Cross sections and photographs illustrating open spaces within the case study sites.

Figure 3.4.15: Comparison between the use of the spaces next to and adjacent to the two rumah susun Suryatmanjan (Left) and Tegal Panggung (Right), two neighbourhoods separated by the Code River. The inhabited ground-floor at Tegal Panggung demonstrates physical signs of care and ownership. Author's fieldwork 2012.

community stewardship of a neighbourhood (Figure 3.4.15 R.).

Along the Cikapundung River open spaces are rarer and were mostly observed within the urban fabric, away from the river's edge. In the sub-urban area, a densely vegetated riverside park is equipped with a small pavilion. Community groups are involved in revegetation and education programs. Contrastingly, along the Bengawan Solo River near Surakarta the resettlement of a neighbourhood in compliance with the GR 38/2011 has allowed for a park and playground to be located within the floodplain (inside the embankment) (Figure 3.4.15 e.). Additionally, an 'urban forest' has been designed and planted (See Appendix for further detail). The significance of spatial constraints on the design of open spaces within riverside settlements is clearly evident when comparing these five case studies.

c) Limits / boundaries

Walls and embankments

Amongst the urban and sub-urban case studies flood protection was observed to be facilitated largely through the use of walls and embankments (Figure 3.4.16). While walls were observed in varying heights and widths in all of the urban and sub-urban case study settlements, only the Bengawan Solo was observed to have been appropriate for the implementation of a embankment (Figure 3.4.16 e.). This is perceived to mainly be due to the dense settlement of the other case-study neighbourhoods and their often steep terrain. In Yogyakarta walls have been used in riverside neighbourhoods since the late 1980s for protection from flooding, however the Merapi eruption in 2010 — in which lahar flowed along the rivers flooding the city—highlighted that higher water levels were not the only threat in this region.

The wider walls implemented along the Code River in the Kampung Code neighbourhood are adapted by residents and are used for domestic activities such as drying fish and clothing, and recreational activities such as socialising and fishing (Figure 3.4.16 c.). In comparison, the narrower walls implemented at the Cikapundung and Winongo riverside neighbourhoods were observed to be adapted for pot plants (Figure 3.4.16 a. and c.), and the narrow wall along the Code River in Tegal Panggung was observed to only provide a delineation/protection against the steep incline down to the river (Figure 3.4.16 d.).

In the case of the Bengawan Solo (Figure 3.4.16 e.) riverside settlements have been relocated and a embankment protects the city from flood. A road along the top of the embankment additionally provides a path network.

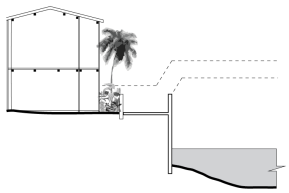
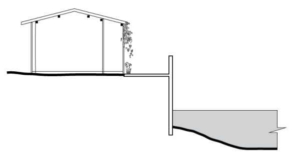
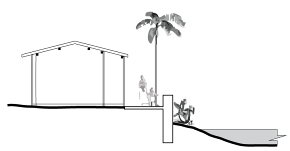
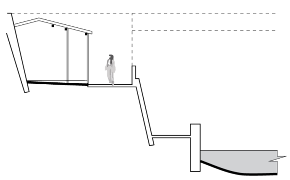
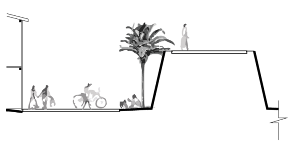
Walls and Embankments			
W/E	Schematic cross-section	Photo	Description
Cikapundung			Type: Wall Height: Variable, half to full Material: Concrete and stone Function: Prevent flooding from water
Winongo (Kampung Dukuh)			Type: Wall Height: Variable, half Material: Concrete and stone Function: Prevent flooding from water
Kali Code (Kampung Code)			Type: Wall Height: Variable, half Material: Concrete, stone, gabions Function: Prevent flooding from lahar (eruption) and water
Kali Code (Tegal Panggung)			Type: Wall Height: Variable, half Material: Concrete, stone, gabions Function: Safety and prevent flooding
Bengawan Solo			Type: Embankment Height: - Material: Earth with concrete roadway Function: Prevent flooding

Figure 3.4.16: Walls and embankments

3.5 Findings from the case studies

3.5.1 Synthesis of socio-cultural and spatial aspects of transformation of riverine landscapes

Specifically, I concluded that the following socio-cultural and spatial/physical aspects were common to positive examples of riverine landscape transformation when undertaking river improvement in Indonesia:

Firstly, transformations are often triggered from the 'ground-up', with communities and/or NGOs driving improvements to the physical environment. In cases such as the Code River in Yogyakarta (and Stren Kali Surabaya) changes to the river environment were proposed and implemented by communities and NGOs. Local residents can contribute site-specific knowledge based on their experiences living in riverside neighbourhoods, which may result in self-sustaining improvements.

Secondly, community involvement was an important socio-cultural factor within the case study sites. Amongst these case studies I observed various opportunities for ongoing engagement with the river environment, such as environmental programs, served to educate and involve residents in changes within the river corridor. Additionally, the siting of cultural activities such as festivals and community celebrations along (and within) the river added to a sense of ownership and responsibility toward the river. These all contributed to a sense of, and indeed evidence of, environmental stewardship being present within neighbourhoods. Community involvement was also observed to contribute to ongoing maintenance of riverine landscapes, with neighbourhoods engaging in upkeep of vegetation buffers, and sediment harvesting—which helps to sustain river flow.

Thirdly, I observed that positive examples of river improvement in

Indonesia–such as those described here—reveal the need for physical connections between neighbourhoods and rivers. Amongst these case studies, lively and cared-for riverfronts—like that of the Winongo and Kampung Code in Yogyakarta—illustrate the role of spatial orientation, accessibility, and scaling of spaces in establishing connections between neighbourhoods and rivers. Obstacles such as high walls, embankments, and embankments were physical barriers which limit interaction between neighbourhoods and the river (see also [222]). I observed that re-orientating neighbourhoods to face the river, ground floor activation, providing pedestrian access along and to the river, and providing spaces of adequate size for social, recreational, and other domestic or economic activities (whereby they do not impinge on the condition of the river themselves) were key spatial measures in these neighbourhoods. These resultantly supported an ongoing relationship between communities and the river, providing an opportunity for residents to interact directly with the river environment (see also [222]). Additionally, this physical proximity ensured residents with given a means to observe the temporal cycles of the river, which in turn supports resiliency and serves to educate them and make them aware to ecological changes. Retaining sightlines, and making channel dynamics visible, has been discussed to positively influence the ability of communities to monitor changes of rivers, which may lead to increased safety [195]. Interestingly, none of these case studies exhibited signs of vehicular access being provided along the river edges. While this could be seen as increasing risk during emergency events, vehicles were still able to access all neighbourhoods to some degree and riverside paths were wide enough for small vehicles such as motorcycles and carts.

Fourth, that resilience or tolerance of designs and communities to ongoing environmental disturbance (as illustrated by case studies in Surakarta Yogyakarta) was similarly important Figure 3.5.1. Based on their

Temporal aspects	Variables	Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta (Kampung Code)	Kali Code, Yogyakarta (Tegal Panggung)	Bengawan Solo River, Surakarta
Susceptible to-	Flooding	•	•	•	•	•
	Volcanic eruption (risk)			•	•	
	Sedimentation	•	•	•	•	•

Figure 3.5.1: Sites vulnerable to ongoing environmental disturbances such as flooding, volcanic eruption and sedimentation.

physiology the rivers suffer sedimentation (evidenced by the foreshores that have formed along their banks), as well as flooding. From our Yogyakarta case study, I observed that volcanic eruptions causing lahar flows were also a hazard. Therefore, some degree of separation can be seen as necessary to protect riverside neighbourhoods. However socio-cultural aspects can still be seen as valuable to maintain connection between the communities and the river. This reveals the challenge of separating—for the purpose of protection—while still maintaining visible and physical connections between neighbourhoods and the river. As such, benefits can be seen in implementing stepped/transitional designs, facilitating river access through selective spatial expansion, and providing submersible or tolerant infrastructures and structures such as walkways and buildings on piles. Existing stepped typologies were observed to be likely more a result of neighbourhoods working with existing—often steep—terrain, however, these were observed to facilitate neighbourhood resilience during events such as floods.

3.5.2 Typological study of riverine landscape transformation in Indonesia

Conclusively, restructuring of the inner-city river-edge allows the outer boundary of the river to be transformed and can contribute to the amelioration of rivers. This transforms the narrow river-edge into an interface and may lead to a stronger awareness of the river—including its water level fluctuations—and increases and differentiates useability [195]. Of the five process spaces identified within their catalogue, the sites included within the comparison fall into three categories: embankment walls and promenades; embankments and flood walls; and flood areas. Within this study I have observed the following limitations of Prominski et al's typological study, or Design Catalogue, of European exemplars within the densely settled context of urbanised areas in Indonesia.

First, economic, territorial and legislative limitations as a result of the typically bottom-up implementation of transformations discussed mean that larger spatial restructuring and implementation of innovative solutions is less likely to occur. For example, the 'extending space' category presents a range of methods to allow the water to spread, including setting back the embankment, retention basins, and flood channels. However, in the case of the Indonesian examples, projects were often limited to minor interventions and were unable to make strategic changes to the corridor such as these. The restriction working at independent sites means that small insertions such as retention ponds will have little impact beyond the local scale. A second example is the use of sand bags as temporary resistance and portable flood protection within projects. I observed that community deployment of flood protection elements, such as sand bags, was an important aspect of neighbourhood flood resilience. On the one hand such approaches are more low-tech than those proposed within the Design Catalogue. Resultantly, they ensure that neighbourhoods can

Design Tool	Design Measure	Cikapundung River, Bandung	Sungai Winongo, Yogyakarta	Kali Code, Yogyakarta (Kg. Code)	Kali Code, Yogyakarta (Tegal Panggung)	Bengawan Solo River, Surakarta
Linear spatial expansion	Intermediate levels		•	•		
Selective spatial expansion	River access parallel to the bank	•				
	River access perpendicular to the bank		•			
	Retaining sightlines	•	•	•	•	
Placing over the water	Suspended pathways (bridges)	•	•			
Tolerating	Vegetated foreshores (Designed or natural)		•	•		
	Economic foreshores	•			•	
	Submergible riverside paths	•	•	•	•	
	New embankment walls		•			
	Paths within the flood plain					•
	Sports facilities and playgrounds					•
	Parks within the floodplain					•
Differentiating resistance	Embankments as path networks					•
Vertical resistance	Integrating flood protection walls	•	•	•	•	
Temporary resistance	Portable protection elements (i.e. Sandbags)			•		
Placing over the water	Buildings on piles				•	
	Escape routes			•		

Figure 3.5.2: Design tools and design measures based on Prominski et al [195], and revised for the Indonesian context according to Author's fieldwork.

respond to threats as necessary, rather than needing to wait for assistance. As well, in the case of sand bags, local sand (such as that brought down the river by sedimentation) may be used to fill bags and thus also helps to maintain the river corridor. On the other hand, such measures ultimately only provide temporary resistance and must be coupled with other measures.

Second, classifications are typically limited to formal or 'designed' activities that don't allow for local human agency, which was demonstrated to be a significant factor in the success of the Indonesian projects. For example, foreshores were disclosed as an example of tolerance within constrained channels with boxed cross-sections, which have been common to many of our Indonesian case studies. While the ecological aspect of these marginal zones (their value as stepping stone biotopes) is represented within these sites — with such areas being colonised with vegetation either naturally or deliberately (by residents) — , I also observed that the deliberate colonisation of these areas often had an economic or domestic driver. A second example of the role of human agency is the integration of flood protection walls within neighbourhoods. While I observed that shallow and broad flood protection walls were often well-integrated into neighbourhoods this was largely by the efforts of communities to find alternative uses for them during the dry season rather than a deliberate decision of those responsible for its implementation. Thus I observed that an Indonesian toolkit needed to engage human agency as a contributing factor to riverine remediation within settled areas.

Third, classifications don't address the significance of perceived relationships between the river and the surrounding urban area. For example, the retention of sightlines between the river and the neighbourhood was revealed to be important in 1) establishing local stewardship, and 2) supporting resilience, amongst the Indonesian projects. Within the Design Catalogue retained sightlines — through the use of removable or transparent flood barriers — are acknowledged as a form of temporary resistance to flooding, which retains visual connections between the city and the river. In the Indonesian context the case is often the opposite, whereby due to increasing urban development and the deterioration of the river corridor neighbourhoods may have lost visual connections toward the river. In this case, sightlines and access — and the spatial restructuring necessary to achieve them — is integral to the success of designs and is observed to have a positive impact on local stewardship and resilience of neighbourhoods who are able to assess risk and evacuate when necessary [180].

3.5.3 Outlook

From these observations I recognise the challenges of the situation, as well the turning of the backs of these cities on their rivers, both figuratively and literally. Addressing RQ1 I can observe that to date, urban riverine remediation practice in Indonesia has largely fore fronted perceived civic aesthetics, housing, and river engineering, over locally embedded cultural and ecological concerns. These case studies illustrate the potential of projects centred on neighbourhoods and the local scale to have positive environmental impacts.

Addressing RQ2, a good overview of the improvement measures taken within the case study sites could be provided through the use of a socio-cultural and spatial framework. Additionally, the use of multiple sites allowed for comparison between such measures offering insights into the benefits (or landscape services offered) of particular approaches. Thus a comparative approach at the local landscape scale is demonstrated to be a potentially useful tool in understanding the range of measures, their spatial constraints, and provides a basis for future local-river specific planning as recommended by [285]. Applying such a spatially explicit methodology provides useful insights on how particular spatial measures, or typologies, contribute to the behaviours of those living within riverine landscapes.

According to Elizabeth Meyer culture ought to be sustained through landscapes, as the 'design of landscapes enables social routines and spatial practices, ... [and] translates cultural values into memorable landscape forms and spaces' [148]. Meyer goes on to argue that a sustainable landscape design should perform socially and culturally. She calls for an: 'intermingling of ecological and social temporal cycles… [Which] links the activities of everyday life and the unique events of a particular city to the experience of the dynamic biophysical aspects of the environment' [148]. Based on this study, I view sociocultural factors (such as education, involvement in changes, and consideration of social, cultural and economic needs of residents and communities) as equally as important as physical factors of sustained improvement.

While analysing the four rivers and the five case studies discussed here, unexpected aspects were identified, establishing new analytical criteria, and generating a more comprehensive and combinatory inventory of strategic design tools. Figure 3.5.2 above serves as a base for considerations during the research, thus leading to a wider methodological reflection useful in practice. Meanwhile, the series of locally specific spatial typologies—which have been informed by the socio-cultural and biophysical conditions of four Indonesian rivers—provide an indication of key spatial and socio-cultural measures, which ought to be considered in designing sustaining improvements. Through this analysis it has become increasingly apparent that while studying riverine landscape transformation through the lens of socio-cultural and physical factors is useful for analysis, they cannot be separated completely as both affect the other.

Every town grows up in a given place, becomes wedded to it and, with very few exceptions, never leaves it. The original site may or may not be a wise choice: its initial advantages and disadvantages stay with it forever.

Fernand Braudel, 1973

4 Practices Revisited

4.1 Historical overview of riverine landscape transformation in Jakarta, Indonesia

4.1.1 Rivers as organisational structures, evolving attitudes and practices pertaining to riverine landscapes

Marshall [139] contends that waterfront regeneration concerns both past and future. Thus, the origins of cities proximal to water, means that regeneration projects focused on the waterfront offers an opportunity to reconnect and revitalise precincts and human-water relationships [224]. This chapter aims to offer an alternate perspective on the role of rivers as organising structures in urbanising Southeast Asia. This angle highlights the richness of the precolonial water narrative, in which water — and its management — held an integral and sacred role in indigenous societies. Furthermore, it suggests that the problematic waterscape of Jakarta has been acknowledged since the precolonial era, however was aggravated by material practices of the colonial and postcolonial eras.

I study this complex relationship between urban regions and water through a focus on the Ciliwung River in West Java, one of 13 major rivers that cross the city of Jakarta—which was previously known as Sunda Kalapa (<1527), Jayakarta (1527-1616), Batavia (1616-1942) and then Djakarta (1942-1945) (See figure **??**). The study takes an interpretive-historical approach to the study of the riverine landscape. Firstly, it initiates the primary case study of the neighbourhoods of Kampung Melayu and Bukit Duri (which is the focus of Chapter 5), locating them within the context of the region's development. Secondly, it aims to explore the evolving attitudes and behaviours relative to the riverine landscape in Jakarta, and the belief systems that shape this, as was called for by [182] within the literature review (See Chapter 1.3). A set of maps documenting the city's development along the Ciliwung River, along with photographs of river—human relationships provides insights to the transformations of the riverine landscape.

4.2 Approach to the historical study

Water management practices formerly embedded in Southeast Asian urbanisation have been compromised in favour of its modern development policies. In the first millennium CE, around 80% of Javanese settlements were proximal to rivers, with Javanese water systems benefiting villages and communities. To date the evolving role of Jakarta's rivers and water systems has remained incomplete, with contemporary discussions focussed on either the colonial and/or postcolonial periods

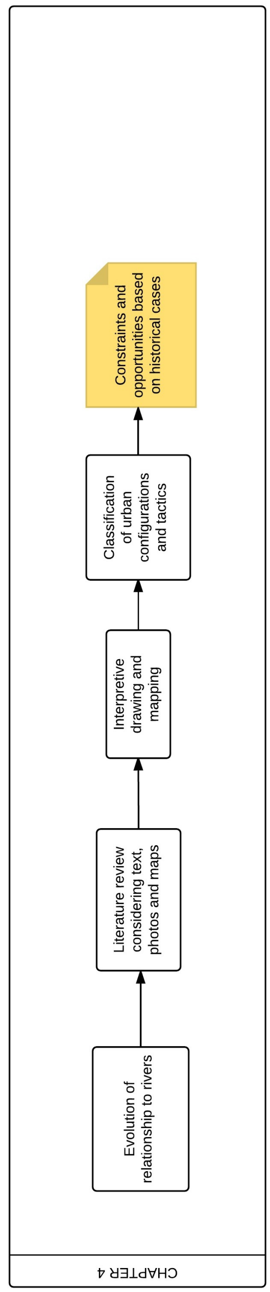


Figure 4.1.1: Overview of Chapter 4.

[111, 197, 199]. In this chapter I seek to study the extended socio-cultural evolution that has transpired, charting the transition of the settlement from dispersed villages within a state, to a growing urban area under colonial rule, to a megacity. I study this complex relationship between urban regions and water through the Ciliwung River.

The imposition of foreign landscape logics—including water management strategies—which failed to recognise the local rhythms and processes of the landscape, changed the region's relationship to water. A downward vector of environmental conditions paralleled an upward vector of urban development. Consequently, settlements re-oriented, turning away from rivers and water bodies, physically as well as socio-culturally. Paradoxically, rivers and water systems have retained significant influence in the city—although now largely in the form of disruptions—despite these transformations.

The urban growth of Jakarta has been documented through map series [243], and through the combination of maps and historic postcards [146, 147]. While Surjomihardjo's study provided a good understanding of the shift of the urban limits and triggers for development within the greater Jakarta area and Ciliwung River catchment from the precolonial time until the 1980s, the rudimentary nature of the supporting maps and diagrams prove difficult for comparison and are now outdated. On the other hand, Merrillees' spatially explicit study of historic photographs and maps provides insights into the development of the Jakarta city centre. However, the two-book series—by nature of its focus—does not elucidate on the area beyond the core, nor does it focus on any one component of the city's development (such as rivers).

Following the water urbanism approach, Prathiwi Putri and Rahmanti[197] and Bruno De Meulder[57] study the evolution of the territory in relation to its water narrative to understand its challenges. Putri and Rahmanti attribute the 'problematic waterscape' of Jakarta to:

first, material practices that have been socially constructed through history; and second, the water sector and spatial development issues. De Meulder similarly connects the problematic waterscape of Jakarta to its spatial development, linking this to the formative spatial planning of the city. Both tie the development paradigms of the colonial period to these troubles. While Putri and Rahmanti attempt to discuss the transformation in the perception of water throughout the development of the city, a clear perspective on the precolonial period is lacking, as are the more recent (2000-2010) proposals for the Jakarta area.

Other authors have discussed the engineering accomplishments of the colonial period, focussing on irrigation and drinking water supply [199], and the socio-cultural aspects of water use and water delivery [111]. Meanwhile, Nagtegaal's[155] examination of the ongoing process of the development of Batavia/Jakarta uncovers significant transformations in the perception of the value associated with urban greenery.

The precolonial history of the city is largely absent from these perspectives of the socio-spatial development of Jakarta. Resultantly, I argue that to discern the conceptualisation of riverine landscapes (RQ1) it is necessary to take a full transect through the history of the city, from the precolonial to the present-day. Additionally, I suggest that the photographic, cartographic, and descriptive records of the city may shed light on the tactics and behaviours of transformation of those living within and affecting the city's riverine landscapes (RQ2).

4.2.1 Materials, methods and framework: Unfolding interpretive mapping as a tool to understand the interdependent relationship to landscape

The nature of the information available for each timeframe meant that I took a slightly different approach for pre-colonial, and colonial/post-colonial periods.

Firstly, with the precolonial, colonial and postcolonial timeframes as a framework for the study, I use archaeological and historical data to produce a spatial and chronological sketch of the evolving relationships of settlements to the river. Seeking to understand the shift in settlement from a chosen 'proximity to water' to 'avoidance of water' I analyse the perceptions and practices of these periods that have resulted in these landscape patterns. This chapter reviews the available literature and cartographic data to understand the attitude toward water bodies within each timeframe. These attitudes are then used to decipher the cultural precepts of those societies.

Secondly, from the cartographic data I construct a series of interpretive-analytical maps to draw out spatial patterns within the development of the settlement. Kelly Shannon [226] positions interpretive mapping as a 'first step to transform a territory'. Perceived as an inevitably subjective act, within which one reframes documentation, it is at the same time creative. Interpretive mapping as a tool to describe, understand and interpret the processes conditioning urban landscapes draws its origins from the descriptive urbanism of the 1990s [226]. Descriptive urbanism sought to address the challenge of visually representing the phenomenon of urbanism and structurally intervening. It comprised new means of drawing, mapping and describing urban forms. Shannon, following urbanist Bernardo Secchi, cautions against describing without revealing new knowledge and argues for an operative process which involves a careful and critical reading of territories, resulting in 'designerly investigations of potentials'.

Thus, building from the approaches of Surjomihardjo, Putri and Rahmanti and De Meulder [57, 197, 243], I use a comparative mapping process to discern changes within the paradigm of urban riverine landscapes. At the same time building from the approach of Merrilees [146, 147], and Kooy [111] I couple photographs of spatial conditions with a discussion of the development processes of the city. From the photographic information I further piece together a description of the attitude toward water within the later time frames.

4.3 Precolonial transformations <1616: The origin of the human-water relationship

4.3.1 Concepts and cultural practices

While data on aspects such as early urbanisation in Southeast Asia is rare [17], the coupling of water and religion is evident within Java [45] through a review of the theme of water within the archaeological and epigraphic record. Having reviewed the tax charters of the period (which have been preserved in inscriptions) Christie concludes that it '... seems unlikely that the origins of these states [in Java] reflect a perceived need for central direction of large-scale, regional water control schemes' [45]. This indicates that Karl Wittfogel's popularised and debated thesis of hydraulic civilisations , which peaked in Asia, is less useful here in framing the precolonial significance of water for the region. Conversely, the pervasive role of water in the society of Java is clear in many aspects of the precolonial society [32, 45, 184].

The following section discusses the pervasiveness of the human—water relationship in Java, and specifically the area of West Java the Ciliwung River flows through. I give examples of the relationship between cosmology and symbolism, and spiritual and political aspects with Javanese water management and settlement; spiritual connections to landscape topologies and sites; ecological gradients; and myths, stories and folklore.

Cultural interaction between India and Indonesia is evident in Java as a result of travels for trade and knowledge enquiry during the time of the sea-based Srivijaya kingdom (ACE 600-1290). The exchange was reciprocal, and indigenous ideas are revealed to have fused with Indian ideas, providing 'fertile ground for the growth of the Hindu-Buddhist classical tradition' [211]. The pre-existing indigenous Southeast Asian culture was essentially characterised by animism and nature worship, the belief in a 'life force' animating objects and beings. This life force was seen to be exceptionally strong in particular persons, animals, or locations, including mountains and ancestors. Literature suggests that this place-centred aspect of indigenous beliefs largely influenced the reception of Hindu-Buddhist beliefs within Southeast Asian religious systems within Java. Resultantly, Mahameru cosmological concepts—where the sacredness of mountains is central—appear broadly influential [211].

Following Hindu-Buddhist cosmological ideas, the universe centres on Mount Meru, which is surrounded by seven oceans, and seven continents (Hindu) or mountain ranges (Buddhist), arranged in concentric zones (See Figure 4.3.1). Considering the idea of the fundamental relation between universe and state, the state was to be centred on Mount Meru, with natural hillocks—representative of the heavenly mountain—being a strong determinant of location in earlier periods [89]. The religious system provides horizontal and vertical spatial structuring principles, corresponding to the hierarchical order of the universe, which inform the physical form and spatial organisation and distribution of settlements and agriculture [210, 211]. Meanwhile, myths, legends and lore of particular geographic locations serve to explain environmental or social interactions and conditions [271].

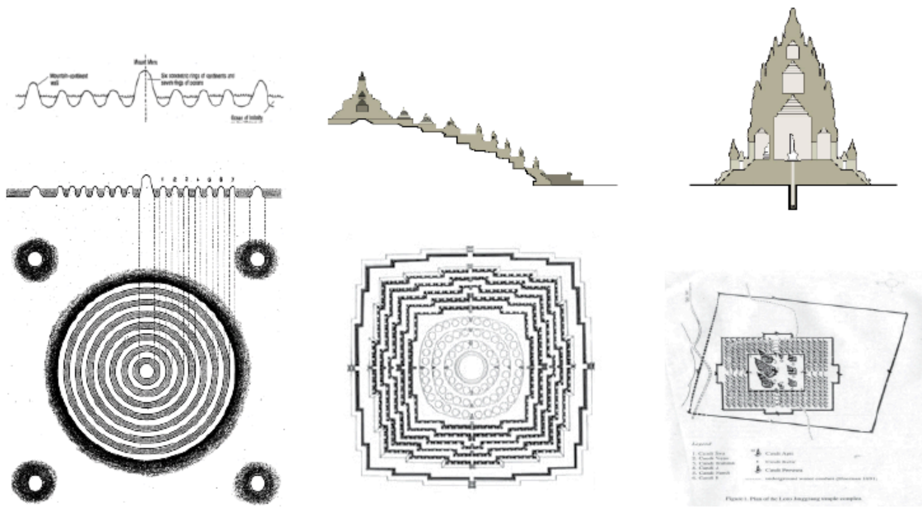


Figure 4.3.1: Sections and plans showing the mandala- or cosmologically-derived organisation of structures in Java (left), including Borubur (centre), and Prambanan (right). Sources: Redrawn by author from [241]

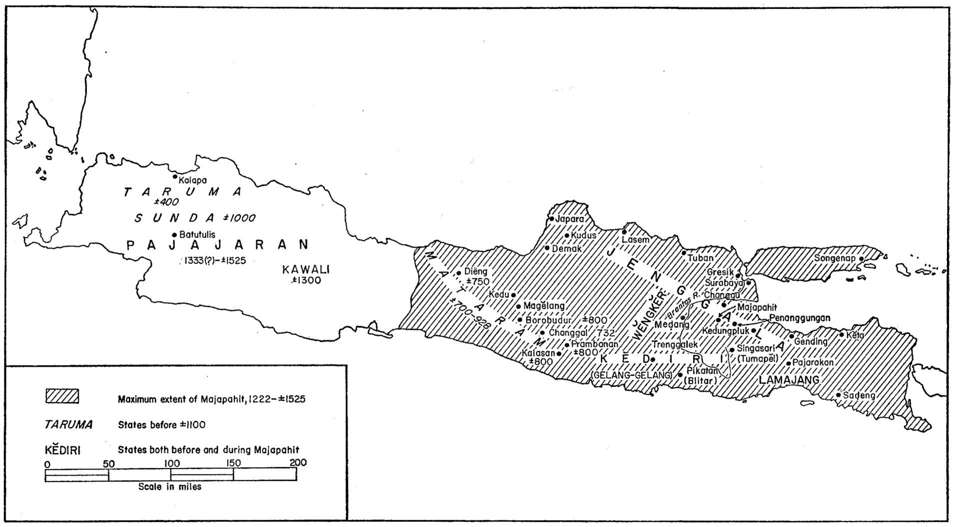
Spiritual and political aspects of water management

States founded on a Hindu cosmological model were hinged on a belief that 'the state should be a microcosmic reflection of the larger cosmos, and that the organisation of the state must parallel that of the cosmos' [278]. There is plentiful evidence of the cosmological basis of state and kingship in Southeast Asia, found in literature and inscriptions, nomenclature, rites and customs, art, and organisation and structure of settlements and architecture. The cosmic state was intimately bound up with the idea of divine kingship. The divinity of kings was conceived in various ways according to the prevailing religion. Where Hinduism prevailed the king was considered to be either an incarnation of a god or a descendant from a god or both [89]. Christie observes, 'rulers had an intimate link with water through their role in religion' [45].

According to Hindu mythology the condition of the realm or kingdom directly reflected the state of the ruler: 'a tranquil and proper king on the throne would naturally lead to tranquillity and welfare in the realm' [273]. Early rulers were thus responsible for the wellbeing of their kingdom, like the god Indra, 'who manipulated the serpent-cloud on Mount Meru' [241] and was god of rain and fertility. A kingdom's wellbeing might be indicated by physical abundance, which was attained primarily through the successful provision and management of water [165, 211, 273].

Five inscriptions from the fifth century ruler of the Tarumanagara kingdom, Purnavarman, reveal a consistent link between water, leadership, and religion. Most of these inscriptions were located along rivers [45] (Figure 4.3.7). The kingdom of Tarumanagara existed between the fourth and seventh centuries and appears to have seen its peak in the fifth century during Purnavarman's rule [85, 273]. The kingdom is known primarily from these inscriptions . Taking their locations as an indicator, Tarumanagara covered much of West Java, west of present-day Jakarta (Figure 4.3.2). Several inscriptions are located proximal to present-day Bogor, and the Tugu inscription—of particular interest here—is situated to the east of present-day Jakarta's Tanjung Priok harbour [273]. It is broadly hypothesised that the Tarumanagara state's centre may have been located here because of the inscription's content [168, 273].

'The Candrabhaga [canal], formerly dug by the great king of kings, Pinabagahu, passing along the famous city, flowed into the sea. The beautiful Gomatī [canal] with clean water, dug within 21 days – beginning from the 8th day of the dark fortnight of the month Phalguna to the 13th day of the bright fortnight of the month of Caitra – in the 22nd year of the prosperous reign of the illustrious Purnavarman, glorious, virtuous and powerful as also most excellent among kings, – measuring in length 6122 dhanus [bows], cutting across the cantonment of the grandfather, the saintly king, and … is [now] flowing forth' [273].



2. Javanese Kingdoms before 1525

Figure 4.3.2: Javanese Kingdoms <1525 Source: Soedjatmoko

The *Tugu* inscription (see above), which is specifically pertaining to water management, must be viewed in the context of these beliefs. The inscription illustrates that Purnavarman was fulfilling his role as a ruler, benefiting his people by constructing a watercourse. The description of the two canals is of significance as it serves to conceptually align Purnavarman's palace (kraton) with that of the god Indra whose heaven is the source of India's sacred rivers [272]. Specifically, the physical arrangement of the palace of a ruler or the city was important, and it was believed that it should lie either between two rivers, or within the oxbow of one, as did Indra's heaven [272]. The first canal, the Candrabhaga, is described as flowing past the city—which Wessing presumes was named Taruma. Meanwhile the second canal, the Gomati, cuts through an ancestral location—the compound of Purnavarman's grandfather—, which is generally agreed to instil the water with ancestral blessings [45, 272, 273].

The naming of the canals is also of symbolic significance, with both named after great and sacred rivers in India. The Candrabhaga and Gomati are said to be transcendental and can purify those who remember, touch, or bathe in them. Moens notes that the transplanting of sacred toponyms often occurred within a process of cultural expansion (Moens in Wessing [273]) — such as that of the Hindu-Buddhist expansion within Southeast Asia—however, in this case Moens and Wessing agree that the symbolic aspect of these names may have had the most significance.

The literature attributes that the other practical uses of the canals — such as irrigation and drainage — would have been secondary to their symbolic function [45, 272]. Wessing observes, that the matter of Purnavarman's waterworks being man-made canals rather than naturally occurring rivers is not unusual, either in Java or Southeast Asia generally [272]. These inscriptions, as the earliest surviving inscriptions of Java and Bali, illustrate a fixation with the ritual over the pragmatic aspects of water and a deep-rooted symbolism at play [45]. Furthermore, I can argue that the worship of the Tugu inscription by villagers using flowers and incense, which was observed as late as 1879 [168, 211], demonstrates a persistent preoccupation amongst the Javanese with landscapes and sites.

Spiritual connections to landscape topologies and sites

Another concept that cannot go unmentioned is the symbolic significance of landscape topologies within the region, particularly relating to cosmology. The general significance of mountains in Southeast Asia is well recognised, correlating to cosmic principles centred on Mount Meru. Local hills and mountains may be used as representations of the centre, or in their absence artificial ones (in the form of hills or structures) might be constructed [89, 271]. The central mountain would thus be largely focused on bringing cosmic energy into the realm, while others might be used as burial places for ancestors and would be places of pilgrimage and spiritual retreat [271].

While shrines and temples were characteristically used for worship, landscape features — such as mountains, forests, rivers, estuaries, springs and caves — were seen to have extraordinary influences often surpassing that of the shrine or temple. Rivers, springs and mists originating in the mountains were believed to have curative, fertilising, and purifying' properties. Thus, it's likely that locations of spiritual structures were influenced by beliefs about the landscape's sacredness to draw from their mystical energies. Additionally, this serves to explain the hidden sanctuaries (including bathing places) in the mountains and caves of Java and Bali, as well as larger temple complexes [211].

Bathing places have been important centres of community life and religious ritual in Java since ancient times. Meanwhile, ritual washing or bathing has long been undertaken—and indeed still is—within major transitional moments of the lives of the Javanese . Bathing places and canals, while seemingly less significant than the huge waterworks elsewhere within Java and Bali as well as Asia and Southeast Asia, served the requirements of the indigenous, animistic religion preceding the advent of Islam . Conversely, the large temples catered to the needs of the ruler and were the focus of state worship. The caves and bathing places served as spiritual retreats and refuges due to their isolation and inaccessibility . Caves were often also connected with water sources—having internal springs or being located near and orientated toward lakes and rivers—and mythical figures, such as Nyai Lara Kidul, described later [211].

Ecological gradients

Based on a study of myths, legends and lore of an area near Bandung in West Java, [271] describes an ecological gradient within Javanese landscapes, running from high to low elevations: 'from the forested mountain top via the dry gardens to the irrigated lowlands running parallel

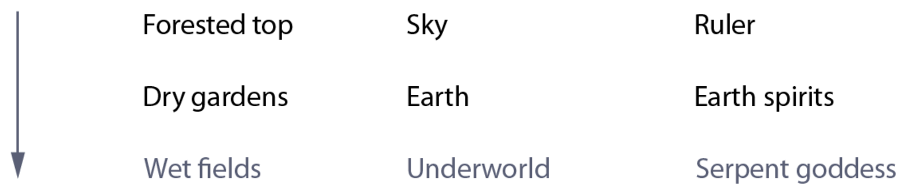


Figure 4.3.3: A spiritual gradient connecting sky, earth and underworld to the ruler, the earth spirits and the serpent goddess. Redrawn from Wessing [271]

to a symbolic/mythical gradient connecting the sky, earth and the underworld via the ruler, the earth spirits, and the serpent goddess' [271]. Here, water can be seen as corresponding to fertility, abundance and femininity, as well as the underworld.

A significant remnant of Old Sundanese literature reveals the importance of regions, rivers and mountains in Javanese spirituality. The story of Bujangga Manik (told in the Sundanese language in narrative poetry, and written circa late fifteenth to early sixteenth century) relates the journeys of a Hindu-Sundanese prince at the court of Pakuan who had chosen to live as a hermit. Included are accounts of two expeditions departing from Pakuan, and in both instances he travelled across central and eastern Java. While the story is in essence fictional, the accuracy of the topographical detail described in the narrative proves the story was based on contemporary reality. The narrative as a whole lists some 450 names of places, regions, rivers and mountains met with by Bujangga Manik, some of which still exist in present-day Java [169]. One of these journeys, from Kalapa, which was the principal commercial port of the kingdom of Pajajaran (14th-16th century) (now: Jakarta), to Pakuan provides background on the regional significance of the Ciliwung River and its sacredness. The narrative proclaims the 'Great Mountain'—identified by Noorduyn as Mount Gede—as the source of the Ciliwung (Ci-Haliwung), the site of the sacred lake (Talaga Warna), and a sacred place of the people of Pakuan Pajajaran (now: Bogor).

'When coming to the Great Mountain: that was the source of the Ci-Haliwung, the holy place of the people of Pakuan, the sacred Talaga Warna.' (Translated in [169])

Understanding this passage, along with an appreciation of Wessing's ecological gradient of Javanese landscapes, we see that specific topological features (for example: reservoirs such as the lake at the top of Mount Gede) have held spiritual and symbolic roles, perhaps in addition to more practical functions [31, 45]. In addition, '... the special power of these water sources is connected with an attitude about the sacredness of nature and the landscape' [184]. Which may be attributed to pre-Hindu-Buddhist beliefs [184, 211].

According to [207] the traits and habits of the Betawi—the indigenous people who lived in the area of modern-day Jakarta—were 'shaped by the natural environment of Jakarta' and this directly influenced their concepts of space. Based on archaeological findings Rizal describes the Betawi as 'riparian people who identify themselves with trees, even forests, and water' and draws on historic placenames as evidence, which each describe the characteristics of the local environment and illustrate the attitude of the Betawi who saw nature and humans as integrally linked.

Myths, stories and folklore

Numerous folklores or myths are also tied to this notion of cosmology and ecological gradients. Within these stories water — in various forms — often plays a role. These stories are often tied to particular landscape topologies and mythic constructions about a particular place. Often a story has geographic ties to multiple landscape regions, and protagonists are recognised to share identities. The example of Nyai Lara Kidul — the

Goddess (or Queen) of the Southern Ocean — , an underworld character often associated with water, fertility and abundance, will be used to demonstrate this.

Nyai Lara Kidul is associated with both West and Central Java. Throughout these regions she is recognised as a fertility goddess and ceremonies are held to ask her protection and blessing [90, 127]. Meanwhile, she is also linked to other Javanese and Sundanese ancestral figures, including the Hindu goddesses Durga and Dewi Sri [186, 271] who are also said to be fertility goddesses. Prior to her incarnation as an underworld goddess she is believed to have been the daughter of a ruler of Pajajaran, in West Java. Nyai Lara Kidul is said to have committed suicide after becoming ill by throwing herself into the Southern Ocean. Following her death, she was healed from her illness and immortalised, and is said to rule over the evil spirits [271].

Nyai Lara Kidul is particularly known for her otherworldly affiliation with Central Javanese royal courts—the House of Mataram and the later sultanates of Surakarta and Yogyakarta—, where she is believed to be a serpent goddess, who consorted with Central Javanese rulers in their palaces, such as the Taman Sari in Yogjakarta. Similar legends—of rulers engaging with serpent goddesses—exist within other parts of Southeast Asia. According to mythology the serpent demons (Naga) are the rulers of the soil, thus, consorting with the Naga—as the rulers of Central Java are said to have with Nyai Lara Kidul—legitimises the claim of the king and forms a link between the heavens and the earth. [89]. Naga are broadly recognised as the 'guardians and controllers of water' (Crooke, in [271]) and were believed to be able to transform into women at night, visiting and bestowing ambiguous gifts, 'blessings and injury, life and death, health and sickness, wealth and ruin' (Hidding, in [271]). As I connected earlier, using Wessing's ecological gradient, water corresponds to fertility, abundance and femininity, as well as the underworld and politics.

4.3.2 Urban morphology

Water in architecture and settlement patterns

McGee groups early Southeast Asian cities into two loose categories: 1) the 'sacred city'; and, 2) the 'market city'. Sacred cities commonly feature architecture following cosmological principles. Monumental structures, observed in Prambanan, Borubudur (8th 9th century) and Trowulan in East Java and Batujaya in West Java, indicate that urban forms might have already existed within these eras. Market cities like Kalapa (4th century Jakarta—See map of 1618, Figure 4.3.8, illustrating the form of the 'market city' of Jayakarta (17th century Jakarta), on the cusp of its colonial transformation.), instead, have left limited built evidence [142], being structured around a trading port and drawing income primarily from maritime trade. The outward-looking focus of market cities means that they are by nature 'more cosmopolitan' than sacred cities [142, 278], and hence these have been characterised by ongoing transformation.

Archaeological findings from the Srivijaya period (in which maritime powers dominated, see Figure 4.3.6)) indicate that layouts of royal capitals from this period (such as Majapahit in East Java) followed the Indian, Hindu ordering principle of Mandala ([276]; and others). Evidently, cosmology also had strong implications on settlement patterns within SEA [10, 241, 277], with poles of universal order (high to low) also informing village placement and organisation of functions (Figure 4.3.5). With this physical organisation, the river functioned as the main axis of transportation between the outside world and the hinterlands, and resultantly villages established along rivers. Widodo writes that vernacular settlements — or kampungs — were found within particular landscape settings, being typically sited between a high point (such as hills) and water (the coastline or a river) (Figures **??** and 4.3.7). Important buildings and functions were positioned either on the highest land in a village's

Figure 4.3.4: Map of the maximum extent of the influence of the Srivijaya Kingdom, around 8th century, including expeditions and conquests. Redrawn from Gunawan Kartapranata 2009.

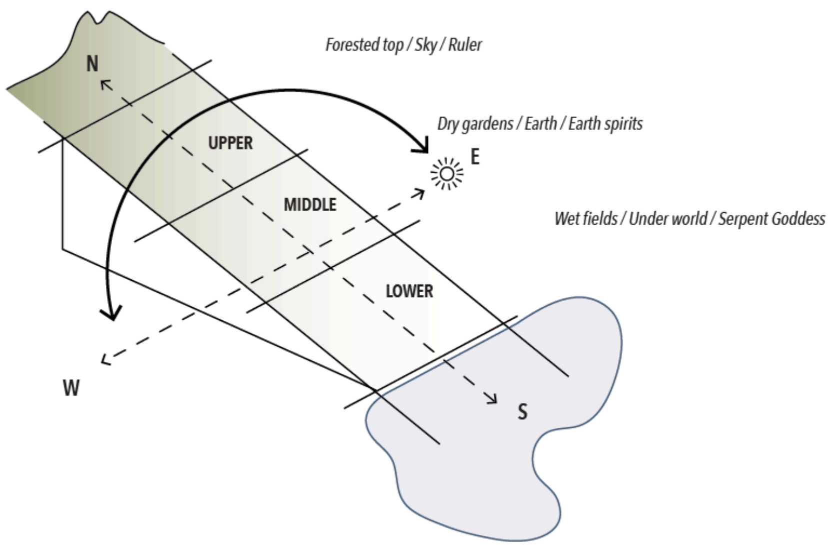


Figure 4.3.5: Illustration of the ordering principles of settlements based on cosmology in relation to the spiritual gradient. Redrawn from Widodo [276], and Wessing [271].

proximity, or in line with a mountain. The least important buildings and functions — including those correlated with death and impurities — were placed on lower terrain, often toward the waterfront. I observe that this correlates with Wessing's ecological gradient, described earlier. Thus, within Figure 4.3.5 I ascribe two parallel and complementary gradients influencing the organisation of precolonial settlements: the cosmological and the ecological.

Historically, Kalapa was the commercial hub of the kingdom of Pajajaran. It was connected to the royal seat of Pakuan Pajajaran—which was located in the foothills of Mount Gede Pangrango—by the Ciliwung River (Figure 4.3.7). The port town remained significant to the later kingdom of Sunda,

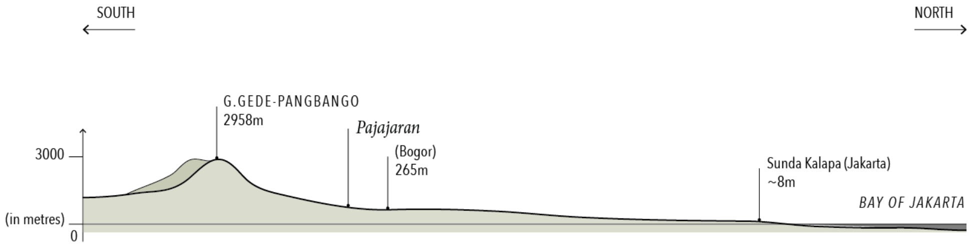


Figure 4.3.6: Cross section illustrating the situation of Gunung (Mount) Gede—Pangrango, Pajajaran, Bogor and Jakarta, in relation to the Bay of Jakarta Illustration by Author, based on Van Bemmelen 1977 c.f. Caljouw [40].

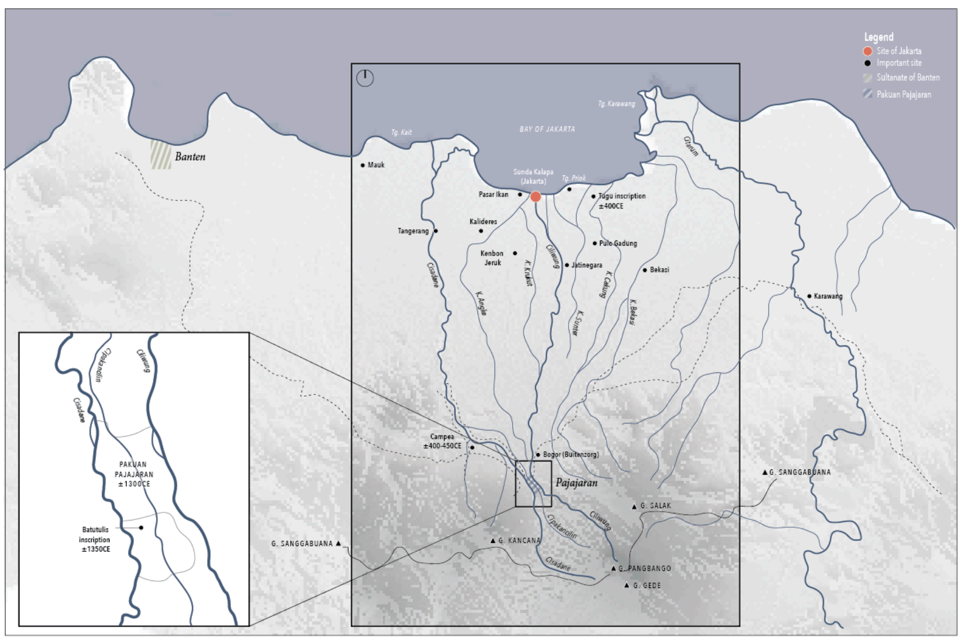


Figure 4.3.7: Map illustrating the location of historical sites within the region demonstrating the impact of the ordering principles region's structure. This includes the Tugu inscription, the port of Sunda Kalapa (now: Jakarta), and the royal residence of Pakuan Pajajaran (now: Bogor), West Java, which is sited between two rivers in the highlands toward Mt. Gede. Map by Author, based on Ten Dam's 1951 reconstruction of the Pajajaran Kingdom in [243] and Heuken's 'Historical Sites of Jakarta' [94].

which lasted from the 8th-16th centuries (hence the name Sunda Kalapa). The eastern boundary of the Kingdom of Sunda was demarcated by the Citarum River, and the port cities (such as Kelapa) providing important links between the maritime trade routes and the hinterlands and royal residences located in the highlands (such as Pakuan Pajajaran) (See Figure 4.3.7). A sketch of settlement along the Ciliwung in the kingdom of Sunda, or the later precolonial era, can be drawn from the tale of Bujangga Manik, meanwhile the accounts of Portuguese and Chinese traders can also provide some detail. As observed earlier, the narrative of Bujangga Manik, which mostly describes travels between West and East Java, includes mention of both the port town of Kalapa and the royal residence at Pakuan Pajajaran. This may be cross-referenced with accounts from the literature. Such reports of Kalapa mark some of the earliest descriptive records of what is now known as Jakarta.

a) From Kalapa to Jayakarta

The port town of Kalapa is believed to have existed since the 4th century ACE, and was the primary commercial port of the region from around the 14th-16th century ACE. Overland travel existed though water-based navigation was evidently significant. Bujangga Manik's tale describes arriving in the port after a one-month sea voyage from Pamalong, a town on the northern coast of Central Java. Prior to its demolition by the Dutch in 1619, Jayakarta was described to be a town of around ten thousand people, built on the western bank of the Ciliwung. Consistent with Javanese town planning, the town was centred around royal residence (dalem) of the Prince of Jayakarta, which was located next to the square (alun-alun), and mosque (masjid). The market (pasar) was located on the bank of the river. This may be seen in the 1618 map (Figure 4.3.8), which reveals the significance of the river in the organisation of the precolonial town. The square and royal residence lie along a north-south axis, consistent with the Hindu-Javanese cosmological principles of organisation that were practised (described earlier) [10].

The town had a reputation as a provisioning port; as it had a good harbour, fresh drinking water, local timber for repairs, and 'arak' - a Chinese rice wine. Incoming ships were controlled by customs officials at an office (pabeyan) which was situated west bank of the Ciliwung River, near the river mouth [169]. The town itself was surrounded by a timber palisade. Beyond this lay a thinly-populated region of swamps and jungle [2]. These swamps are likely to have acted as 'sponges' or natural drainage systems.

Kalapa was known to Chinese traders as a source of pepper, and remained the principle port of West Java until the 1520's. Early written sources describing Kalapa include the journal of Portuguese traveller Tomé Pires who visited Java's northern coasts between 1512 and 1515. Pires describes Kalapa as a 'magnificent port… the most important and best of all. … [W]here the trade is greatest and thither they all sail from Sumatra and Palembang, Laue, Tamjompura, Malacca, Macassar, Java and Madura and many other places'. Products in circulation included pepper, rice, vegetables and fruits, animal products and gold. In 1527 a Portuguese armada arrived in the harbour of Kalapa seeking to overthrow the local administration, however Muslim forces from Demak and Cirebon defeated them. The port town was named Jayakarta, and at this time became a secondary port to Banten.

b) Pakuan Pajajaran: the royal residence

Within the larger landscape region it is again evident that the location of cities and residences was closely tied to water. I have described the significance of the Ciliwung River linking the port city of Kelapa to the hinterland and Pakuan Pajajaran. But Noorduyn goes further, writing that the Ci-pakancilan River was said to have 'flowed through the length of the

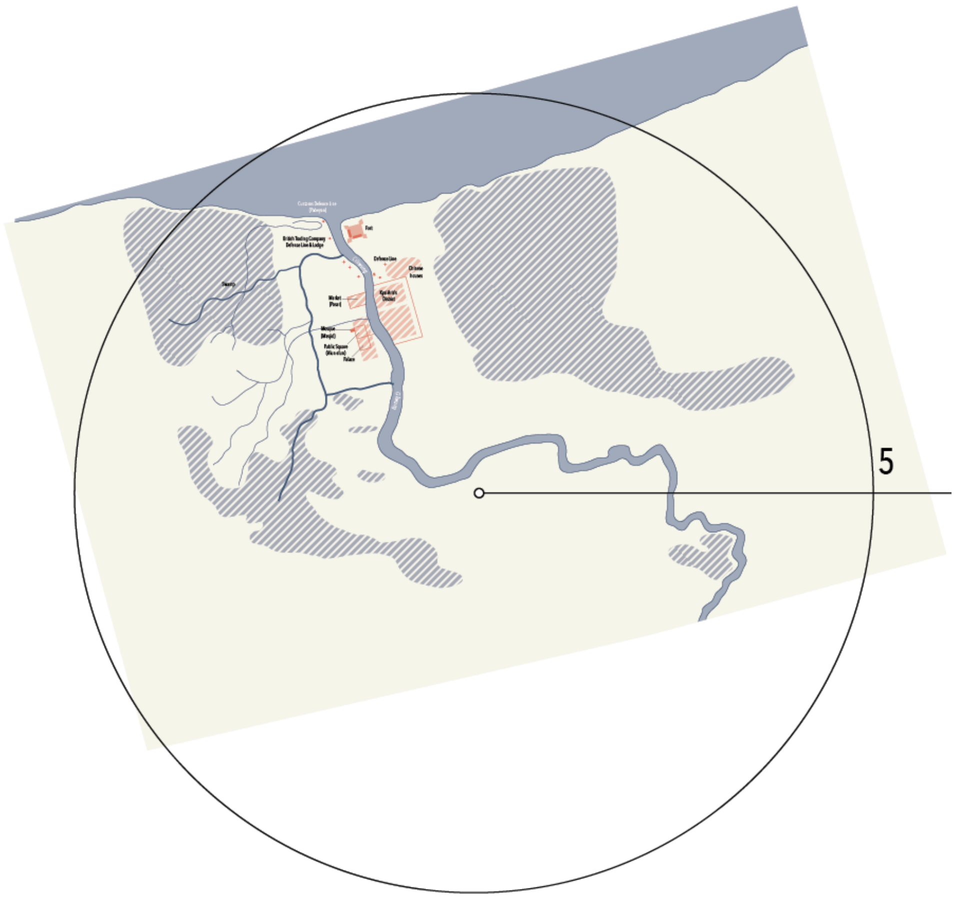


Figure 4.3.8: Map of the settlement of Jayakarta 1618. The first (Left) image illustrates the extent of the settlement in relation to the surrounding context, while the second (Right) shows the settlement organisation in more detail. The source of this map is the earliest such that illustrates the settlement prior to significant colonial influence. The initial footholds of the colonial town are already evident, with both Dutch and British present. Map by Author, based on De Haan in Breuning[35])

royal residence of Pakuan Pajajaran (near present-day Bogor), while the Ciliwung River flowed to one side' [169]. The inset in Figure 4.3.7 illustrates this condition, revealing the the residence of Pakuan Pajajaran along with batutulis—an inscribed stone—, located between the major rivers of the Ciliwung and the Cisadane and with the Cipakancilan river running through it's centre. It is evident that the same concepts — spiritual and geographical claims to leadership — continued to impact the placement of settlements from the 4th century until the later precolonial period.

4.3.3 Water and landuse

In brief, distributed water management and control for productive and economic gain is believed to have occurred throughout Java. The alluvial plain on which the early port town was sited was a more-than five-thousand-year-old delta formed by the sedimentation of debris from the volcanoes in the south (such as Mt. Gede Pangrango and Mt. Salak) (Figure **??** and 4.3.7). The area was subject to flooding even before the major anthropogenic transformation of the colonial period [40], and the waterworks marked by the Tugu inscription have been linked to drainage of the lowland system. The alluvial plain is traversed by 13 major rivers and numerous minor rivers. The river outlets are heavily silted due to the slow-flow of water through the shallow incline of the plain. High tides, which wash inwards on the low-lying territory, reduce the outflow; meanwhile, seasonal heavier flows in the wet season bring heavy silt down from the highlands. This combination of conditions has caused inundation of the delta throughout history.

Although water management for agriculture (such as 'receding flood' cultivation in Siem Reap, and subak systems in Bali) has been practiced throughout Southeast Asia, due to differences in the physical and political landscapes it is believed that these were not practiced in West Java.

Landuse (English)	Landuse (Old Javanese)
Irrigated rice fields	Sawah
Dry hill rice fields	Gaga
Dry fields planted with other crops	Tgal
Fallowed or brush land	Sukat
Homegarden and residences	Pomahan
Orchard land planted with fruit trees or other long-lived perennials	Kebwan
Pastureland	Padang
Betel gardens	Paserehan
Taro-gardens	Patalesan
Cotton fields	Pakapasan
Saltern	Lmah asinan or pawuyahan
Forest	Alas
Mountain slope	Rwang
Marsh	Renek
Riverbank	Tpitpi

Figure 4.3.9: Landuses mentioned in Old Javanese inscriptions. Author based on Christie [45].

Furthermore, the practice of wet rice (sawah) cultivation and the use of dams (waduk) is not widely believed to have occurred in West Java prior to colonial times due to territorial insecurity , and it was only with the increasing control of the region that came in the later colonial period that cultivation was practiced at a regional scale. However, it is believed that in Java—as in Bali— '... societies handled irrigation at the village or sub-village level' [205], with leadership coming from the below rather than from above.

A variety of different types of productive land are noted within the inscriptions (namely tax charters of the 8th and 9th centuries which are written in Old Javanese), which illustrates that diverse land uses did occur through the precolonial period [45]. Differentiation is made amongst these documents between dry and irrigated rice fields (sawah), dry hill rice fields (gaga), and dry fields planted with other crops (tgal), among others (See figure 4.3.9). More notably, the riverbank (tpitpi) is registered as a type of productive land, which indicates its significance to early communities.

4.4 Colonial transformations 1616-1945: The origins of Jakarta's problematic waterscape

Through the colonial period of transformation, three phases of development are recognised: 1) urban scale water management; 2) regional scale water management; 3) marginalised water and large scale infrastructural projects.

4.4.1 Urban scale water management (1616-1849)

Development of an urban core with canal system (early 17th Century)

Geopolitically, the port town was strategically important for the opening up of the region to trade, and was targeted by Portuguese, British and Dutch traders. The Dutch took control of the port town of Kelapa in 1619 renaming the town Batavia and positioning it as a major port city in Java. The early port town was already structured around the Ciliwung River, and the bulk of the vernacular settlement was located on its west bank. The first traces of the colonial town may be seen on the 1618 map (Figure 4.3.8), including: the customs house, a branch (batang) or obstacle for the control of the river mouth, the Dutch fort, various defence structures, and residential areas for indigenous communities and foreigners. Most of the structures were sited on the east bank of the river, separated from the existing town structures by the running waters of the Ciliwung.

Following repeated sieges by the King of the Mataram Sultanate in 1628 and 1629, the Dutch city model of Simon Stevin was implemented within the colonial town to strengthen defence. The beginnings of Stevin's design are already visible in the 1625 map (Figure 4.4.1). An archetype of water urbanism, Stevin's model integrated fortification, town, harbour and

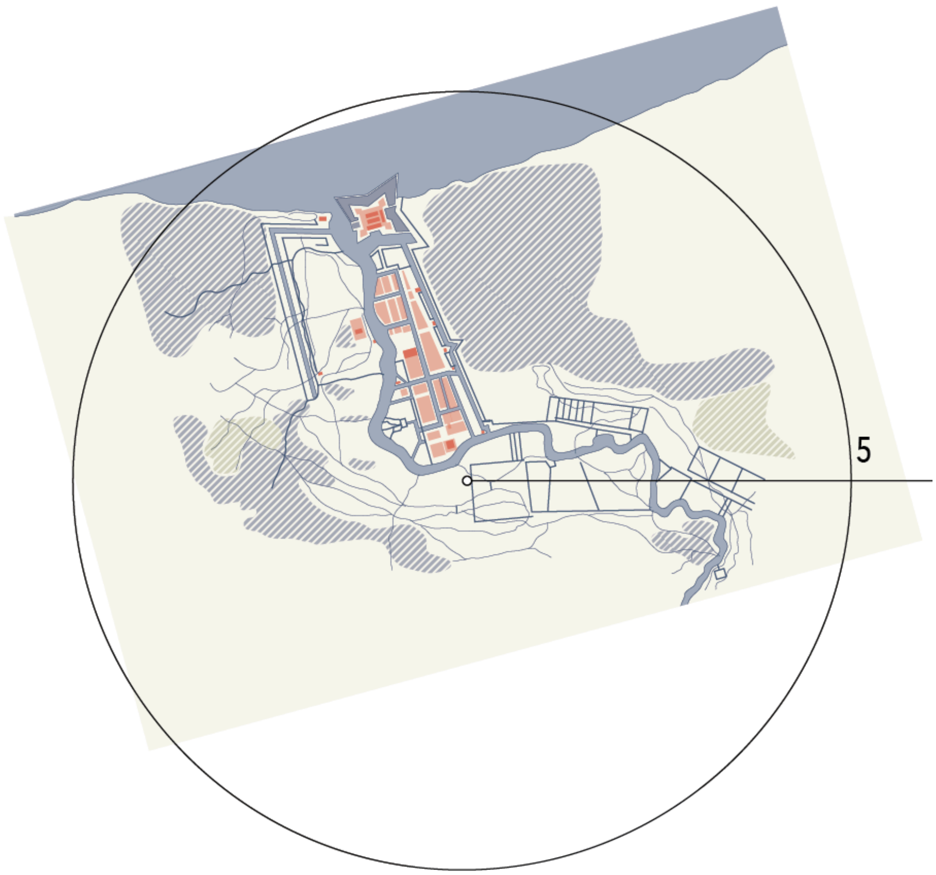


Figure 4.4.1: Map of the settlement of Batavia in 1625. The map illustrates the extent of the settlement in relation to the surrounding context. The form of the colonial town is becoming established with the fort at the mouth of the river and a series of canals providing drainage to the settlement. Map by Author, based on 'Kaart van Batavia omstreeks het jaar 1625', Batavia Topographisch Bureau, KITLV.

waterways. Described as a founder of urbanism [57], Stevin's approach unified hydraulics and urbanism and saw the flows of the Ciliwung River straightened by canals.

Rivers as an axis of development into the territorial hinterland (mid to late 17th Century)

By 1650, the area of Batavia had increased threefold. However, the town experienced several major floods over this period as a result of both anthropogenic and natural factors.

The low-lying swampy land around Batavia needed to be raised and drained before it could be cultivated. Before this, it was difficult to travel inland and the principal means of transport was by water. Rivers were the main routes of transport and communication before the introduction of extensive road and rail networks. In addition, river transport was especially significant — to both the urban and rural sectors — as many roads were impassable during the wet season.

The increasing stability of the territory — as a result of peace with Bantam (1684) and the transformation (or taming) of Batavia's environs [250] — throughout the later 17th century led to a shift to an 'inward-looking' perspective, with the Ciliwung River used as an axis of development into the territorial hinterland (Figure 4.4.3). The rivers of the so-called Ommelanden, or surroundings, were used both as highways and for irrigation. They were vital suppliers of water to the rice-fields, sugar industry and the market gardens. The riverine lands were ideal for cultivating water-hungry crops, and provided exceptional pasturage for cattle-breeding. Economic activities of the rural landscapes were centred on river banks making the lands bordering rivers, such as the Ciliwung, of high demand [107]. During these early years of Batavia's development, the town was green, with trees lining its canals and found within areas yet undeveloped, those assigned horticultural use, and the hinterlands.

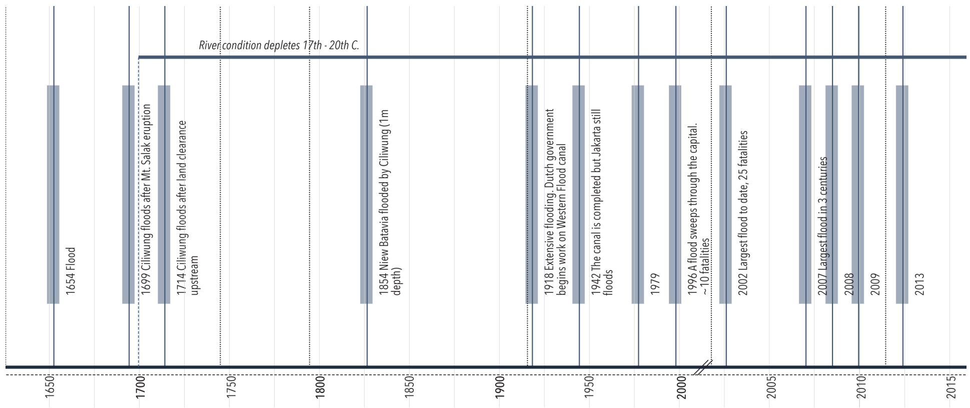


Figure 4.4.2: Significant historical floods. Redrawn from Marschiavelli [138]

Increasing stability led to cumulative deforestation and irrigation works for agriculture. While floods have been recorded in the region since precolonial times, human intervention in the hinterlands of Batavia caused the flooding experienced by the town and outskirts to worsen. Rivers and canals functioned as conduits for both the best and the worst of the city that was proclaimed the 'Queen of the East'. On the one hand, the Ciliwung served as the main conduit for logs and bamboo that were felled in the upper catchment and used to fuel the growing city's industries and as a construction material. On the other hand, human waste — including sewage, and organic and inorganic garbage from homes and industries — was dumped into the rivers and canals. Blockages were repeatedly reported in records kept by landowners and efforts were made to dredge the build-up of mud and waste using mills, nets and human labour [28, 107]. Coupled with the deforestation of the upper catchment of the Ciliwung River for tea plantations and to fuel the sugar industry, and waterworks for wet agriculture such as rice, these contributed to increased runoff and higher flows in rivers and canals during the wet season [30, 107].

Floods were experienced in 1654 and again in 1714 (see Figure 4.4.2). Other natural events also caused floods, such as high rainfall in the wet season, and sedimentation from the eruption of Mount Salak (1699). Numerous canals and waterworks — such as dams, sluices, and canals — were constructed from the 18th century [113] to mitigate the city's flooding problems.

Lauded canals and waterways (early 18C)

Concurrently, greater prosperity, luxury and security led to residents of Batavia seeking to move outside the city's congestion to the 'spaciousness' of the countryside. Pleasure gardens were built along the river, and city-dwellers took day trips up-river. While firstly smaller homes were built from non-permanent materials and used for weekends, later on homes were built from durable materials and became permanent residences [250]. These were built along the Jacatraweg and the Molenvliet (Figure 4.4.4 and Figure 4.4.5). The properties built along the Jacatraweg stretched as far as the Ciliwung River, and along this edge were well-cultivated gardens, bathing places, and landing stages for boats. Small boats were used by gentry to visit friends who lived along the rivers and canals. While rivers and canals were attractive real estate, residents were unable to rely solely on the river for access, and estates were dually oriented to roads running either parallel to waterways or at their opposing side (Figure 4.4.4). On top of its agricultural use, urban greenery was valued for its natural scenic beauty and served to counter the uncontrolled urbanisation and resultant 'messiness' of the urban landscape [155]. Batavia was praised for its beauty during the early part of the 18th C (Valentijn cited in [157]; Jan De Marre cited in [250]).

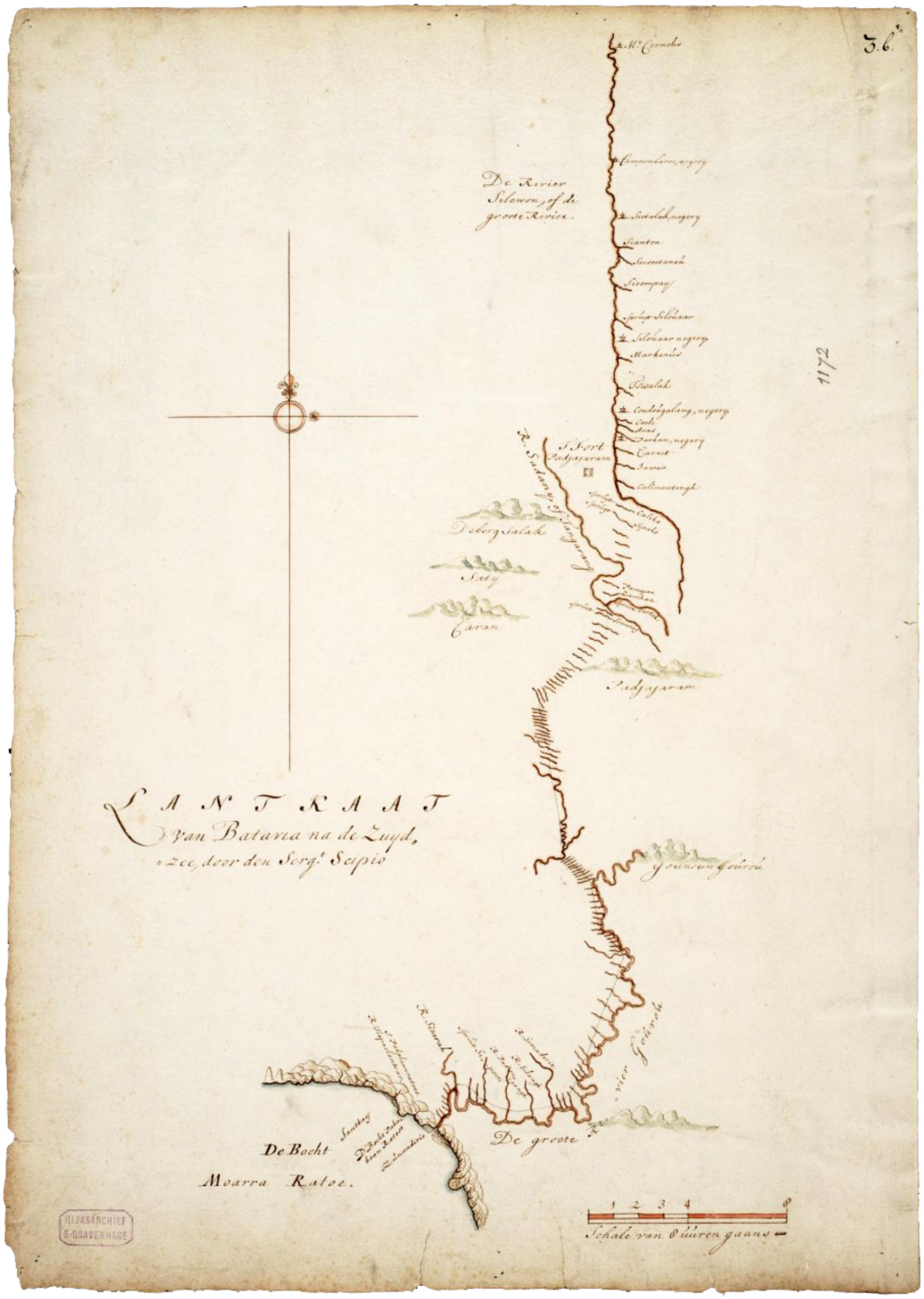


Figure 4.4.3: Map of part of the northern coast of Java, in the Batavia area (bottom orientates to North). The map includes geographical features such as mountain ranges and rivers, and locates these in relation to the Ciliwung River. The map includes Pajajaran. Source: Kaartcollectie Buitenland Leupe, GahetNA.

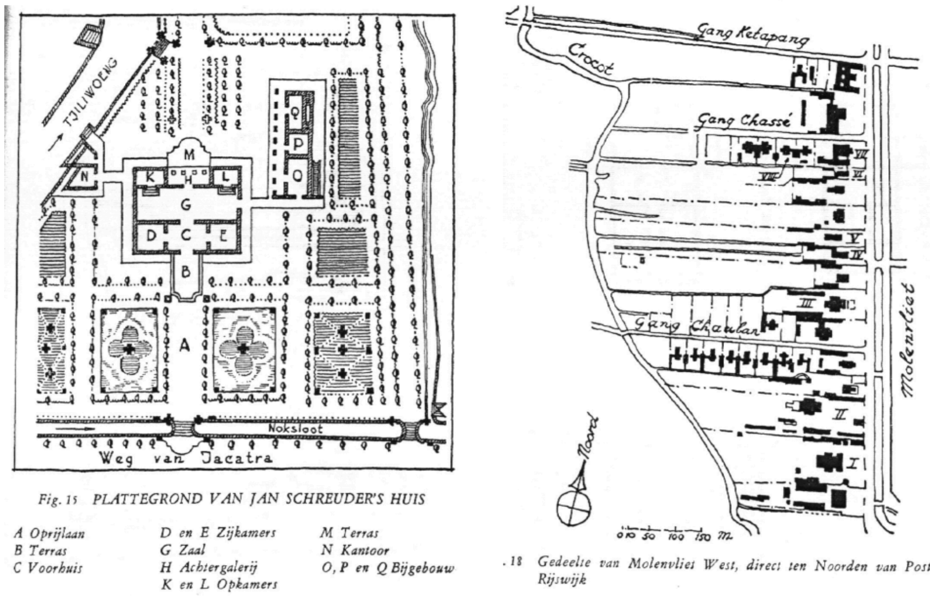


Figure 4.4.4: Development along waterways such as the Ciliwung River (Tjiliwoeng) and Molenvliet Canal Source: Breuning [35].

Figure 4.4.5: House along the Ciliwung River, near Parapattan, around 1860-1900. The river was seen as a desirable frontage during the early colonial period. Source: Tropen Museum

Figure 4.4.6: Map of the settlement of Batavia 1740. The settlement has begun to expand along the canals, which are used for transportation as well as water management. Map by Author, based on 'Kaart der Hoofdplaats Batavia omstreeks het jaar 1740', Batavia Topographisch Bureau, KITLV and Breuning [35].

Ecological disaster: Exploitation/deterioration of canals and waterways (later 18C)

Despite the splendour of the early 18th century, by the latter part Batavia was observed to have transformed 'from a healthy city into a graveyard' [157]. Various reasons have been attributed as the cause. Leonard Blusse attributes Batavia's deterioration more so to the pollution of the drainage system contaminated by the effects of sugar cultivation in the interior; and less to the Dutch layout of the town or natural disasters experienced (such as floods and volcanic eruptions) [28]. Peter van der Brug, on the other hand, attributes the premature decline of Batavia to the fishponds on the northern coast between the settlement and the sea, which provided a breeding ground for malaria mosquitoes [38].

Physicians Cornelis Swaving and Pieter Bleeker attributed the ill-health and disease of the city to environmental factors, caused by human activity [188]. Both tied the alteration of the landscape, natural—such as the 1699 earthquake which reduced the flow of the Ciliwung to a trickle—and anthropogenic—such as the changing of rivers' courses, digging of canals, logging of forests, and draining of swamps—to the poor health of Batavia. The latter heavily implicated the Dutch city layout in the problem, its waterways, and the close proximity of cemeteries. Bleeker also criticised the local habit of throwing garbage into canals.

In the views of Swaving and Bleeker, along with Dutch engineers in the Dutch East Indies, 'the alleged unhealthiness of Batavia could mostly be explained by unfortunate actions on the part of early colonialists, and the imprudent or immoral behaviour of later ones. It could be reversed when engineers and sanitarians took charge of town planning and the quality of cultural life in the colonies improved' [188, 199].

On the whole, this decline triggered a government-sponsored shift in 1807 of the town of Batavia to Weltevreden , located to the north on somewhat higher terrain (See Figure 4.4.7). Then governor, Daendals' main goal was to improve health conditions in the city. At the same time, they had considered to move the capital to Central Java or Surabaya, but discussions found this would be expensive and have its own problems [157].

4.4.2 Regional scale water management (1850-1944)

Shift from colonial heart, development toward the hinterland, industrial changes (19C)

By the late eighteenth century, as suburbanisation took place and the city spread beyond its walls the green of the city had lessened. It was observed of the Koningsplein that by this point 'it lack[ed] in size and construction… the allure of the usually heavy with beautiful trees, mostly banyan bejewelled Indonesian Square, "alun-alun", which constitute[ed] the heart of many Javanese sites' ([35], trans. by the author). Notwithstanding, the use of vegetation was still principally considered within planning processes. Urban developments (such as Weltevreden and later Menteng, see Figure 4.4.11) inspired a garden city feel, featuring wide tree-spanned lanes and grand houses within gardens [155]. Trees, such as tamarinds, performed multiple services, bringing shade to gardens, canals and streets, as well as a sense of grandeur and greenery [250]. Meanwhile the village, or kampung, areas — where the indigenous population lived — that were found between the old and new town 'had plenty of trees and rural atmosphere' [155].

It was during the 19th Century that the matter of providing sanitation, drinking water, and the protection of urban areas against floods from the sea or rivers (banjir) called for a structured approach to development, as urban agglomerations increased throughout the archipelago [199]. By 1800 Batavia was a small city with no more than 50,000 inhabitants. As a

Figure 4.4.7: Map of the settlement of Batavia 1790. The map illustrates the extension of the settlement toward the south, including the Weltevreden Estate. The coralstone canal, built to manage the increasing sedimentation of the river mouth, is seen extending from the Water castle. The shoreline at this point has extended a further 2-kilometres into the Bay of Jakarta [57]. Map by Author, based on 'Situatiepla van Batavia ...', Carel Frederik Reimer, KITLV.

result of a dual need to house more civic functions, along with the decreasing environmental condition of the old town, urbanisation in Batavia began to extend southward onto higher ground. Extensive waterworks continued as a result of this movement.

Historically people in the villages (desa) and cities (kota) obtained water from rivers and natural springs, collecting rainwater, or from shallow hand-dug pits where the water welled up as a result of the high water table [199]. In areas where groundwater was not available (through springs and wells), people made do with collecting surface water and rainwater. Larger rivers which flowed even during the dry season supplied water for the central public waterworks, meanwhile the smaller rivers supplied the smaller masses. In those areas where dry season water flow was inconsistent, reservoirs (wodoeks or waduks) were constructed. The waduks were either made as reservoirs separate to the river, or in dammed off river sections — termed valley closure dams. Irrigation canals — sometimes with purification plants — were also used for domestic supplies [199]. In the rural areas it was largely possible to cope with primitive and small-scale drinking water supplies, sanitation, and flood protection measures were often part of irrigation projects. This in many places until the end of the colonial era [199].

The development of alternate infrastructure through the late 19th and early 20th centuries—such as rail-lines and roads linking Batavia to Buitenzorg (now: Bogor)—led to the further compromise of rivers. The railway opened in 1873, and was electrified in 1925, meanwhile the tramline and roads provided new urban structure (see Figure 4.4.10)

By the end of the 19th century the Europeans had begun to concentrate within the newly developed suburbs of the capital city which were now more accessible. Satellite towns began to emerge around the city's centre, such as Weltevreden, Tanah Abang, Gondangdia and Meester Cornelis (now: Jatinegara), and these were ringed by kampungs (Figure 4.4.10).

Engineer Van Ray observed in 1915:

'The Europeans were mainly settled in a small strip along 'den Grooten Postweg' [the large mail-road] running through Buitenzorg [now: Bogor], Meester Cornelis, and Batavia, and so within the neighbourhoods of Salemba, Kramat, Passer Senen, Waterlooplein, Noordwijk and Molenvliet... The governments water provision using artesian wells only reached along that strip. What lay outside that strip was not considered.' ([262] in [111])

As Van Ray perceives, the piped water was only afforded to the Europeans, meanwhile the indigenous populations were increasingly dependent on surface water (including rivers) in their daily lives. As Kooy narrates, 'native spaces were noticeably absent from the maps of urban infrastructure', despite the indigenous population making up the majority of the area's population (2008). This socio-spatial bias is evident in the maps where the European settlements can be observed to shadow the roads and railway infrastructure (Figure 4.4.10), and the vernacular kampung, or indigenous settlements still appear to largely follow water networks. The initial segregation within the artesian water hydrant and reservoir system led to even greater differentiation as the city developed. European communities formalised around individual hydrants and reservoirs, and indigenous households were spatially excluded from access forced to continue their reliance on the numerous surface water channels for all of their water needs. This left them to display their 'traditional habits' of washing, bathing, and defecating along the riverbanks, which were so deprecated by the colonial government [111] (Figure 4.4.8 and 4.4.9).

Through the early 20th century communal, enclosed, washing and bathing facilities were constructed for indigenous residents, to 'keep the [indigenous] population out of the canals' ([262], in [111]). This marked the larger rationalisation of the use of urban space and water, with bathing, washing, and recreation viewed as distinct functions. Significant to this

Figure 4.4.8: Photographs illustrating the use of the Ciliwung by indigenous populations during the 1930s and 40s. Source: Merrilees [147].

Figure 4.4.9: Left – 1907 view of the Kali Besar (Ciliwung River) near the sea. Right - 1912 view along one of the canals near the Java Bank, illustrating access-ways and the canal's profile. Source: Merrilees [147].

narrative, indigenous settlements were considered to be legally — if not geographically — separate to the European city, lying outside the responsibility of the European dominated municipal council. Hence, in most maps from the colonial era settlement is differentiated by European and 'kampung' (illustrated in interpretive maps in dark red and red respectively).

Parallel to the development of potable water- and transport infrastructure through the late 19th and early 20th centuries, significant works were taken to drain the plain on which the city was erected. The subject of numerous surveys, water soaked terrain was classified as: drainable, drainable only at low tide, and drainable by rivers when 'normal' water levels exist ([57] – Batavia). Naturally saturated terrain was labelled as 'flooded', with distinction made between that which was flooded continuously, yearly during the banjir, or less frequently (Figure 4.4.12 - Left).

As flooding encroached on the city more often Herman van Breen, a water management engineer developed a design for the West Flood Canal (Banjir Kanal Timur) (Figure 4.4.12 - Right). The overlayed 1897 settlement map and the 1913 flood maps reveal that most areas which were reported as being 'regularly flooded' were lower lying lands occupied by indigenous populations and those which were then used for rice and agriculture. Van Breen proposed to redirect the abundant flows of the Ciliwung River (north of Meester Cornelis) through western Batavia toward the sea. He also proposed the straightening of river segments, and that excavated material was used for poldering along Batavia's coastline ([40]). The plan was enacted in 1920. At this time the area of Batavia at this time was approximately 25-square-kilometres [197]. The Banjir Kanal was also used as a raw-water source by the company providing potable water for the capital.

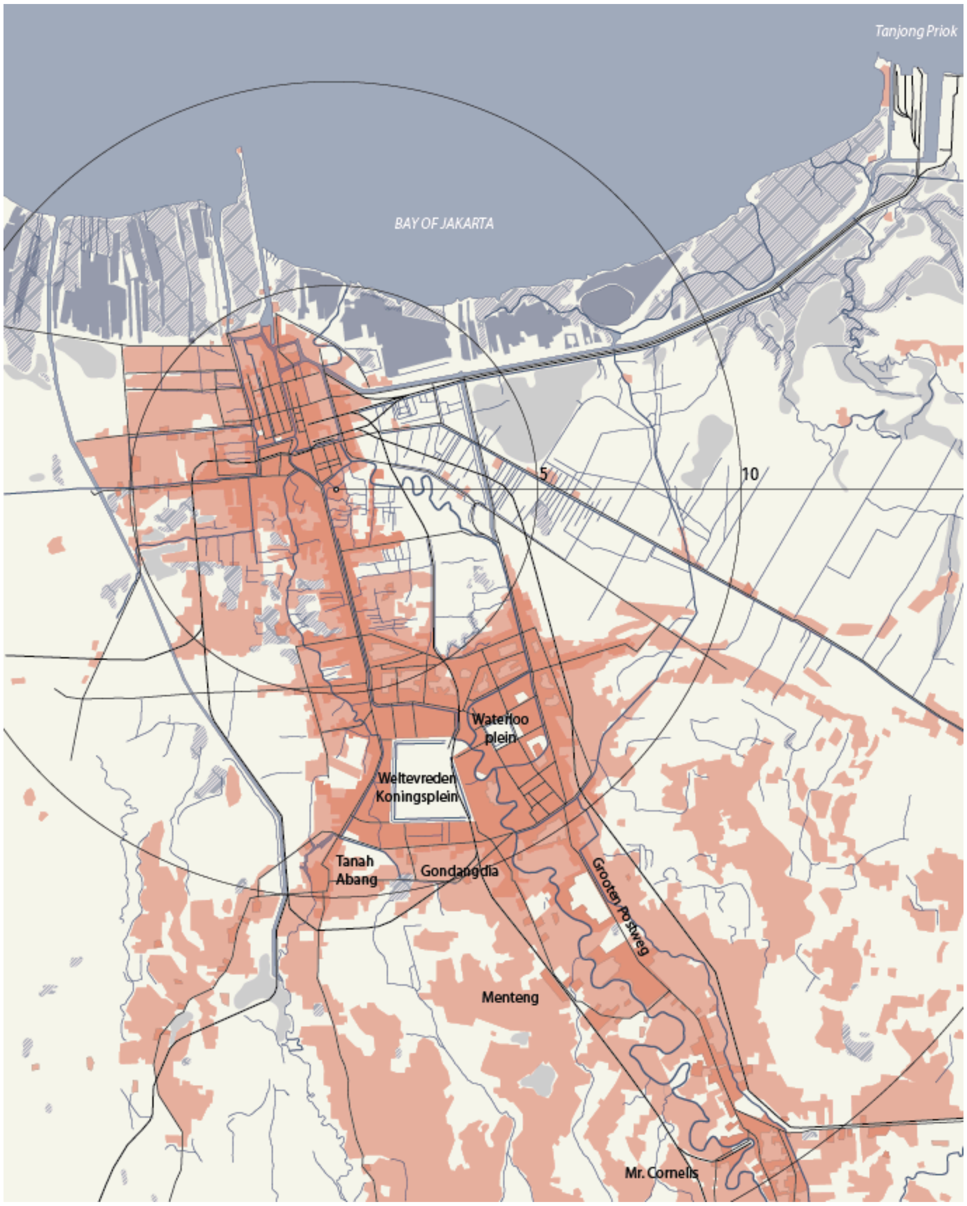
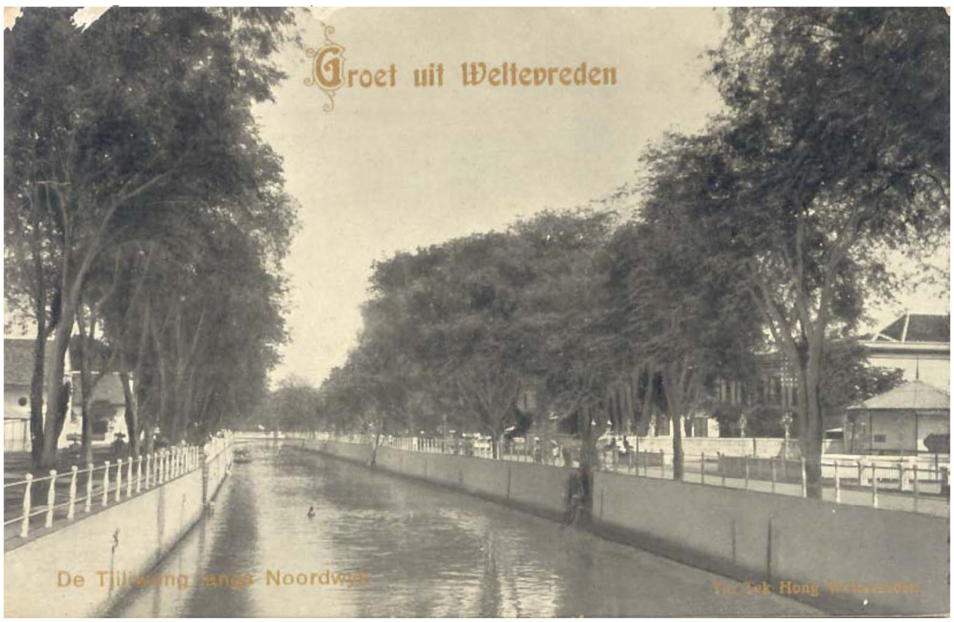


Figure 4.4.10: Map of the settlement of Batavia 1897 illustrating the extent of the settlement in relation to the surrounding context. Map by Author, based on 'Batavia van omstreeken', Topographisch Bureau, Universiteit Leiden.



Afb. 36 Noordwijk in 1907, de gekanaliseerde Ciliwung richting Harmonieplein

Figure 4.4.11: 1907 view of the canalised Ciliwung River, near Rijswijk. Source: http://www.indonesia-dutchcolonialheritage.nl.

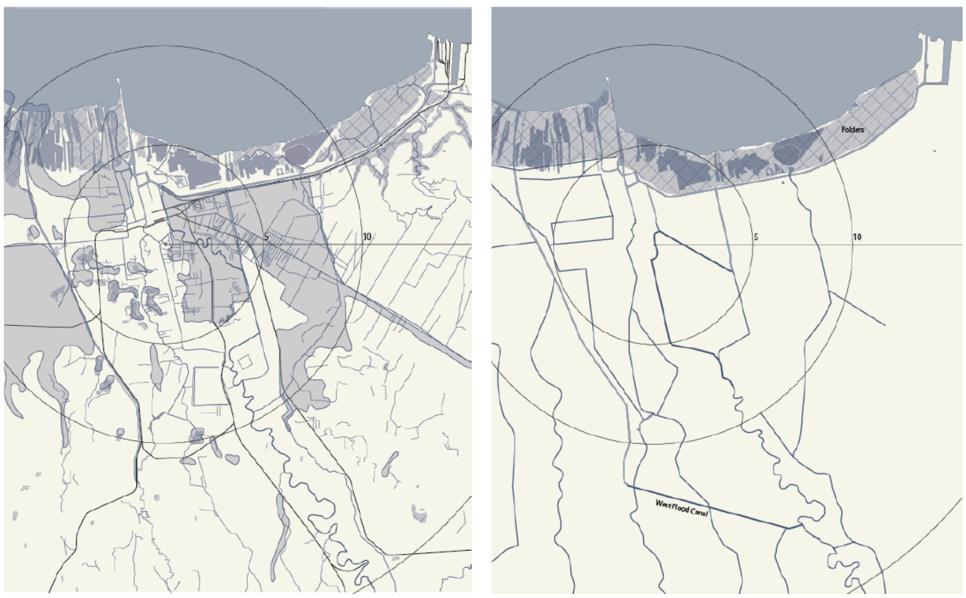


Figure 4.4.12: Left, Map of areas regularly flooded in 1913. Map by Author, based on Van Breen c.f. Ravestein [199], overlaid on the settlement of Batavia 1897. Right, Van Breen's 1917 design for the West Flood Canal (Banjir Kanal Timur). Map by Author, based on Putri and Rahmanti [197])

Though overlooked in [197] study, Van Breen's proposal also proposed a range of minor works to improve hygiene and drainage, including the development of '… a green area to the south of Batavia as a way to prevent floods as well as to supply fruits to the city' (Suryana c.f. [207]). Suryana obliquely attributed the longstanding integration of nature within the architectural space of the Betawi to the sensitivity of the colonial government to Van Breen's scheme. Later on the value of urban green space was strengthened and brought as a reference for other Javanese cities in an explanatory document on city planning for Java, the Toelichting op de "Stadsvormingsordonantie Stadsgemeenten Java" [207].

Concurrently, the colonial government continued to struggle with malaria, among other diseases, which were catalysed by stagnant water. These were tackled by eradicating breeding places of mosquitoes such as pools and fishponds by: 1) cleaning them; 2) draining them; or 3) petrolising them. The ponds were sometimes flushed with sea water. Biological controls included removal of plants growing along the banks, and introducing fish species for larvae and plant control. Ponds and pools were also simply filled with soil [113], again reducing the capacity of the landscape to buffer the abundant seasonal waters of the city.

By the middle of the 20th century, the area of Batavia had expanded to around 34-square-kilometres [197] and a population 823,000 persons. Batavia still suffered from inundation following the completion of the West Flood Canal in 1942 [40]. At this time the city had more than 90-kilometres of canals and major waterways [113] (Figure 4.4.11). Another proposal was made, this time by WJ Van Blommenstein for the west Java region. The proposal was an integrated system of irrigation and drainage infrastructure, with dams and lakes to be used for electricity in the highlands. As part of this, dikes and polders continued to be constructed within northern Batavia.

4.5 Postcolonial transformations < 1950s – Marginalised water and large scale infrastructural projects

4.5.1 Soekarno Soeharto: Large scale infrastructural works and nation-building (1945-1998)

Early nation-building (1945-1965)

With the Dutch capitulation of Batavia in 1945 a new phase of governance began, characterised by a re-envisioning of the capital city. After independence the population of Jakarta more than doubled, reaching an estimated 1.5-million in 1949 [77]. In the early postcolonial period (c. 1960) Soekarno, the first president of Indonesia made it his campaign to elevate Jakarta to world city status, with Jakarta as an instrument to demonstrate the nation's prestige and pride to the world [77].

During this nation building period, a symbolic link was drawn between progression and urban greenery with monuments and statues constructed in parks and squares throughout the city [155]. Like the later colonial period, urban greenery continued to be valued for its symbolic meaning and recreation. One such example was the remaking of Koningsplein into Medan Merdeka, meaning Independence Square. Later, the Monas, the National Monument, was erected determining Medan Merdeka as the nation's alun-alun.

Construction of large scale infrastructure projects such as the Monas, and the Asian Games' sports complex were results of the urban policy of the 'Old Order'. Soekarno's urban development priorities did not include deteriorating areas of the city, or urban flooding. Likewise, the fore fronting of road-based infrastructure projects over public transport improvement led to private urban developments [55].

While Soekarno transformed the Betawi architectural landscape into

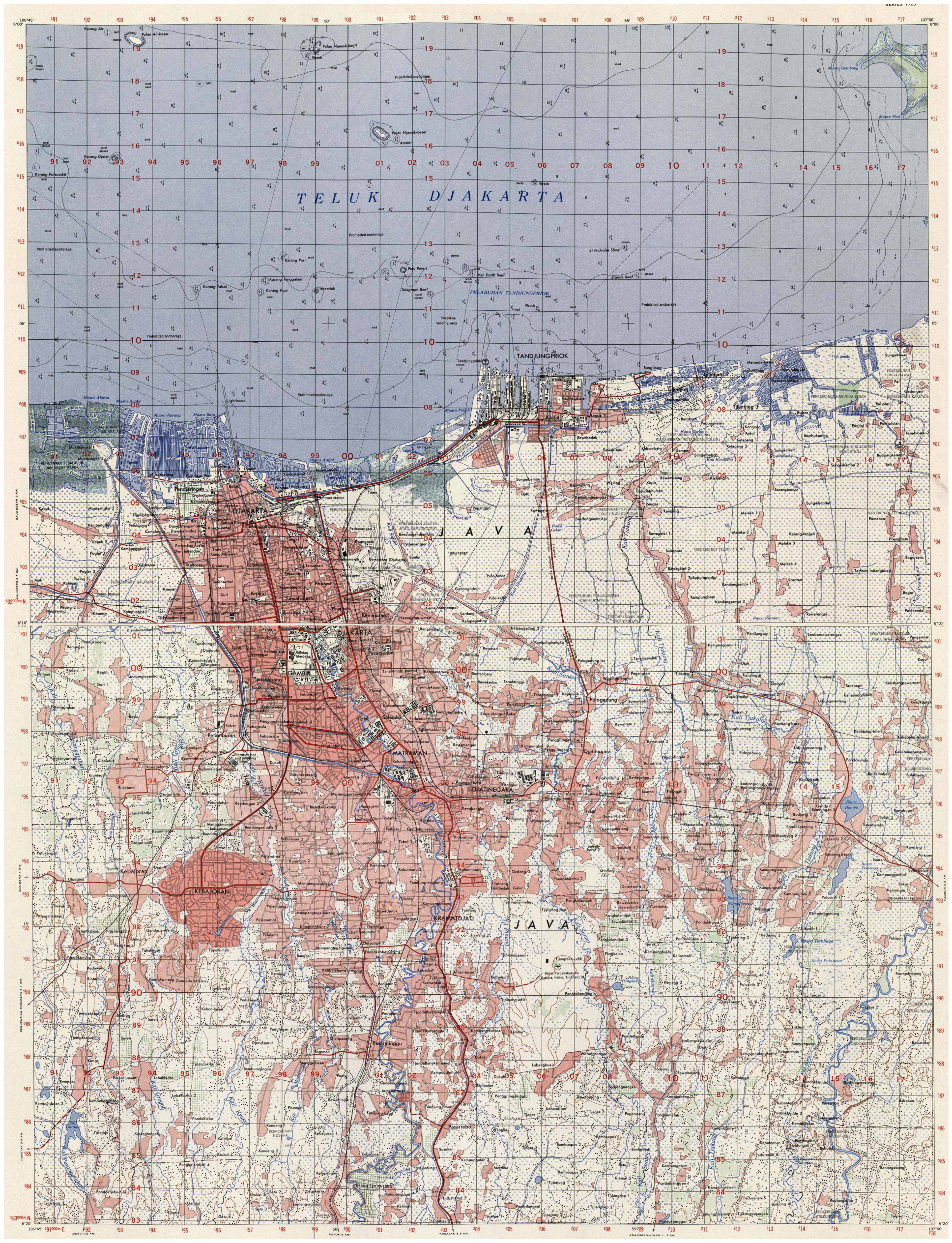


Figure 4.5.1: Map of Jakarta 1959 illustrating the significant extension of the urban areas of Jakata by this time. Source: UTexas.

urban greenery to support his nation-building efforts (such as the sports complex and monuments); further south, in Pasar Minggu, the role of Betawi architecture was reasserted through the 1950 Jakarta Masterplan (See Figure 4.5.1). Within the plan (designed under Kenneth Waits UN and Mayor Sudiro) private gardens were conceived as part of a city-wide green belt to prevent floods, and to create water catchment and storage [207]. This organisation grew the distribution of garden houses (rumah kebon) in Pasar Minggu. This marked a time whereby the government had successfully promoted 'the participation of its residents on a massive scale to create a productive green environment'. Later on in the 1970s, in a further move to strengthen the cultural identity of Jakarta, Condet was set aside as a Betawi cultural reserve. This included a bylaw regarding Betawi houses and surrounding uses, which 'gained a stronger assurance, not only about the fruit supply, but more importantly about the use of Betawi architecture as the fortress to preserve green space in the city's south in the effort to prevent floods and filter drinking water supply for Jakarta' [207].

Later nation-building (1965-1998)

Soeharto's New Order (1965-1998) continued the large and mostly road-based infrastructure projects, wrapping boulevards, toll-roads, highways and flyovers around the city [197]. The Soeharto government took a programmatic approach to development, using five-year development plans, to tackle shortages in the provision of infrastructure and services. Such projects were often strongly lacking behind the rapid growth of the city (Figure 4.5.2) — with parts of them being implemented when the city population and built area were extended already two to three times. In fact, between 1961 and 1980 the population of the JABOTABEK connurbation (not including Depok at that point) doubled from 2.9 to 6.5 million ([42] – See Figure 4.5.2). While extensions were planned for the

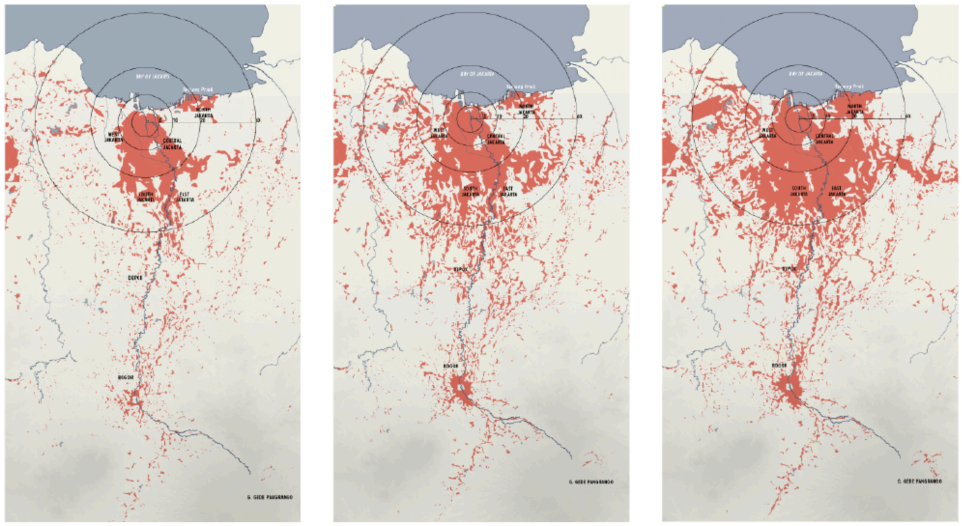


Figure 4.5.2: Growth of Jakarta from 1970 to 1990. Between 1961 and 1980 the population of the JABOTABEK (not including Depok at that point) doubled from 2.9 to 6.5 million [42]. Maps by Author and Vollmer, based on 'The Study on Integrated Transportation Master Plan for Jabodatabek, 2004', included in [145].

West Flood Canal around the 1970s, they proved impossible to implement as a result of speculations on land use ([112]).

Activities established during the colonial period were continued such as pollution of rivers through domestic (including sanitary purposes) and industrial waste. The Ciliwung continued to be used for transportation of materials such as bamboo, which were rafted together and floated along waterways from rural areas to villages and cities where the bamboo was used for making hedges, furniture and other bamboo items (See Figure 4.5.3). Based on the 1965-1985 master plan, ([221] c.f. [40]) identified that during the 1970's the city's river and drainage network was functioning poorly as a result of: 1) reduced capacity of rivers and drains caused by waste disposal and because of inadequate maintenance and dredging; 2) reduced capacity of estuaries due to siltation; 3) damaged and inefficient water constructions; 4) poor road drainage; 5) reduction of water retention capacity caused by development. The Office of Public Works initiated a long-term project for the dredging of rivers and estuaries, construction of reservoirs and canals, and implementation of pumps, bridges and flood control gates. This included the East Flood Canal, undertaken by Dutch and Japanese consultants. Residents from an area of some 478 hectares were also relocated.

Meanwhile, controls were put in place to protect environmentally critical areas such as upland forests, areas over regional aquifers, and ecologically fragile coastal zones from the growth of the city and to encourage development in surrounding areas of Bogor, Tangerang and Bekasi [63]. The strategic response to the declining urban environment followed the approach of the New Order government and used public infrastructure as an attractor for investment. The controls were largely unsuccessful because they were firstly directed and implemented by only one ministry; and secondly, because they were driven by incentives with no punishments to check lack of compliance. Resultantly, environmentally sensitive zones such as the mountainous Puncak area between Jakarta and Bogor which was increasingly deteriorated due to the building of weekend homes [63].

The DKI Structure Plan 1985-2005, which characterises the third phase (urban greenery is valued for environmental reasons), highlighted the necessity of the conservation of nature within the city, in particular through the retention of urban greenery. The document brought forward several areas needing protection, such as the northern coastal zone—at—risk from salt—water intrusion—, water catchments in the southern zone, agricultural areas in the western zone, and the green belt in the eastern zone, along with green corridors penetrating the built-up area, and green spaces including parks, sports fields and cemeteries. Notably, the green corridors discussed in the plan comprise rivers, railways and highways. Around the same time a booklet was published on greenery policy, which stressed the maintenance of cleanliness, beauty and coolness within the city. The booklet also emphasised the productive aspect of greenery, and brought policy closer to the household level providing guidelines for home gardens [155].

By the year 2000 around 25 percent of the developed area was occupied by industries and businesses, with many of those along rivers running untreated wastewater directly into the river, contributing to worsening water quality [20]. From the mid 1970's the pollution of rivers had been a national concern, and the national Environmental Act was introduced in 1982 to address this, for the first time bringing a political dimension to an environmental problem [130, 268]. Although a number of regulatory provisions had been in existence prior to this, the Clean Rivers Program (PROKASIH, or Proyek Kali Bersih, 1989-1990) demonstrated the government's priority to address river pollution, in which they sought to 'clean up 20 of the most polluted rivers in 8 of Indonesia's 27 provinces' [129]. They targeted heavy pollution caused by the industrial sector (from which it was difficult to obtain compliance) and during this time NGO's provided affected communities significant support in communicating local knowledge, negotiating compensation, upgrading systems, and rehabilitating waterways [129, 268].

A highly controversial project of the Soeharto government, was the North Jakarta Revitalisation and Waterfront Reclamation Project which was slated to advance commercial, residential and industrial development. The plan, for a new waterfront city located along the North Jakarta coast, comprising of a total area of about 2,700 hectares reclaimed from the Jakarta Bay was approved through the Presidential Decree No 52/1995, and placed responsibility for the development within the DKI Governor's office. The proposal included high rise buildings, historic area revitalisation, and expansion of recreational facilities. Around 16% were to be used for green areas, including the creation of a mangrove forest to protect the coastline against erosion. Work on the North Jakarta land

Figure 4.5.3: Left – 1960 rafts and houses along the Ciliwung River. Source: United Press International photo, Author's collection. Right, For the community of Kebon Kacang across the Cideng canal, the dense settlement meant that 'the only storage space for bicycles was on the banks of the canal. To gain extra storage space, second storeys were added to the original houses and wooden ramps were built over the canal' Jellinek [104].

reclamation began in 1996.

4.5.2 Development and management in the 2000's and 2010's: The Lost Decade

The population of Jakarta continued to rise (Figure 4.5.4). Of this number, around 5-million people living within the greater Jakarta area were estimated to still be without basic infrastructure such as sewage and water supply (UNESCAP c.f. [179]). The intensity of land development in the urban core has meant that low income migrants and large numbers of people of modest means have settled within the city's most flood-prone areas, along rivers, highways and railways [145, 179]. While some of these areas have existed for decades, as is revealed by the mappings of [39], and are thoroughly integrated within the urban life and local economy. These settlements are often classified as 'illegal' slums or squatter settlements and blamed for the fluvial floods that affect the city (Figure 4.5.6).

Between the years 1970-2000 undeveloped land within the Ciliwung River catchment had decreased from 66 to 38 percent. Meanwhile, from 2000 to

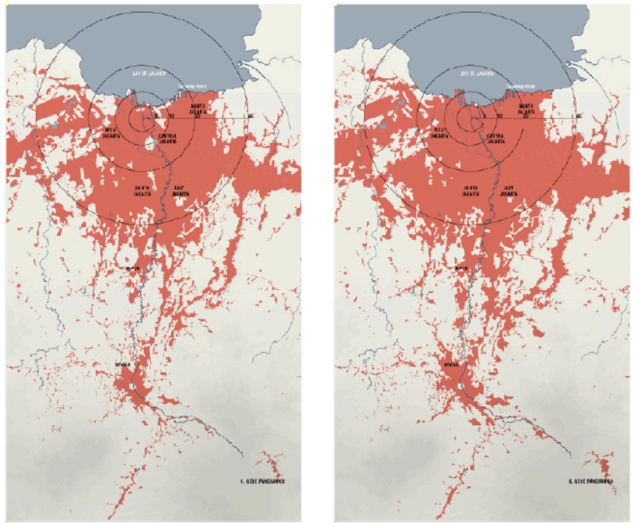


Figure 4.5.4: Growth of Jakarta from 2000 to 2010. Maps by Author and Vollmer, based on 'The Study on Integrated Transportation Master Plan for Jabodatabek, 2004', included in MercyCorps [145].

2008 the remaining green and permeable areas were significantly diminished ([69] c.f. [179]). Coverage has continued to decline as forests are cleared and converted into plantations, and older plantations are transformed to settlement and industry (BPDAS Ciliwung and IPB Agricultural Faculty c.f. [179]), which causes erosion and landslides and increases sediment loads in runoff from the upper watershed. This in turn exacerbates the damage of flooding downstream. In those areas within the north of the city the undeveloped area has declined to two-percent.

Floods and water management in Jakarta from 2002-2013

While the number of floods per year has been increasing the number of floods does not necessarily signify the magnitude of flooding experienced in the city [179]. For example, the 1996, 2002, 2007 and 2013 floods were classified as the largest and most destructive in Jakarta's extended history

[64]. However, these years had significantly less reported floods than others such as 2008, 2010 and 2011. Additionally, the official number of recorded floods is anticipated to be significantly lower than the actual number of occurrences, as vulnerable areas of the city along waterways and the coast (such as Kampung Pulo) experience flooding as frequently as once a month.

The area of land affected by flooding has also increased. While in earlier years Jakarta's physical extent and population meant that the impacts of flooding were less acute; the severity of the 1996, 2002, 2007, and 2013 floods were compounded by the intensity of land development and high population.

The number of fatalities caused by the 2002 flood is estimated at 80, meanwhile the direct damage is estimated to be Rp 5.4 trillion and indirect damage Rp 4.5 trillion ([164] c.f. [40]).

As much as 75% of the city was flooded during the 2007 flood, displacing 430,000 people from their homes, with an estimated economic cost of US$450 million ([235] c.f. [64]). Many of these were poor, living along Jakarta's waterways. As with the 2002 flood the impacts of the flood were experienced beyond the recession of the floodwaters; with health impacts (such as diarrhoea, skin and respiratory problems, dengue fever), breakdown of basic urban services, and loss of livelihoods affecting communities ([287] c.f. [64]). Many health impacts are tied to the poor quality of water within the river as a result of industrial and sewage contamination.

The torrential rains of 2013 caused a levy to break in the inner city, which resulted in some of the more affluent areas which are typically protected to flood. Largely however the land coverage was similar to the 2007 flood impacting coastal areas and those along rivers. The 2013 flood inundated over 100,000 homes, left 47 dead, and shut down the entire city for several days [79] c.f. [64]). The estimated economic cost was more than $3 billion

As of 2005, Caljouw et al [40] observed that the system of flooding had largely been unchanged since the division of the Ciliwung River into two channels, including the river and the West Flood Canal in the early 20th century. While the floodgate to the West Flood Canal was opened in 2002 so that flood waters could disperse into West Jakarta, the gate to the Inner City Ciliwung was closed until the highest state of emergency was announced five-days later. Caljouw et al attribute this—to some degree—to the severity of flooding that year, particularly in eastern parts of the city including Kampung Melayu. Residents of Jakarta were highly critical of the government and the flood was 'considered the result of decades-long mismanagement of the city's water management infrastructure'. However, they observe that by 2005, the tragedy was largely forgotten and cited causes such as the garbage floating in rivers and canals, and the illegal development of water-catchment areas, were no longer debated.

Presently, proposals for policy and action in the city of Jakarta have (similarly to van Breen's 1917 proposal) focussed upon major infrastructural investments to reduce flood vulnerability, including: the East Flood Canal; the Jakarta Urgent Flood Mitigation Project/Jakarta Emergency Dredging Initiative (JUFMP/JEDI) (Figure 4.5.6); Jakarta Comprehensive Flood Management (JCFM) and the coastal defence management plan with a proposed massive sea wall in the Jakarta Bay (Figure 4.5.5).

Recent changes to river policy

In 2011, following intensifying floods in the region, a new policy for rivers was released by the Ministry of Public Works, the Government Regulation (GR) on Rivers (Peraturan Pemerintah on Rivers, 38/2011) which largely

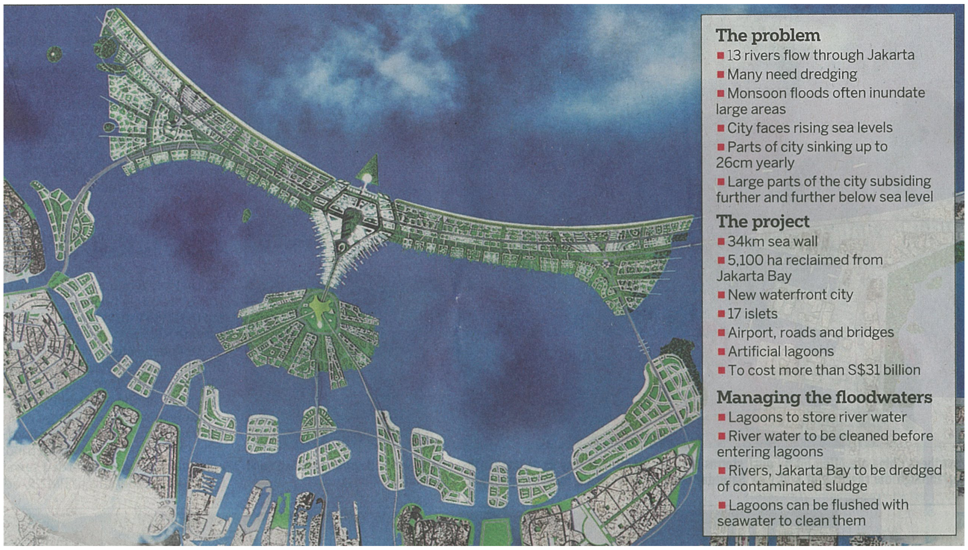


Figure 4.5.5: Jakarta's sea wall project is anticipated to provide protection from rising sea levels, and help ease annual flood misery. Source: Souriatmadja [229].

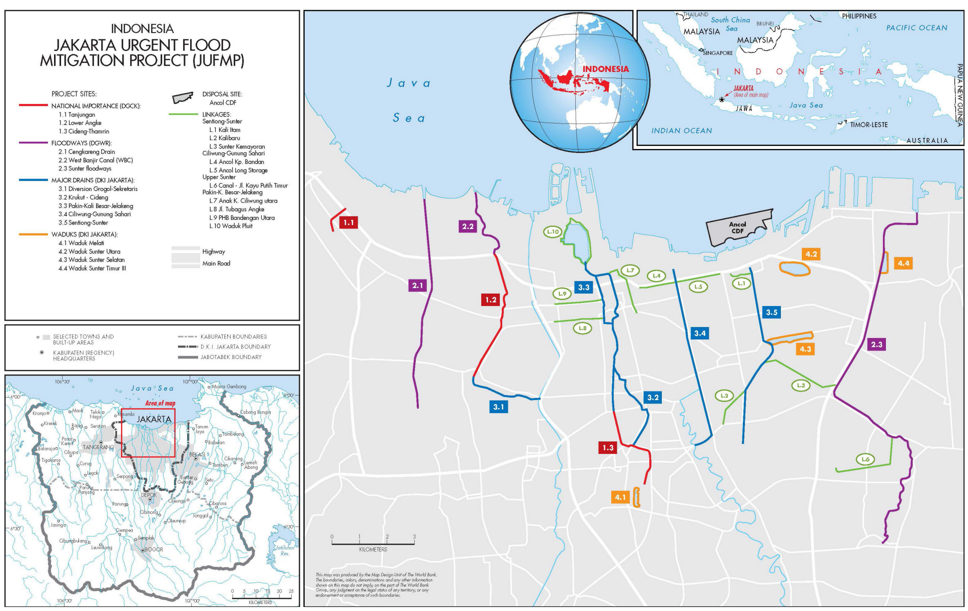


Figure 4.5.6: Jakarta Urgent Flood Mitigation Project Source: JUFMP 2011.

defined river management up until 2015 and specified physical restrictions to urban areas and vegetation in relationship to rivers. The ruling took a significantly different stance on vegetation within urban river corridors to earlier rulings. While the DKI Structure Plan 1985-2005 had previously advocated the conservation of existing vegetation within river corridors, the GR Rivers 38/2011 mandated riverbank areas to be cleared of all functions (outside of those deemed relevant by the ministry) and limited riverbank vegetation within urban areas to grass [58]. The regulation's key goals were to protect and restore river function and included programs to demarcate and sustain the river border, and reduce pollution.

The 2011 policy is being demonstrated through projects such as the JUFMP/JEDI (Figure 4.5.6 and 4.5.7), which focuses on the dredging of major rivers and canals in the north of the city and is being implemented in three phases (See Figure 4.5.8). The project is undertaken by the Ministry of Public Works and aims to reduce flood risk in Jakarta through dredging and restoring functionality (i.e. carrying capacity) of a number of rivers, drains and basins within the city. Such actions are locally termed 'normalisation' or normalisasi. For the Ciliwung River this includes channel widening (from a typical width of 15 metres to 50 metres, See Figure 4.5.7), dredging, and the construction of a service road for a 19 kilometre stretch of the river that flows between Tanjung Barat and Kampung Melayu. The Ministry of Public Works estimated that around 71,000 households (350,000 people) will have to be relocated from the riverbanks for this to occur. While, the project was initially supported by a World Bank approved a loan of USD 140 million, the funds were later returned. Reputedly this was to avoid relocation benchmarks which the World Bank had tied to the funding.

Impact of recent river policy

The implementation of the regulation, through the normalisation project, has spatial, socio-cultural, and ecological implications. Approaches taken are derived from engineering practice, and include dredging, simplification of channel structure, and bank stabilisation. The first, dredging—the removal of inorganic and organic debris—results in decreased habitat value of the water system [37]. While rivers were identified amongst the green corridors highlighted in the 1985-2005 Structure Plan, their 'green' is being compromised in recent transformations. The implementation of the 50-metre channel cross-section will result in the loss of vegetation buffers, which may still play an important conservation role for biota [82]. Additionally, considering the historical significance of the Ciliwung River in its immediate and extended context (within Southeast Asia), dredging has the potential to disturb heritage artefacts that may be buried beneath the riverbed which are as yet undiscovered (see earlier sections within the chapter). The second, channel simplification usually involves deepening and rationalising the system; coupled with the third, bank reinforcement using hard materials for stabilisation.

On the one hand, the proposed trapezoidal channel has a significant carrying capacity, and will serve to accommodate predicted extremes [182]. On the other hand, this project fails to consider issues such as:

- The loss of socio-cultural value of riverbank area (for recreation and other activities relating to the current integration of the river within the lives of residents);
- The need for continuous maintenance of the channel to prevent siltation;
- The loss of vegetation, will impact both habitat value along with the natural reinforcement of the river edge and trapping of sediment

Figure 4.5.7: The normalisation of the Ciliwung River, among others, under the Jakarta Urgent Flood Mitigation Project has been underway since 2012 and includes river widening and dredging, the implementation of a service road, and requires resettlement of communities living within the demarcated river zone. Source: Kementerian Pekerjaan Umum, Daerah Khusus Ibukota Jakarta and Kementerian Perumahan Rakyat 2011.

from upstream.

Under his gubernatorial term (August 2012 until July 2014), Joko 'Jokowi' Widodo, announced plans to relocate 870 families from riverbanks in Bukit Duri, South Jakarta, to low-cost apartments called Kampung Deret, which translates directly to 'lined-up villages'. These residential buildings were to be constructed further away from the river. While this may have been viewed an improvement on the plans of his predecessor — who planned to construct 24-storey towers to house the residents (See Figure 4.5.7 Left) —, considerable attention to the river itself is still lacking. The exaggerated scale of the river, in the JUFMP/JEDI project, presents the river as a static barrier which lacks spaces for interaction rather than connective tissue in the city, and still fails to learn from the past lessons of Jakarta's water systems relating to: seasonal variance in flows, and a natural tendency toward siltation.

Other projects proposed in 2013 include the construction of a 34-kilometre sea wall, along with 5,100 hectares of reclamation within the Jakarta Bay (Figure 4.5.5), aided by the Government of the Netherlands; and an immense deep tunnel with channels for underground roads and

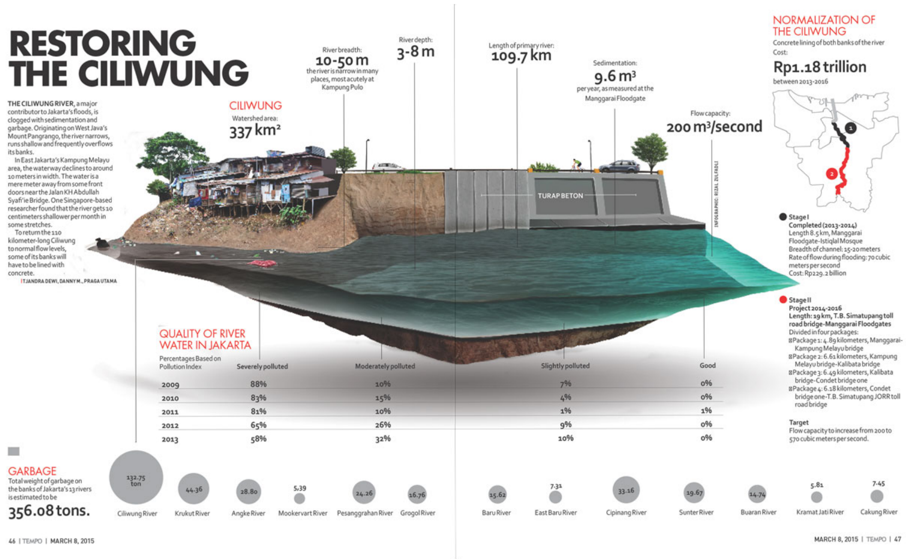


Figure 4.5.8: Strategies for 'Restoring the Ciliwung', Source: Tempo, March 8th 2015, p.46.

drainage (Proyek Sodetan Ciliwung).

4.6 Findings from the historical study

Through this extended chronological study, the river is recognised as a key protagonist in the city's growth across three timeframes, the precolonial, the colonial and the post-colonial. The explanations gathered shed light on the relationship between the economic expansion of Batavia into its hinterland and its ecological deterioration [107]. Within each timeframe the conceptualisation of water and water landscapes, and tactics and behaviours (practices) relating toward these differed significantly. I frame the conclusion with a summary comparing and contrasting these within each timeframe and this is accompanied by a large graphic (see Figure 4.6.1).

4.6.1 Change in conception of- and behaviour/tactics toward water since precolonial time

Precolonial timeframe

Through this study a persistent link between water and religion is evident throughout the early Javanese inscriptions, particularly in regard to the management of water. The importance of 'local genius' [32] is evidently significant in the establishment of early settlements and places of spiritual focus. Royal residences connected themselves to water through association to the gods and the ancestor spirits of the mountains from which water and fertility originated [46] either through the specific selection of sites or the modification of these; however, the everyday coordination of water for irrigation was handled at the local level. Water linked the dead and the living, and the immortality of the spirit and the fertility of the soil [45]. Meanwhile, narratives and stories tied to the river, along with physical artefacts, reveal the Ciliwung River to have been the heart of the precolonial kingdoms of West Java.

While Putri and Rahmanti[197] acknowledge the tendency of Javanese Kings to avoid easily flooded lands (such as the swampy lowland plain); I draw a higher significance to this settlement tactic. I acknowledge correlations between spirituality, cosmology and terrain which caused the royal residences to be sited in the highlands and influenced the spatial design of individual villages such as the port town of Sunda Kelapa (early Jakarta). This said, the folk stories of Nyai Lara Kidul and others attribute an unhealthiness to lowlands which I perceive may have been a result of human experience, which has served to inform such narratives and resulted historically in the placement of settlements on the riverbanks (built higher with sediment) and in upland areas — ie. an avoidance of swampy land.

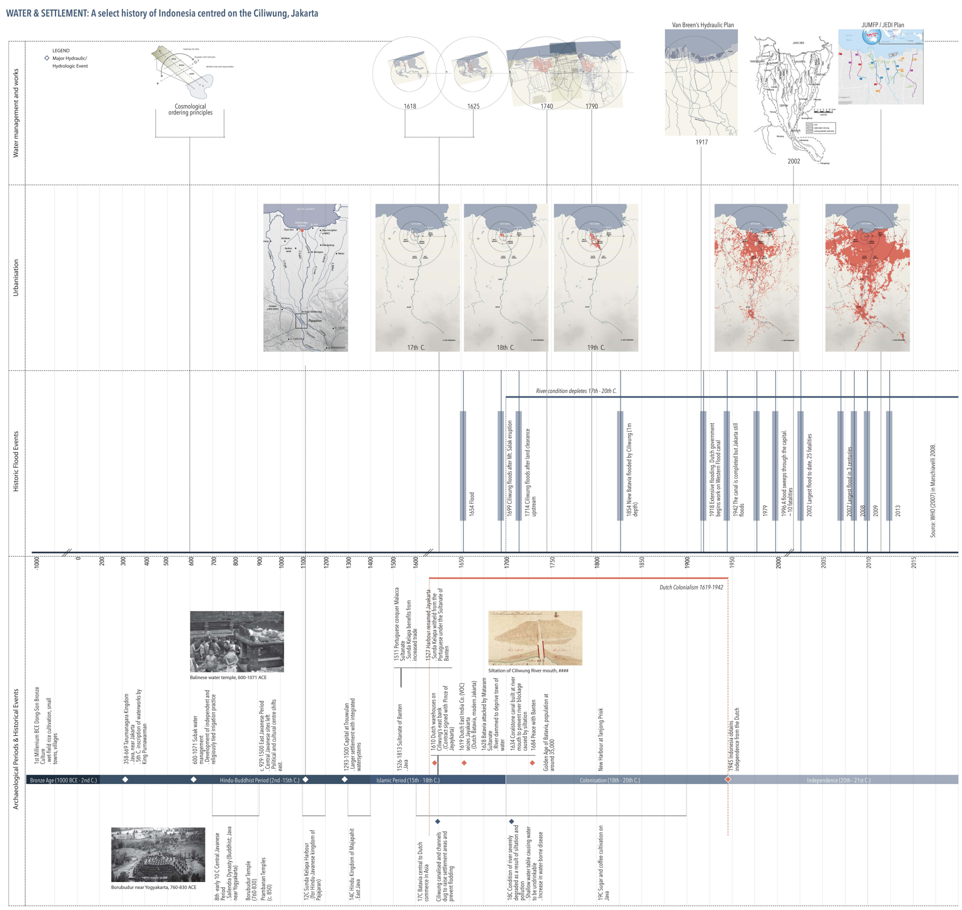


Figure 4.6.1: Consolidated timeline graphic of the transformation of Jakarta.

I observe that although floods were a normal phenomenon throughout its precolonial and colonial history, over the past decennia the severity and frequency of floods in the city have seriously increased as a result of geographical, environmental and infrastructural causes [36, 40, 252] c.f. [208]. Where in earlier years widespread flooding was uncommon (see early maps of flooded areas) and impacts were lesser than today; the impacts of flooding are now significantly greater given the increasing of the city extent, lessened porosity, and increased population [63].

Superimposition of foreign visions

The implementation of the Dutch canal system in early Batavia marked the beginning of an era of of foreign or 'borrowed' visions [226] in Jakarta which still continues today. These visions are foreign in two ways: firstly, because they were projected by foreigners, or outsiders; and secondly, because they were not 'of the place'. The spatial logics of the colonial and postcolonial periods were inconsistent with the past indigenous spatial logics, and saw the widespread conversion of natural drainage landscapes into impermeable urban areas.

Desire to justify proposals using local technologies/ knowledge/ cultural inspiration

Throughout the colonial and postcolonial timeframes efforts have been made to justify and/or legitimise proposals using local technologies and knowledge. In both timeframes this has served in the construction of ideas of national heritage. For the colonial period this was engendered through the waduk, described by Van Oosterhout [261] as a 'technological and social hybrid: a mix of precolonial, colonial and postcolonial technologies, materials, tools, religious practices, and organisational forms'. Meanwhile, it was engendered during the earlier postcolonial period through the use of Betawi architecture and settlement typologies to inspire greenbelts; and in the later postcolonial period with the sea wall project, which claims to be culturally inspired. Viewed from the air it will 'resemble the giant mythical Garuda bird, a central feature of Indonesia's national emblem' [229] (refer back to Figure 4.5.5). While cultural inspiration is consistently drawn on within top-down strategies, it seems lacking within the human-scale of these proposals and the final delivery.

Contemporary timeframe

Contemporary water management approaches continue in the same vein as those of the later colonial and postcolonial period and have largely proved unsuccessful in mitigating the massive flooding which is now an increasingly frequent event in Jakarta. Resultantly, '... the need for more effective means of guiding urban growth and change becomes ever more apparent' [63].

4.7 Implication for future riverine landscape transformation paradigm

Following Putri and Rahmanti[197] I caution that transformations of the urban river landscape cannot be separated by inhabitants' conceptions of- and behaviours and tactics toward water. While social and ecological studies of riverside communities exist ([103]; Salak – Condet; Yogyakarta); as in the case of Bangkok observed by Mcgrath [143], disciplinary separation ensures that 'design and planning rarely [take] advantage of social and ecological research's rich knowledge base, and waterways [have become] data for hydrological modelling rather than the sites of local life and livelihood' [143]. Despite Jakarta's rich history of lives closely intertwined with rivers, little meaningful inspiration has been taken from the rich knowledge base of communities and past practices.

As the Dutch government's control over the region stabilised, the city increasingly turned away from rivers and orientated towards beneficial infrastructures such as roads, railways and municipal water networks. I observe here that the conception of the river as a beneficial infrastructure had lessened by this time. Geenen and Derden[75] identify the 'unilateral shift' from water to road in most parts of Southeast Asia as a 'dangerous strategy' in the practice of contemporary development (See also [16, 189, 206]. And equally, many water-related challenges of the region may be viewed as a 'problematic product of colonial exploitation' [227]. Indeed, in the case of Jakarta recent floods have been catastrophic. However, as Geenen and Derden acknowledge, the answer ought not be a binary acceptance of one or the other, but rather a strategy of co-existence.

Thus, I conclude that apart from having a hydrological understanding of water, it is important to have an understanding of how water is conceived and affected by local actors. Such an understanding can produce knowledge of both successful and unsuccessful water management strategies, along with how such strategies have influenced the conceptualisation of- and behaviour toward rivers within urban landscapes.

I argue that in order to support stewardship of the city's rivers and waterways a paradigm shift should occur in which learnings from studies are brought into future landscape configurations. I acknowledge that while it is impossible to revert to the past state (due to density of urbanisation, industrialisation, and the degree of degradation), aspects such as the integration of the river in the city need to be reinvigorated for such a shift to occur.

All human landscape has cultural meaning, no matter how ordinary that landscape may be.

Pierce Lewis, 1979

5

Explorations and Speculations

Some sections of Chapter 5.2 have been included within the following refereed journal articles.

- Prescott and Ninsalam 'The Synthesis of Environmental and Socio-cultural Information in the Ecological Design of Urban Riverine Landscapes' Sustainable cities and societies, 2015
- Padawangi et al. 'Participatory Mapping' Sustainable cities and societies, 2015
- Vollmer et al. 'Understanding the value of urban riparian corridors: considerations in planning for cultural services along an Indonesian river' Landscape and Urban Planning, 2015

5.1 Introduction

This chapter builds from Nassauer's principles 'landscape as medium' and 'landscape as method'. The research develops an approach to understand the socio-spatial processes within these landscapes, and connect residents' everyday experiences to other actors and processes involved in riverine landscape transformation (Figure 5.1.1). These are examined through the architectural devices of cross-sections and maps (section 5.2). This approach allows the research to integrate varied perspectives of landscape transformation, from both communities and government (Section 5.3).

On the one hand, the study revealed that while there are a variety of spatial relationships to the river that illustrate positive aspects of the river's services and community attitudes, some elements of the urban structure of these communities are contributing to negative environmental behaviour. On the other hand, ecological knowledge regarding the socio-environmental aspects of the urban riverine landscape contributed to the development of tactics that resulted in more resilient communities and landscapes.

As outcomes of the chapter, and the cumulative knowledge of the thesis, the following are presented: a catalogue of interventions; a chart of these interventions relative to three key aspects identified in the fieldwork; and finally, two design scenarios reflecting the design intervention.

This chapter addresses most specifically research questions two and three.

- What kind of tactics and behaviours of those producing the built environment emerge within urban riverine neighbourhoods? (RQ2)
- What is the relation between riverine landscapes, tactics and behaviours, and socio-spatial change? What theoretical and practical lessons can be drawn? (RQ3)

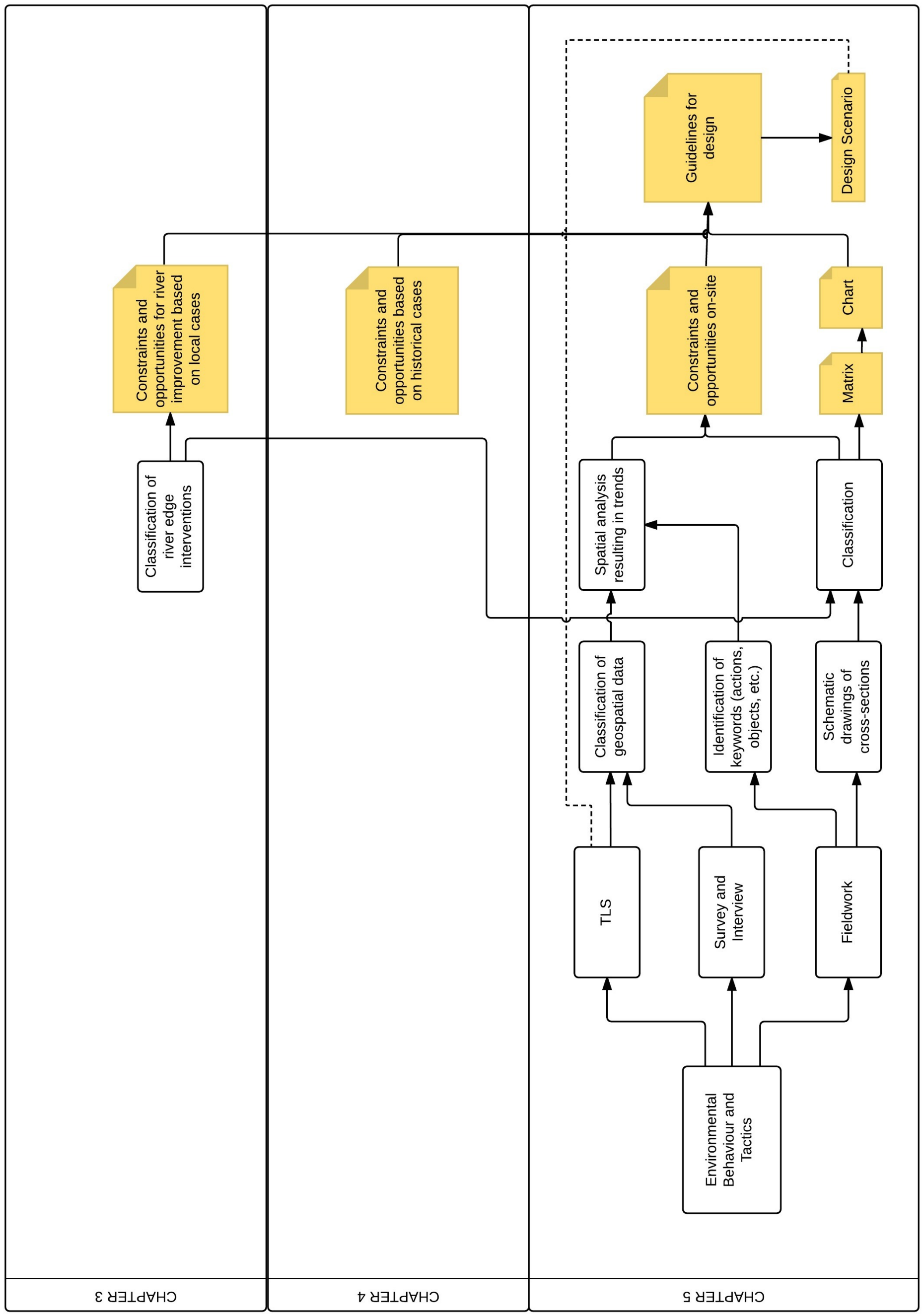


Figure 5.1.1: Overview of Chapter 5 illustrating the integration of outputs from chapters 3 and 4 within the catalogue, charts and scenarios.

5.1.1 Background: Jakarta DKI Field Conditions

Evolution of Kampung Melayu and Bukit Duri subdistricts

The development of the city of Jakarta from a port town into a megacity was described in the previous chapter. This included the set of regulatory tools (such as master plans and management plans) with spatial connotations for informal settlements.

Particularly relevant to Kampung Melayu and Bukit Duri is the spatial pattern that resulted from the strategies of racial segregation, which were practiced in colonial planning within much of South and Southeast Asia [111]. These strategies saw indigenous communities increasingly concentrated in kampungs in less desirable and poorly provisioned areas such as the outskirts of the city, and in easily flooded areas, and along waterways, such as the Ciliwung River. The area of Kampung Melayu, previously known as Meester Cornelis, developed from around the late 19th century. Even then the kampungs were sandwiched between the Groote Postweg (now: Jalan Jatinegara Barat) and the Ciliwung River by a layer of European buildings that fronted onto the road (See Ch4).

Many of the areas classified as kampung in the Dutch colonial map of 1938 still show kampung-like characteristics today [39]5.1.2. Although these areas have been extended further since that time (dark green), there are areas which date back to 1938 (light green). These areas have retained their particular character, throughout the intense urbanisation of Jakarta which began in the 1960's.

Now one of the biggest cities in Southeast Asia, Jakarta has a population of 9.6 million inhabitants 5.1.3. Its greater metropolitan area, JABODETABEK, has a population of more than 27 million—making it the second largest total metropolitan area in the world. It is vital to

Figure 5.1.2: Kampungs today and their historic roots: all green areas are kampungs; black outlined overlay (main map) shows the extent of the kampungs in Dutch colonial times. Many kampungs established before 1938 are preserved up to this day (light green). The inset shows the study area of the thesis relative to Cairns and Friedrich's 2013 mapping. Source: Cairns [39], Inset redrawn from Cairns.

	Variables	Ciliwung River, Jakarta
Overview characteristics	River length (kilometres)	119 km
	Watershed size	384 km^2
	Population pressure (Size of city/urban region)	9.6 million (Special Capital Region of Jakarta)
	Districts crossed	–
Case	Case study settlement(s)	Bukit Duri and Kampung Melayu
	Land classification (for case studies)	Urban

Figure 5.1.3: Basic statistical information on Ciliwung River

understand the physical and spatial complexity of this damaged landscape in order to develop a transformative understanding of the site that is both culturally respectful of traditions and ecologically congruent. The scope of the requirement for the research may be measured through extent of damage and deterioration, particularly in regard to: water quality and flooding; natural environment and ecology; and, urban environment and hygiene.

Ciliwung degraded and misused

a) Water quality and flooding

As was demonstrated by Chapter 4, The Ciliwung River (Kali Ciliwung) has a long history of use and misuse, and its condition is no longer natural. The worsening condition of the river, partly caused by uninhibited urbanisation along the river's banks, means that the river can no longer be relied upon as a water source. Ground water pumps are used to extract water for domestic use, and bottled water, supplied by local water sellers, is more expensive than in other areas of the city. These conditions – coupled with a lack of basic urban infrastructures, and increased imperviousness – have contributed to excessive ground water extraction impacting the water table, causing the substrate to compact and the city to subside. Forty percent of the city's area already lies below sea level, vulnerable to tidal flooding, storm surges, and future rises in sea level. The hardening of the city surrounding the river, together with deforestation and on-going urbanisation upstream near to Depok and Bogor, play a role in repetitive flash flooding which has worsened through the last decade. The 2007 flood was particularly significant with the floodwater in some areas reaching a depth of 10 metres above the riverbed [18].

b) Natural environment and ecology

The dumping of organic and non-organic waste into the river and drains further provokes the intensification and increased frequency of flood events. In 2009 the Jakarta Post quantified the daily volume of rubbish being dumped daily into the thirteen rivers of Jakarta at approximately 600-tons. The environmental consequences of this negligence for the Ciliwung are immense, its flow capacity reduced to 19% and garbage contributing to synthetic sedimentation on banks and riverbed. The consolidation and subsequent impermeability of this composite layer further add to the health and environmental problems of the city. The riverbanks are in poor condition, exacerbated by the increasing informal urban encroachment and neglect, garbage sedimentation, and uncontrolled run-off. Remedial action is not taking this into account and serious flooding leads to further erosion, sedimentation and damage. Local residents using plantings of bamboo, sandbagging, and timber or bamboo fences address erosion informally, however this further consolidates the river's infringement. The narrow, vegetated corridor of the river is not only compromised by the close proximity of settlement and garbage deposition, but also suffers increasing damage due to its harvest for construction materials. Despite this, the river itself is largely inaccessible, disengaged from the city by layers of garbage, and settlement.

c) Urban environment and hygiene

While housing, land use and zoning laws exist; these are largely unenforced, allowing for the establishment of informal settlements. While waterways are owned and controlled by either the city or the central government, and laws require vacant easements of ten- to fifteen-metres along waterways (Republik Indonesia 2011), these are precisely the areas that informal settlements establish themselves [18]. Weak government regulation of where people are allowed to live is compounded by the lack of provision of basic services such as adequate housing, clean water, and garbage collection; and certain riverbank housing can be categorised as slums due to the proliferation of unsanitary, ramshackle conditions [170]. The insubstantial delivery of sewage systems and infrastructures – resulting in toilets located over drains, wastewater discharge directly into the river, and floating toilets and wash areas (getek) – contributes to poor hygiene, with links being made to the prevalence of disease and skin irritation. Public- and circulation spaces are similarly compromised due to the density of settlement and inadequacy of drainage and garbage systems.

5.1.2 Study Area

The study area is located in South Jakarta and includes the subdistricts (Kelurahan) of Bukit Duri and Kampung Melayu (Figure 5.1.4). Within each subdistrict we selected a community unit (Rukun Warga, RW) adjacent to the river to provide an urban context (Figure 5.1.5). A 30-metre by 100-metre urban transect was taken of a neighbourhood (Rukun Tetangga, RT) to act as a representative sample for descriptive purposes (Figures 5.1.6 and 5.1.7). In addition, I also examined the area of Kebon Pala in Kampung Melayu in some detail, through survey, interview and observation. This was useful as the terrain variation across this area and connectivity to the main road is more marked, and as a result — following the analysis of the survey results and interview responses — helped me reflect on the impact of these factors in relation to the other areas.

Located on a peninsula of land called 'Kampung Pulo' the neighbourhood studied in Kampung Melayu has several distinctive elements (open spaces

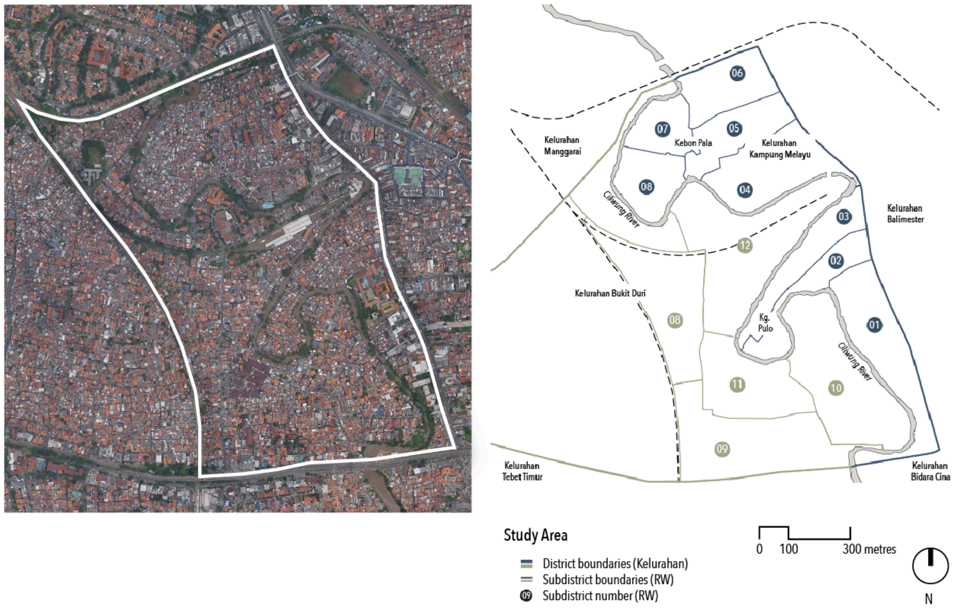


Figure 5.1.4: Bukit Duri and Kampung Melayu are densely settled subdistricts lying along the banks of the Ciliwung River.

along the riverside, communal and private plantings, gentle sloping banks) that define the arrangement of this riverine landscape and influence its condition. In comparison, the neighbourhood studied in the nearby community of Bukit Duri, compressed between the railway siding of KRL-KRD Bukit Duri and the Ciliwung River, has limited river access and riverside open space, houses backing directly onto the river, and less vegetation.

The majority of the research involved surveying and interviewing households within the subdistricts (Kelurahan) Bukit Duri and Kampung Melayu. Kampung Melayu is one of the largest and oldest kampungs, or urban villages, in Jakarta (Figures 5.1.8). The study area is densely and predominantly informally settled, housing over 48,000 people within a square kilometre [265]. The neighbourhoods under study are home to around 80 households each, of which the average household size is 5.7

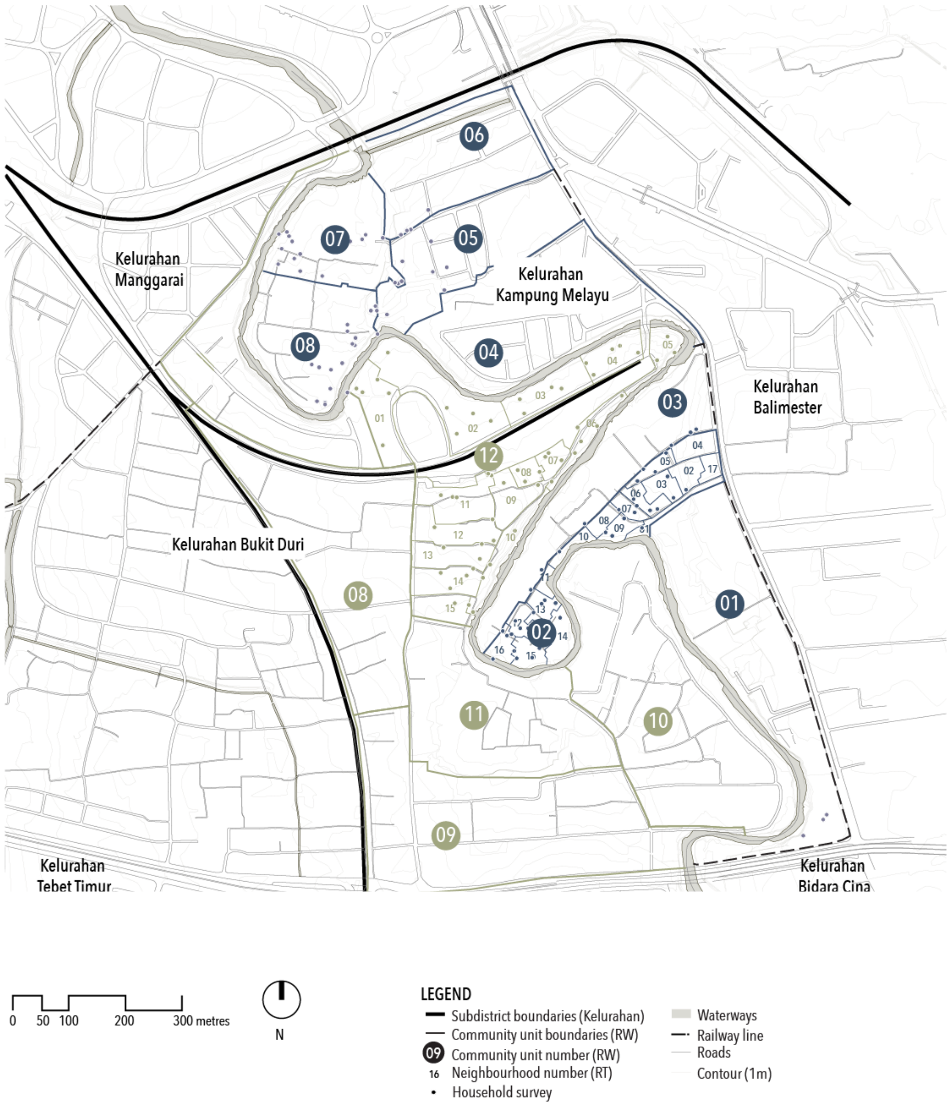


Figure 5.1.5: The Rukun Tetangga (RT), or neighbourhood, structure of the two community units within the subdistricts (Rukun Warga, RW) of Bukit Duri (RW12) and Kampung Melayu (RW2).

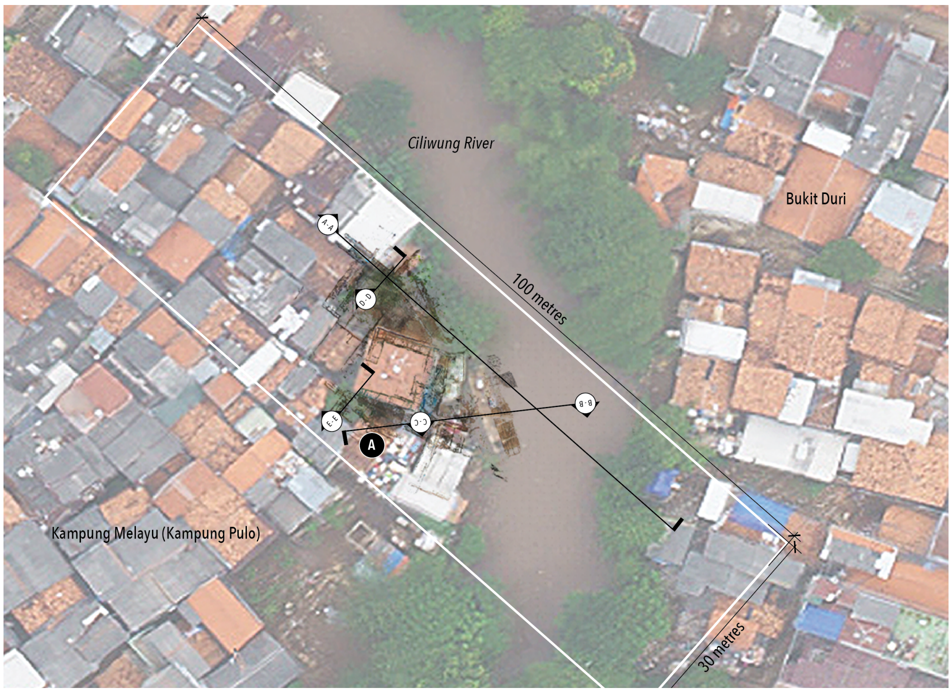


Figure 5.1.6: Aerial photograph (FCL) with overlayed image-based point cloud model of the 100x30 metre transect taken in Kampung Melayu (Kampung Pulo). A series of sectional elevations (A-A to E-E) were taken through the point cloud using Autodesk Revit. 'A' denotes one of the households specifically referred to within this chapter. [193]

Figure 5.1.7: Aerial photograph (FCL) with overlayed terrestrial laser scan model of the 100x30 metre transect taken in Bukit Duri. A series of sectional elevations (A-A to F-F) were taken through the point cloud using Autodesk Revit. 'B' denotes one of the households specifically referred to within this chapter [193].

persons. Households are often made up of extended family groups, and as are result may be multi-generational. The fabric of the neighbourhood is characterised by one and two storey buildings built from timber, brick, concrete and steel. The buildings may be multifunctional, often comprising a combination of home, craft, and business-related activities. Typically, the buildings are adapted and modified as the needs of the household change. The neighbourhoods are structured by a number of streets, laneways, community buildings and common-use spaces, and river access points. These are often populated by socio-economic activities including home industries, home-based stalls, carts, and street vendors.

The location of the neighbourhoods along the downstream reaches of the Ciliwung River means households are subject to fluvial flooding (see also chapter 4). Households have been inundated to depths of up to four meters of water (such as in 2013) during the monsoon season, and experience frequent minor floods of around 0.5m as the river breaks its banks during rain events throughout the year. Due to the increasing severity of the flooding people have adapted, living primarily in the second floor of their homes, leaving the bottom levels empty and using these spaces for home industries, cooking, and basic entertainment (ie. TVs) only when it is dry. An early warning system for floods has been developed at the community level [18, 138, 266]. Repetitive flooding in Kampung Melayu and Bukit Duri, and a culture of community aid — *gotong royong* — founds community resilience, and locally enforced management.

5.1.3 Methods: Landscape as a medium for synthesis

Earlier work, published in [265], provides an overview of preliminary work in this mixed methods approach in understanding the ecosystem services of an urban river corridor in Jakarta, Indonesia. The present research, which is described in this paper, couples site-specific quantitative

Figure 5.1.8: The intense use of the river as a sewer, secondary water source, and garbage disposal—coupled with encroachment and bank consolidation—reduce the river's capacity and compromise its role. However, the neighbourhoods along the river are lively and communities appear to have a higher level of interaction with the river than those in other areas of the city.

spatial acquisition methods and quantitative and qualitative social research. It is important to note that this work, following on from the down-shift in scales called for in Section 1.2, is part of a collaborative research project in which three spatial scales are addressed: the catchment, the corridor, and the local landscape.

Scientific insight by field investigation in the landscape is viewed as relevant for addressing local and global environmental challenges in the 21st century [159]. However, as highlighted in Section 1.5 perceptions of a landscape may differ and communication between different groups can be challenging. We argue that through using the landscape as medium can serve to offer a starting point for discussion between different groups and as a method of synthesising different perspectives for the ecological design of urban riverine landscapes.

Within the investigation we employ a number of different methods, characterised largely by a household survey, interview, observation, and a spatial study, which employs terrestrial laser scanning. This is framed by a grounded theory approach, in which we take the phenomena of environmental behaviour, within this urban neighbourhood and examine it through a process of data collection, coding, conceptualisation, categorisation, leading toward the development of scenarios for improvement 5.1.1. This section (5.2) takes a focus on the methods of data collection, leading into the development of an understanding of how the spatial structure of the river landscape can be transformed to facilitate behavioural change (5.3, 5.4, 5.5, and 5.6).

Environmental services pertaining to the river corridor and vegetation use patterns were of primary interest for our analysis. [263] have identified six distinct environmental services along the river within the same study area: 1) direct sanitary use; 2) recreation; 3) harvesting plants; 4) groundwater use; 5) solid waste disposal; and 6) sewage disposal. Based on our interest in this research we have focused our study on the second, recreation, the third, environmental services acquired from vegetation, which we identify as being largely synonymous with vegetation function, and the fifth, solid waste disposal. For the purposes of our research we expanded the environmental services acquired from vegetation category, from solely the harvesting of plants to include plant cultivation—either in home gardens (including potted plants), in public spaces, or along the riverbanks—and the benefits gained from this. Harvesting of plants is defined as collecting materials (fruits, fiber, medicinal herbs) from plants growing directly in the soil along the riverbanks.

We identify these services as being larger level cues to understanding the riverine landscape.

The project used a range of quantitatively and qualitatively driven methods, including: household surveys; semi-structured interviews; walking interviews; participatory social maps; and participant observation. A terrestrial laser scanner was used to collect spatial information at the local landscape scale; meanwhile an aerial survey was used to capture spatial information at the subdistrict scale. The gathered information was analysed using statistical analysis, grounded theory method, and spatial analysis.

5.2 Explorations and Speculations

Using the landscape as medium, I explore the relationship between residents and vegetation interaction, and spatial condition, of an urban riverine landscape in the Jakarta subdistricts of Kampung Melayu and Bukit Duri. These offer distinct examples of an urban riverine landscape within a growing megacity.

Following Nassauer, I developed an approach to the ecological design of urban riverine landscapes. This is important, because it exemplifies the inherent contradictions and potentials of human-made landscapes [159], and points to a way forward. Nassauer defines ecological as the key term, as it refers broadly to the socio-environmental sciences which are necessary to inform action. Such an approach, requires the 'adequate' understanding of nature before intelligent intervention can occur. The term design is used to mean 'intentional landscape change' [162], and includes change affected by design professions, by development and management of landscapes, and – most significantly – change that results from the "local custom, pragmatic adaptation to circumstances, and unpredictable mobility' of people living their lives [102]. I link this to a concept raised in environment—behaviour research by [52], and earlier by [27]: the interaction between personal and situational variables in environmental behaviour.

The landscape was used as medium to integrate local knowledge for the purpose of ecological design. Using an integrated mixed-methods approach including surveys and interviews, and spatial mapping through drawings and image- and range-based modelling, the study discerned that differences in the landscape configuration of the two sites produced differences in resident interaction with domestic and riverine vegetation, and landscape condition. As such, the method is seen to be useful in providing valuable insights for the design of urban riverine landscapes.

5.2.1 Results and Discussion: Empirical findings from Kampung Melayu and Bukit Duri

Through a process of coding my fieldnotes, interview transcripts, and 3D models of the sites using grounded theory method [44, 213], I uncovered environmental (spatial) and socio-cultural factors influencing the growth of vegetation. Both participant accounts and our spatial measurements identified and supported in each other remarkable shifts in behaviour relative to spatial aspects such as seasonal and longer-term fluctuations in water level, soil stability, and urban density.

Vegetation

a) Attributes of deliberately planted vegetation in urban riverine landscapes (as perceived by the community)

Households within the subdistricts observe multiple functions of vegetation within the urban riverine landscape (Figure 5.2.1). These beneficial features include: their medicinal properties, for eating and use in cooking, for ornamental or 'greening', as a building material, for erosion control, and for shade (Figure 5.2.1 c. and e.). I also observed that residents valued vegetation for its passive cooling function, with a number of households who cited growing vegetation for its capacity to make their homes feel cooler and 'green' (see also [265]). Some households observed multiple benefits of vegetation.

b) Socio-cultural factors influencing the growth of vegetation

Food and medicine

Residents who live within these community units often care for- or harvest from- vegetation nearby their own home, or along the riverbank. They report using the pickings in cooking and consumption and medicinal aspects. An interviewee who manages a fishing pond on the riverbank in Kampung Pulo mentions treating symptoms, such as ulcers, fungal conditions, heartburn and bad breath using the bark of a large Angsana tree (*Pterocarpus indicus*) growing along the river. Another interviewee (Household 'A', see Figure 5.1.6) living nearby, a housewife who had been living in her home for the past 20 years, related that the medicinal aspects of plants are important in maintaining her family's well being. Plants such as Turmeric, locally known as 'kunyit' (*Curcuma longa*), are grown despite

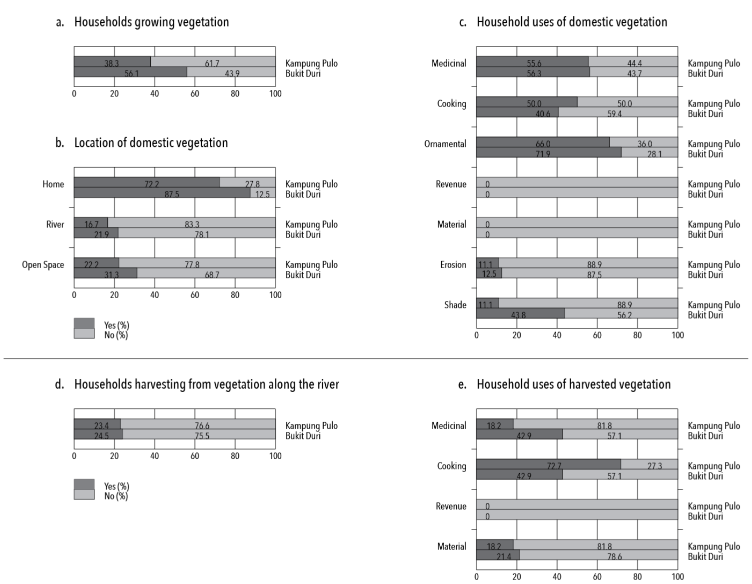


Figure 5.2.1: The bar graphs illustrate the comparison of the household survey results between Kampung Pulo in Kampung Melayu (KP) and Bukit Duri (BD) of a. whether a household grows vegetation; b. locations of domestic vegetation (some households reported growing plants in more than one location); c. categories of beneficial features of vegetation (some households reported growing plants for more than one aspect); d. whether a household harvests from vegetation growing along the river; and e. categories of beneficial features of vegetation (some households reported harvesting for more than one aspect).

the frequency of flooding experienced in this home, which is located 15-metres away from the river and at 2.2 metres elevation above the river. This is described further and illustrated in Figures 5.2.5. Framed within the overall behaviour I measured, this is supported by more than half of surveyed households in both neighbourhoods reporting medicinal use of vegetation (Figure 5.2.1 c. and e.). Use of plants in cooking and for consumption follows this in importance.

Looking across the two community units surveyed, using the probability maps generated from the household surveys, a clear correlation can be seen between a household's proximity to the river and likelihood of them harvesting vegetation from the greenbelt along the river (Figure 5.2.2). Within both areas households within a 50- to 100-metre radius of the river were more likely to harvest from the greenbelt.

Education

An interest in plants is cultivated from a young age with the support of the education system. Children in the community are encouraged by their teachers to bring plants to school—for planting within the school grounds—, or are given plants to take home to look after. It is evident from a number of interviews with parents and children that the situation at home (level of natural light or amount of open space), along with flood-risk, appears to influence whether or not households continue grow plants throughout the year as a result of this program. However, these programs appear to change this tendency in the short term. I have not investigated whether or not this has shifted larger behavioural patterns of growing plants.

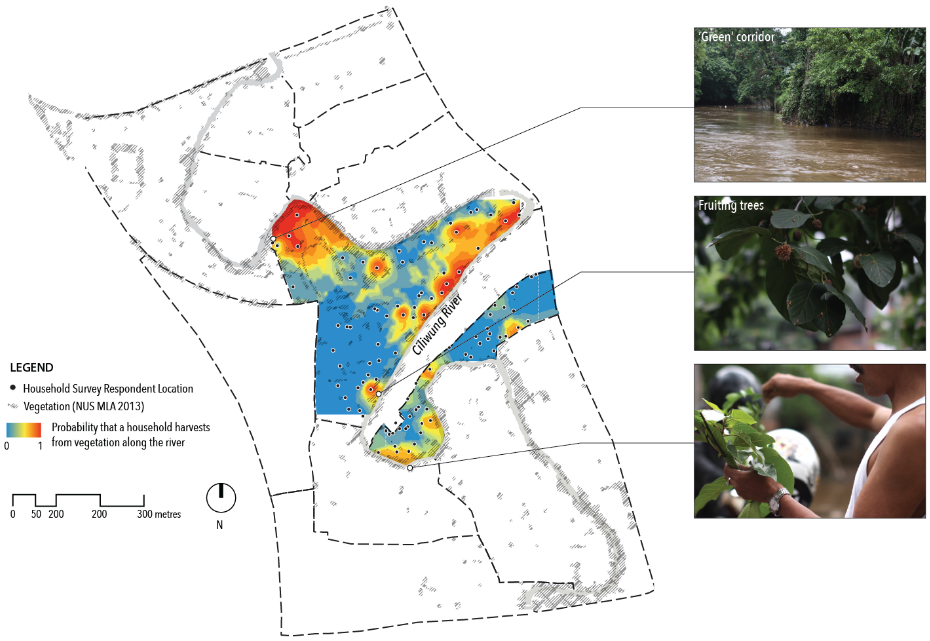


Figure 5.2.2: Probability of a household harvesting from riverside vegetation: Often the mature trees at the riverside are productive. Using Indicator Kriging a clear correlation can be seen between a household's proximity to the river and their likelihood of harvesting from vegetation growing along the river.

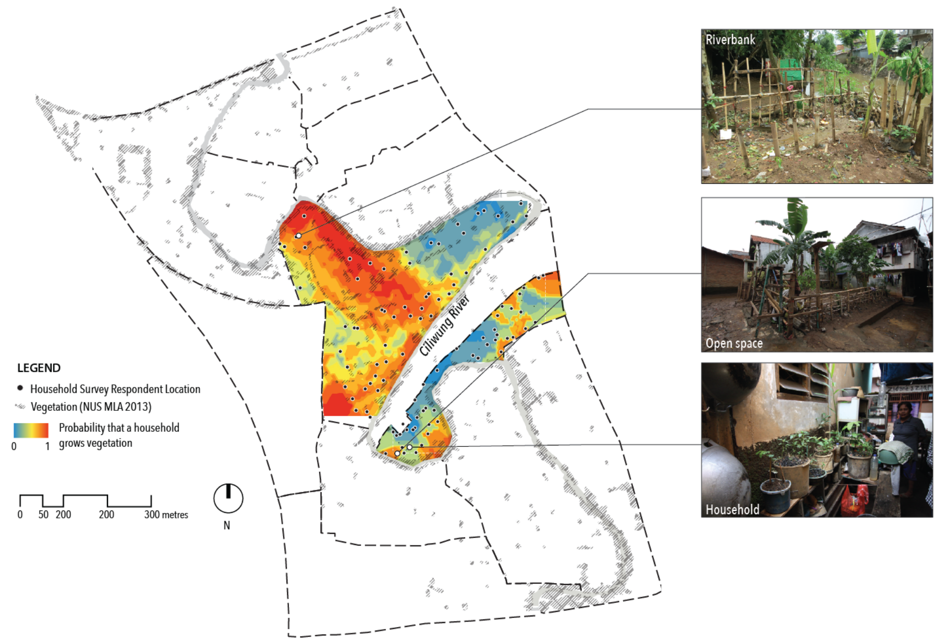


Figure 5.2.3: Probability of a household growing vegetation: Using Indicator Kriging a correlation can be seen between the density of settlement within an area (inferred from site observation) and their likelihood of growing vegetation, either at home, in open spaces or along the river.

b) Environmental factors influencing the growth of vegetation

Flooding

While previously residents saw development as a key factor in vegetation reduction (for example through the 1970s onward), more recently flooding has overtaken this as a significant factor attributed to vegetation reduction within the river corridor. Upkeep problems associated with vegetation including damage caused by repetitive flooding, and rodents, were seen to significantly impact a household's decision to grow vegetation. Those that did persevere implemented a variety of coping mechanisms, including: lifting pot plants above the ground (either temporarily during the wet season, or year round); constructing fences (to prevent damage to vegetation by flotsam); and growing plants elsewhere (Figures 5.2.4 and 5.2.5). In Kampung Pulo, which floods as often as once a month, community leaders and residents have identified flooding as their main livelihood concern [265]. An interview with a neighbourhood elder—who has been living along the river since 1951—reveals that the recurrent floods reduce residents' capacity to assist with upkeep of gardens along the river. Another interview with the vice leader of the Kampung Pulo community unit reveals the neighbourhood constructed a bamboo fence along the river-edge in 2014 (Figure 5.2.5). The fence was intended to prevent damage from floating garbage to a public space and gardens along the riverbank. While it was observed by the interviewee that the fence was unlikely to withstand the forcing of flood-waters during the peak of the season, he commented that at least it would protect them in the short term.

Despite Kampung Pulo's higher susceptibility to flooding (when compared to Bukit Duri)—due to its gently sloping terrain—a significant proportion of households (Figure 5.2.1 a.) persevered with growing vegetation. Interviewee A related that during the wet season they—like other households in this neighbourhood—abstain from planting new plants, choosing to wait instead until the dry season comes (although over the past two-years the area has flooded even throughout the drier months of the year). Additionally, the ground level of the house and garden has been artificially raised 0.8 metres using soil that was deposited in the neighbourhood following floods (Figure 5.2.5). This reduces the impact of the frequent minor floods on the household along with their plants. She observes that while they still grow a few medicinal plants, the number is less than they had previously because the frequent flooding had destroyed many and has deterred them somewhat. Her mother, who was present in the interview, seemed more hopeful and mentioned that they planned to replant other important medicinal plants when it was drier.

Residents have remarked on the environmental changes that have occurred within the two community units, specifically along the river. They echo a downward trajectory, whereby vegetation cover reduces while built area increases. One resident also comments on a parallelled increase in 'big floods'. It is also observed that the vegetation types found along the river are fewer, illustrating that a reduction in biodiversity has been perceived. Vegetation was observed in the past to have also had more diverse uses: for building materials, supplementary income, human consumption, shade, and play equipment. This seems to communicate a correlation between the environmental decline in the site and the prolonged flooding's impact on residents. A resident commented that flooding frequently disrupts the lives of his family and his neighbours and they have no energy to spare for the riverbank. Meanwhile a community leader of the Kampung Pulo community unit observes that flooding deters residents to invest in their environment.

Generally, from interviews within these neighbourhoods it has been revealed that vegetation is removed for a number of reasons identified

Figure 5.2.4: Illustration of coping mechanisms employed by residents pertaining to vegetation including raising plants off the ground (a., b., and c.) and constructing fences (d. and e.).

within the community. These include: for development, for use as building materials, and due to perceived threat during flood events. An interviewee living in Bukit Duri observes that during floods broken vegetation can be hazardous to homes and lives. Prior to the 2014-2015 wet season he and other nearby households removed the limbs of the large tree to protect their homes and families. At the same time, they deliberately chose to leave the roots and trunk intact knowing that these helped to stabilise the riverbank.

Erosion

Vegetation was more highly relied upon as a tool for erosion control along the river edge in Bukit Duri than in Kampung Pulo. It must be acknowledged that the focus site within Bukit Duri was located on an outward bend of the river meaning forces of erosion are stronger than in the Kampung Pulo site surveyed. As such comparison here is limited. In as much, several survey respondents within both focus sites reported the use of vegetation along the river for erosion control. Iterative cross-sections through the Bukit Duri neighbourhood, taken perpendicular to the river, may be used to understand the impacts of temporal changes relative to vegetation removal and retention, within the river corridor. Examining precisely two cross-sections of the riverbank, cut within a few metres of each other in Bukit Duri, the impact a large tree has had on the ongoing stability of the riverbank is observed (Figure 5.2.6). An interviewee (Household 'B', see Figure 5.1.7), who has been a resident of the neighbourhood for more than 30-years, recounts that the riverbanks have been shifting over the years and used to be lined with bamboo. The riverbank below his home (which is raised on stilts) has been scoured out by approximately 1.5 metres. Previously they have used bamboo fencing and vegetation along the edge to try to stabilise the bank, however this has not withstood the floods of the past two-years.

The reasons expressed by residents for planting vegetation along the riverbank varies based on location. An interviewee in Kampung Pulo who had been living along the river for several decades described how their approach to the erosion of the riverbank occurring near their home had changed based on their available income. Before the 1996 flood, they had more available income and were able to use concrete to reinforce the riverbank. Since then, with less available income for this purpose, they have used more informal methods for erosion control such as bamboo sheeting (Figure 5.2.6). Other residents use plants such as bamboo (*Bambusa sp.*) and trees such as Angsana (*Pterocarpus indicus*), Cluster figs, known locally as Lo (*Ficus sp.*) and Starfruit locally known as bilimbik (*Averrhoa carambola*) to reinforce the riverbank (Figures 5.2.6, 5.2.7, and 5.2.8). It is evident that the maintenance of the river edge has to date been largely left to communities, and they have developed precise knowledge

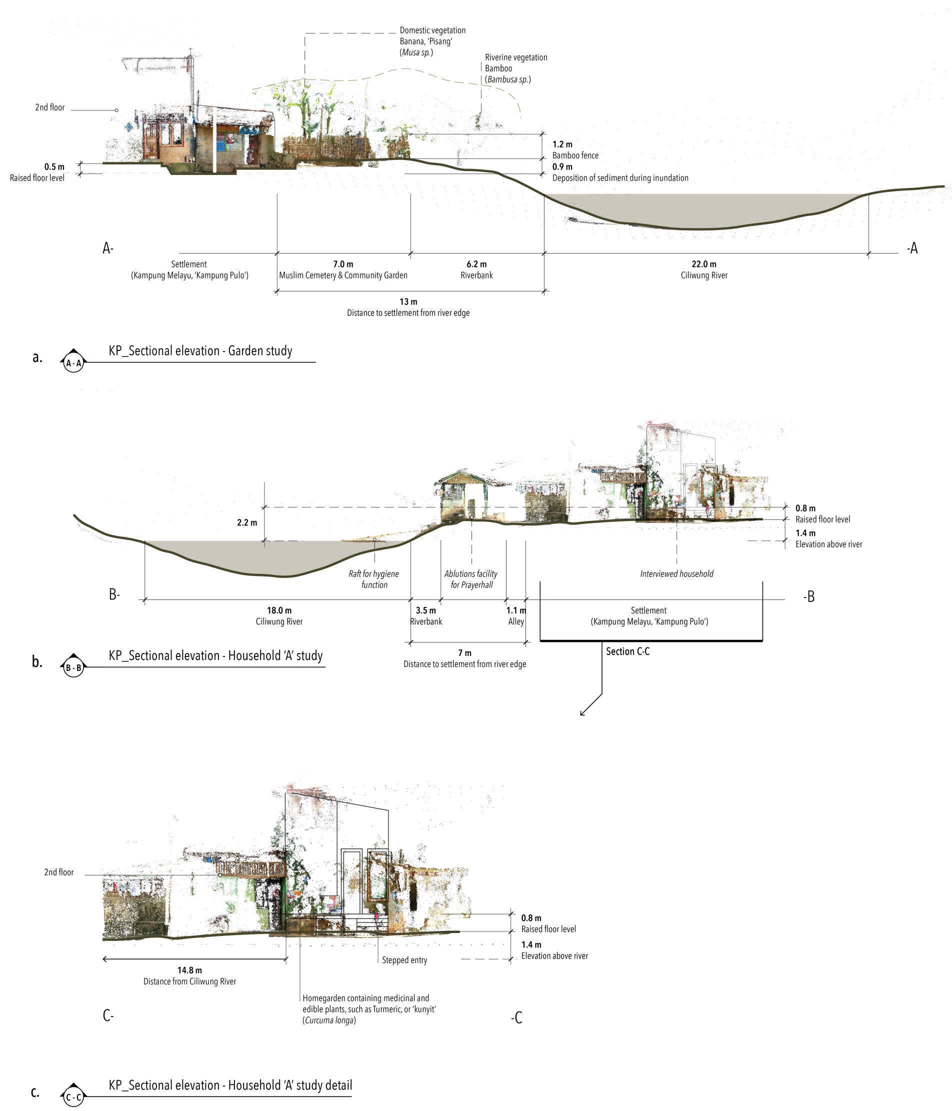


Figure 5.2.5: Alterations taken at the household level for coping with flooding: a. Section A-A illustrates in sectional elevation a community garden-cum-Muslim cemetery located on the riverbank in Kampung Pulo. b. Section B-B Illustrates the relationship between the environmental behaviour of a household and the river edge. c. Section C-C Annotated detail illustrating the alterations taken at the household level for coping with flooding.

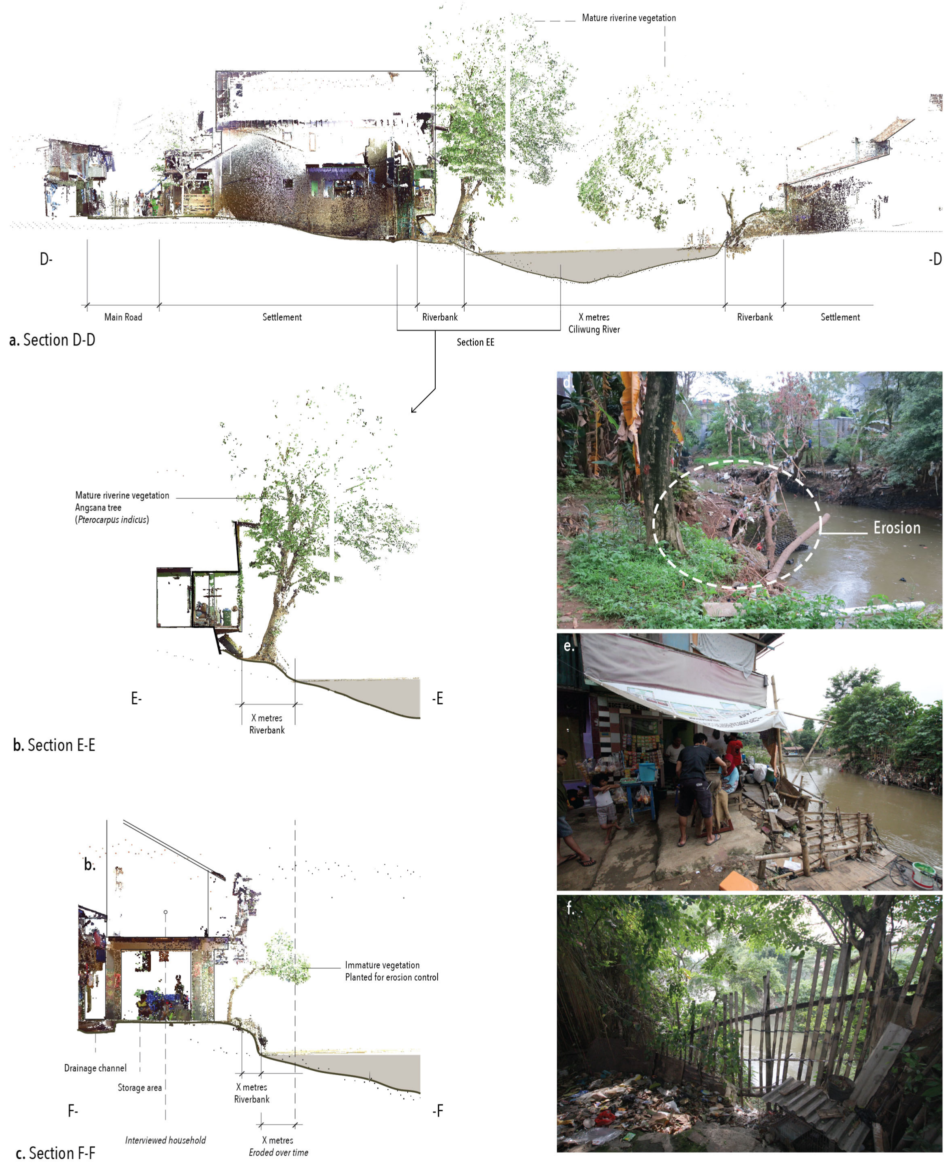


Figure 5.2.6: Terrain: a. Sectional elevation A-A 'NGO' provides an illustration of the height difference between the main street within the Bukit Duri neighbourhood and the river. Homes along the river are typically multi-level which helps households cope with recurrent flooding. b. and c. Sectional elevations B-B and C-C illustrate the role of mature vegetation within the river corridor in stabilising the riverbanks. Various examples of local strategies are visible within the neighbourhoods, including d. hard-edges such as rock and concrete, e. bamboo and timber planks, f. fencing.

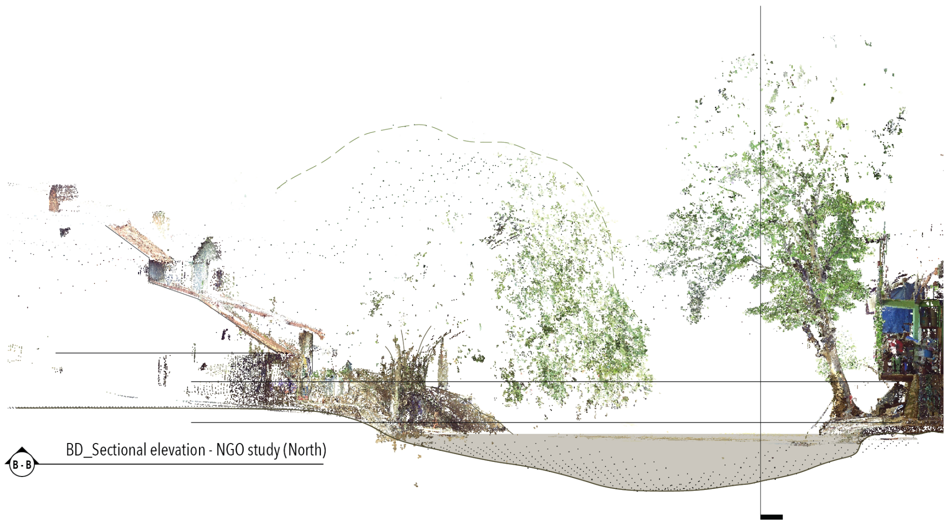


Figure 5.2.7: Along the river mature trees and bamboo clumps still provide some sense of a greenbelt or corridor.

about the tendencies of the riverbanks within their local areas.

Congestion and overcrowding

Spatial limitations were often cited as a challenge or disincentive to growing vegetation in both neighbourhoods. The focus site in Bukit Duri has more generously sized typical street cross-sections than the Kampung Melayu focus site (Figures 5.2.9 and 5.2.10). Residents mention the difficulties they have with finding adequate spaces to grow plants at their homes—spaces with natural light, that are free from flooding, that are either empty or not used by others for conflicting uses (such as children's play, vehicular thoroughfares), and that are not at risk of damage from rodents and cats. A coping mechanism that was commonly mentioned was to keep plants on higher storeys, and/or rooftops, which was often able to circumvent these challenges. A resident observes that if he didn't live on a

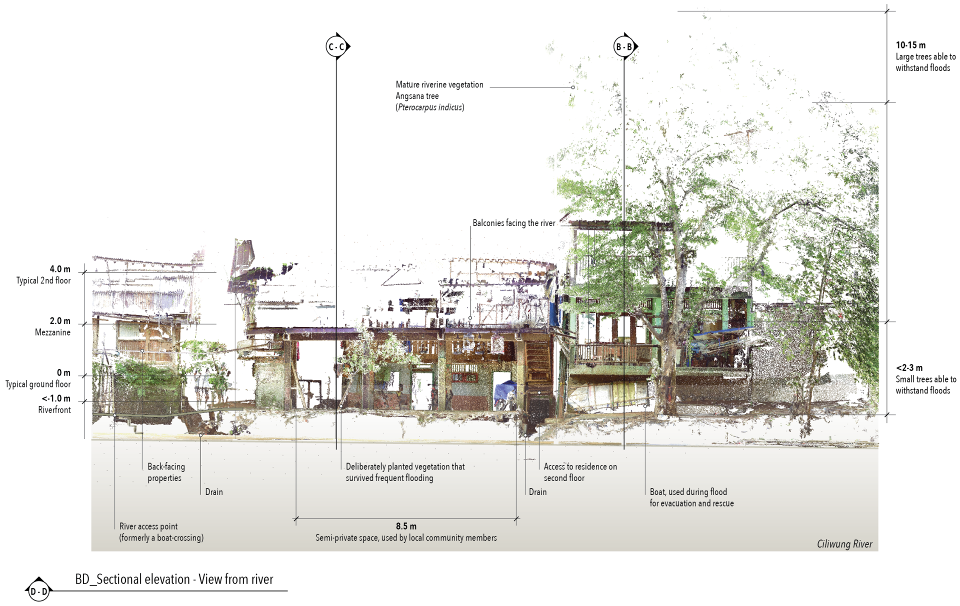


Figure 5.2.8: Annotated sectional elevation illustrating the spatial configuration of the river edge within Bukit Duri.

public walkway and had more space he would be interested in keeping a garden. He doesn't see a possibility in growing plants on the riverbanks as the banks are so polluted with solid waste. Coupled with his observations on the need for higher regulation of laws banning the disposal of solid waste in the river, this suggests that growing plants is an aspiration.

Aesthetics and temperature control (greening and cooling)

One resident was enjoying growing plants despite the initial concerns she'd had regarding space limitations. She had originally moved to the area from Solo (East Java) and described her 'gardening' in Jakarta as 'urban gardening'. Starting small, she initially only had a few plants growing over the drainage canal. As these seemed to do well she began to grow more plants and to an observer her home now appears quite green. She doesn't use her plants for medicinal or consumption, but rather for 'greening' and 'cooling' her home.

An interview with the community unit leader of Kampung Pulo revealed that another factor influencing Kampung Pulo to seem greener might also be the result of an initiative by a gardening magazine Trubus in the 1990s. The organisation helped to set up community groups to share information about plants. Trubus provided the community with seeds for plants (typically vegetable for consumption such as eggplant and cucumbers), and recycled water pipes to use as planting containers. At the same time, the government distributed trees with sizeable growth habits to communities to be planted along the river. Unfortunately for the neighbourhood floods destroyed the majority of plants for consumption before the first harvest. Since then there has been less and less inclination to grow plants as a result of densification and increased flooding. However, he believes that there is still an aspiration to be green if there are methods

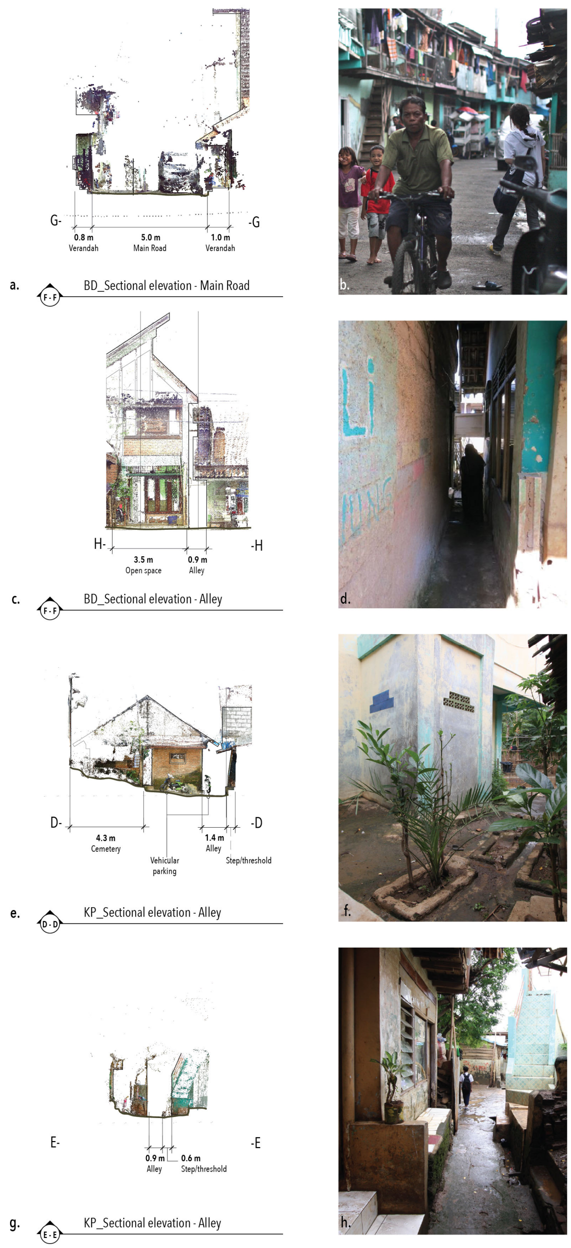


Figure 5.2.9: Annotated cross-sections comparing street widths in Bukit Duri (a.-d.) and Kampung Pulo (e.-h.). The Kampung Pulo area is more congested than the Bukit Duri area, and lacks main roads and accessways wider than one- to two-metres. This limits residents' ability to grow vegetation.

Local name	Common (English) name	*Botanical name*	Consumption	Medicinal	Shade	Ornamental	Superstition	Bank stabilisation	Bukit Duri (RW12)	Kampung Pulo (RW2)	Kebon Pala (var.)	
Plant type			**Plant use**						**Location**			**Count**
Adenium	Desert Rose	*Adenium Obesum*	○	●	○	○	○	○	●	○	○	1
Alpukat	Avocado	*Persia Americana*	●	○	○	○	○	○	○	●	○	1
Anggur	Grape	*Vitis Vinifera*	●	○	○	○	○	○	○	○	●	1
Angsana	Angsana tree	*Pterocarpus indicus*	○	●	○	○	○	●	●	●	●	4
Bambu	Bamboo	*Bambusa sp.*	○	○	○	○	○	●	○	●	○	1
Bangle	Cassumunar Ginger	*Zingiber Cassumunar*	○	●	○	○	○	○	●	○	○	3
Bawang	Spring Onion	*Allium fistulosum*	●	○	○	○	○	○	●	○	○	1
Bayam	Amaranth	*Amaranthus sp.*	○	○	○	○	○	○	●	○	○	1
Beruka Kamboja	Frangipani	*Plumeria sp.*	○	●	○	○	○	○	●	○	○	1
Bilimbik / Belimbing	Starfruit	*Averrhoa carambola*	●	○	●	●	○	●	●	●	●	5
Binahong	Heartleaf Maderavine	*Bassela Rubra*	○	●	○	○	○	○	●	○	○	2
Cabe	Chili Peppers	*Capsicum Annum*	●	○	○	○	○	○	●	○	○	1
Chilli	Chilli	*Capsicum sp.*	●	○	○	○	○	○	●	○	○	1
Delima	Pomegranate	*Punica Granatum*	●	○	○	○	○	○	●	○	○	2
Mahkota Dewa	God's Tree	*Macrocarpa phaleria*	○	○	○	○	●	○	○	○	●	1
Gambas / Oyong	Ridged Gourd	*Cucumis acutangulus*	●	○	●	○	○	○	○	●	●	2
Gelombang Cinta	Flamingo Lily	*Anthurium andraeanum*	○	○	○	●	○	○	○	○	●	1
Jahe	Ginger	*Zingiber officinale*	●	●	○	○	○	○	●	●	○	3
Jambu Air/ - Merah	Watery Rose Apple	*Syzygium aqueum*	●	○	○	○	○	○	●	●	○	4
Jambu Klutuk/ - Biji	Guava	*Psidium guajava*	●	○	○	○	○	○	●	○	○	2
Jarak	Castrobean	*Ricinus communis*	○	●	○	○	○	○	●	○	○	1
Jeruk	Orange	*Citrus Sinensis*	●	○	○	○	○	○	○	●	○	1
Kangkung	Water Spinach	*Ipomoea Aquatica Forsk.*	●	○	○	○	○	○	●	○	○	1
Kelapa	Coconut	*Cocos nucifera*	●	○	○	○	○	○	○	○	●	1
Kencur	Aromatic ginger	*Kaempferia galangal*	●	●	○	○	○	○	○	●	○	1
Kumis kucing	Cat's whiskers	*Orthosiphon aristatus*	○	●	○	○	○	○	●	●	○	2
Kunyit	Turmeric	*Curcuma longa*	●	●	○	○	○	○	●	●	●	7
Lidah buaya	Aloe vera	*Aloe vera L.*	○	●	○	○	○	○	●	●	●	4
Limau	Lime	*Citrus aurantifolia*	●	○	○	○	○	○	○	●	○	1
Lo / Elo	Cluster fig	*Ficus racemosa*	●	●	●	○	○	●	●	○	○	1
Mangga	Mango	*Mangifera indica*	●	○	●	○	○	○	●	●	●	6
Mayana	Coleus	*Coleus blumei*	○	●	○	○	○	○	●	●	●	5
Melati	Jasmine	*Jasminum sp.*	○	○	○	●	○	○	●	○	○	1
Nangka	Jackfruit	*Artocarpus heterophyllus*	●	○	○	○	○	●	●	○	●	2
Pace	Noni / Indian Mulberry	*Morinda Citrifolia*	●	○	○	○	○	○	●	○	○	1
Pandan	Screw pine	*Pandanus sp.*	●	○	○	○	○	○	●	○	○	4
Pepaya / Betik	Papaya	*Carica papaya*	●	○	○	○	○	○	○	○	●	2
Pisang Batu/ - Klutuk	Wild Banana	*Musa balbisiana*	●	○	○	○	○	○	○	●	○	3
Rambutan	Rambutan	*Nephelium lappaceum*	●	○	○	○	○	○	○	●	○	1
Salam	Indonesian Bay-Leaf	*Syzygium polyanthum*	○	●	○	○	○	○	●	○	○	1
Sawi hijau	Mustard Greens	*Brassica juncea*	●	○	○	○	○	○	○	●	○	1
Serai	Lemongrass	*Cymbopogon citratus*	○	○	○	○	○	○	●	○	○	1
Sirih kuning	Betel (Green)	*Piper betel*	○	●	○	○	○	○	●	○	○	2
Sirih merah	Celebes Pepper (Red)	*Piper ornatum*	○	●	○	○	○	○	●	○	○	3
Sirsak	Soursop	*Annona muricata*	●	●	○	○	○	○	●	○	○	3
Sisanya	-	-	○	○	●	●	○	○	●	○	○	1
Sugusugu	Node Weed	*Syndrella nodiflora*	○	●	○	○	○	○	○	●	○	1
Suji	Pleomele	*Dracaena angustifolia*	●	●	○	○	○	○	●	●	○	2
Temu kunci	Fingerroot	*Boesenbergia rotunda*	●	○	○	○	○	○	●	○	○	1
Temulawak	Java Ginger	*Curcuma xanthorrhiza*	○	●	○	○	○	○	●	○	○	1
Terong	Eggplant	*Solanum melongena*	●	○	○	○	○	○	○	●	○	1
Timun / Mentimun	Cucumber	*Cucumis sativus*	●	●	○	○	○	○	●	●	○	1
Timun mas	Lemon Cucumber	*Cucumis melo.*	●	●	○	○	○	○	●	●	○	1
Tomat	Tomato	*Solanum lycopersicum*	●	○	○	○	○	○	○	○	●	1
Ubi ungi	Purple Yam	*Dioscorea alata*	●	○	○	○	○	○	○	○	●	2
Plant type			**Plant use**						**Location**			**Count**
Local name	Common (English) name	*Botanical name*	Consumption	Medicinal	Shade	Ornamental	Superstition	Erosion control	Bukit Duri (RW12)	Kampung Pulo (RW2)	Kebon Pala (var.)	

Figure 5.2.10: Plant types and uses within the study area based on household interview.

for integrating vegetation despite flooding and density designed. According to community leaders in several neighbourhoods in Bukit Duri, plants are still periodically received as a result of the Corporate Social Responsibility (CSR) projects of various organisations. These are often given to the community unit (RW) for distribution or to neighbourhoods directly, although it seems that in the former case this does not mean that the plants are distributed equally amongst community unit (RT). One neighbourhood along the river reported receiving a variety of plants from the subdistrict (RW) and selecting amongst themselves those which were likely to be the most resilient to flooding and therefore suitable for planting along the riverbank. The others were planted in a less flood-prone area along a main road.

Open space

a) Attributes of open space in urban riverine landscapes (as perceived by the community)

Households within the subdistricts observe multiple functions of open space within the urban riverine landscape (Figure 5.2.11 a,b and c.). Spaces directly adjoining homes and the street take on semi-private roles, and are used for domestic activities. While in some cases larger open spaces do have semi-private overlays and are used to accommodate domestic activities, typically these spaces are more public and buffer community and social functions. I also observed that itinerant stalls and other mechanisms for increasing household income were accommodated within public spaces.

Between the two focus sites I observed a similar pattern of use of spaces that were directly adjacent to residents' homes (Figure 5.2.11 a). Social and economic activities were the most reported amongst the survey

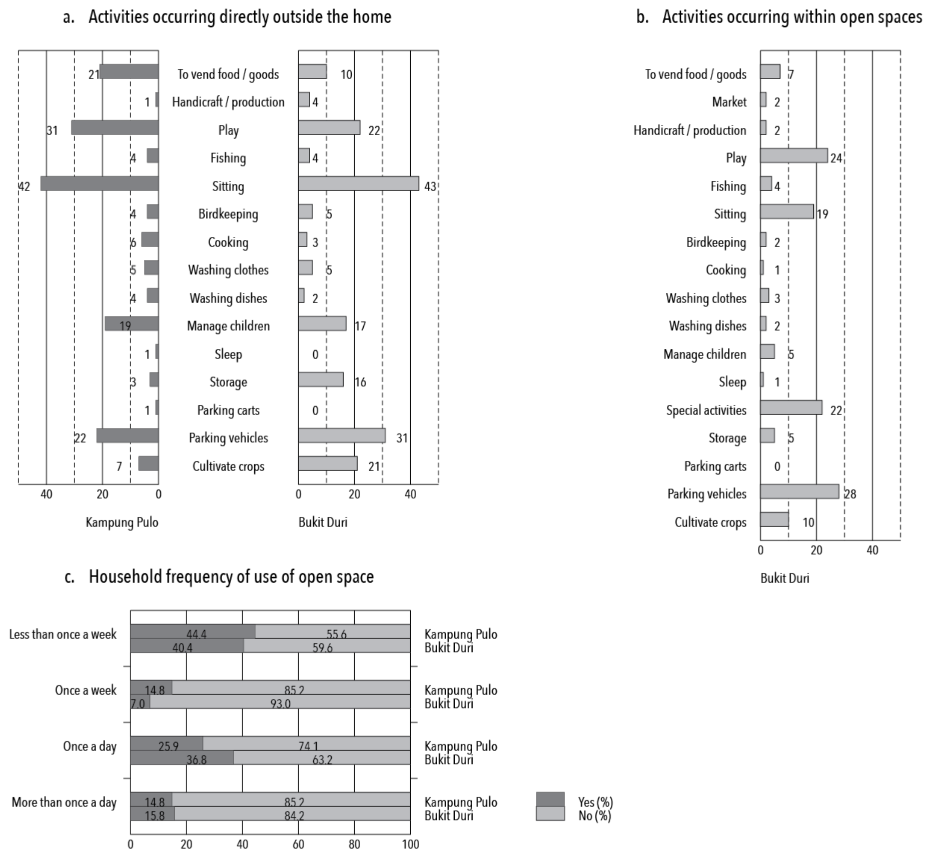


Figure 5.2.11: Activities occurring within urban spaces: Regular open space use (more than once a week) was only reported by half of survey respondents. Spaces that were directly adjacent to residents' homes were primarily used for social and economic activities, along with storage.

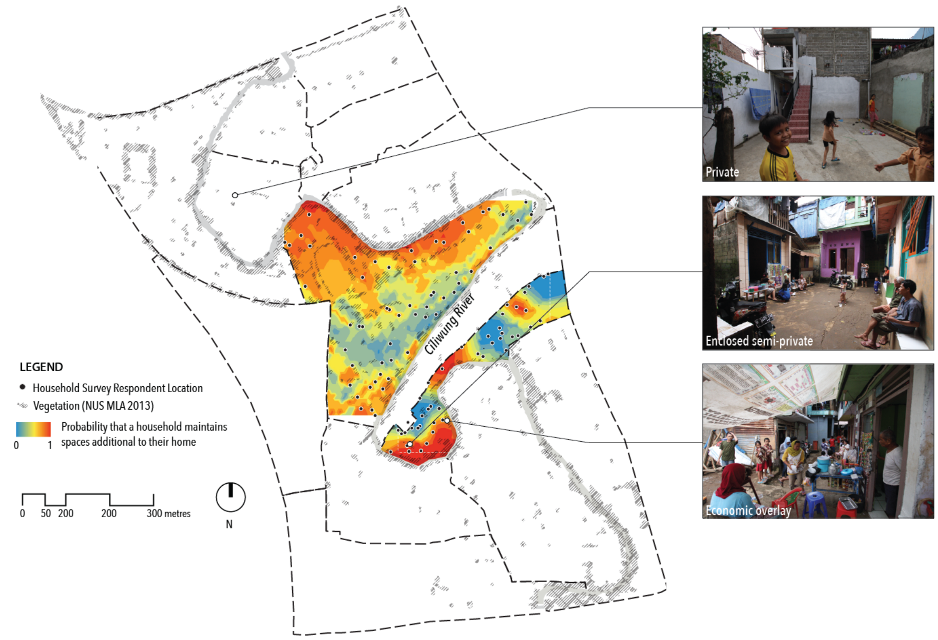


Figure 5.2.12: A clear correlation can be seen between a household's proximity to the river and their likelihood of maintaining spaces additional to their own home. Open spaces were more commonly found along the river's edge, due to a variety of factors. Residents living in areas that are more spatially constrained with few—if any open spaces—are less likely to maintain spaces additional to their own home.

respondents.

b) Socio-cultural factors affecting open space

Development of open space

From the discussions with community leaders it is evident that development within neighbourhoods is typically reactive, or resultant of a particular condition, rather than anticipatory. This is evident in descriptions of the process of establishing public open spaces, which are often only created as a result of the destructive impacts of floods and fires causing land to free up internally. One community leader in Kampung Pulo observed that spaces for community use were difficult to establish because of conflicts between the desire/need of the individual, and the community. Residents are profit oriented (seeking to better their position in life) and economic functions—such as kontrakan, rental housing—are often prioritised over facilities benefiting the community.

This said it seems that some owner-developers recognise the role which open space plays in the physical environment. A Kebon Pala resident, who was building a block of (14) rental flats, informed us that an area adjacent to the building would function as a courtyard. This space, he told us, would provide the apartments with adequate ventilation, green space, and shared functional space. This is a clear example of values embedded within existing bottom-up development practices that can be carried through into other designs. Similarly, another block of rental flats also has an open space integrated within the plot, which is used by the residents and their families for activities such as drying washing and play (Figure 5.2.13).

A desire to improve private space often leads to the compromise of loosely defined, semi-public spaces and even the capacity of the neighbourhood itself. For example, residents have covered drainage channels to extend space for stalls, plants and vehicular parking (Figure 5.2.16). While some are only covered temporarily (such as during the Islamic festival of Eid al-Adha) others are covered permanently. This narrows neighbourhood streets and has impacts at both local and neighbourhood levels. At a local level traffic congestion may increase and neighbourhoods may find it more difficult to implement garbage collection services in already narrow streets. At a larger scale, the covering of channels slows permeation of water that can result in localised flooding.

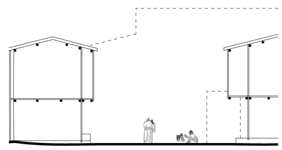
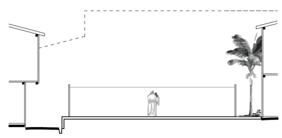
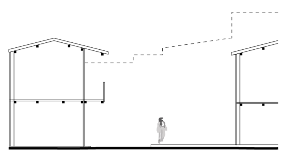
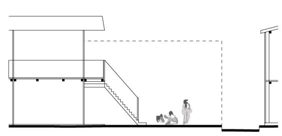
Open Space (Internal)			
OS-I	Schematic cross-section	Photo	Description
Kampung Melayu (RW2)			Type: Courtyard, enclosed Materials: Concrete Function: Semi-private domestic activities, vehicle parking
Kampung Melayu (RW1)			Type: Playcourt, semi enclosed Materials: Concrete Function: Public play area
Kebon Pala			Type: Courtyard, enclosed Materials: Earth Function: Private domestic activities
Kebon Pala			Type: Courtyard, semi enclosed Materials: Earth Function: Private domestic activities

Figure 5.2.13: A variety of open spaces were observed within the urban fabric away from the river's edge. These were often the result of community action.

Maintenance and use of open space

Looking across the two community units surveyed, using the generated probability map, we observe a correlation between a household's proximity to the river and the likelihood of them maintaining spaces additional to their home (Figure 5.2.12). Within both areas, households located within a 50- to 100-m radius of the river were more likely to contribute to the maintenance of commonly used- or public spaces. We argue that this is largely due to the prevalence of open—or undeveloped—spaces along the river, which are used for social interactions and recreation (Figure 5.2.14 and Figure 5.2.15 - river OS). In some cases spaces have private overlays, meanwhile others have temporary or permanent structures and canopies to provide shade. Challenges of provisioning for open spaces were observed by community leaders within the densely settled neighbourhoods away from the river's edge. These spaces often had more complex and layered use patterns, as a result of their physical proximity to houses and the density of the settlement (Figures 5.2.18, 5.2.12, and 5.2.13 - urban POS). While on the whole a household's likelihood of maintaining spaces additional to their homes varied, we observed that the majority of households in both areas used open spaces once a week or more frequently (Figure 5.2.11 c.).

Kerja bakti and gotong royong are two distinctly different practices of communities relating to the management of the urban landscape of the kampung. Kerja bakti is generally observed as a planned maintenance activity undertaken by communities. The regularity (weekly/fortnightly/monthly) is dependent on the community and its leader. Activities are generally preventative maintenance, such as the Jumantik program, which is a weekly (every Friday, hence Jumat) initiative to combat mosquito-borne diseases. On the other hand, gotong royong is conducted on an as needs basis—often following flood—, and is therefore

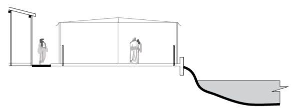
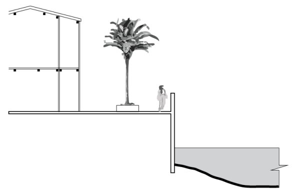
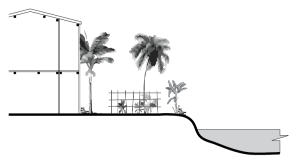
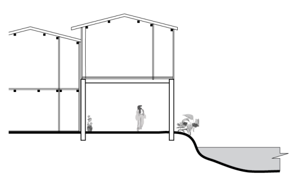
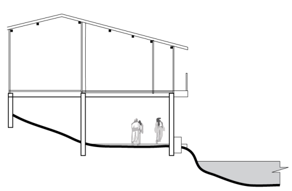
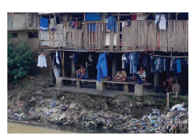
Open Space			
OS	Schematic cross-section	Photo	Description
Kampung Melayu (RW#)			Type: Play court Materials: Concrete floor Function: Badminton court, used for gatherings and special events such as weddings
Kampung Melayu (RW2)			Type: Terrace Materials: Concrete, vegetation Function: Private domestic activities, vehicle parking
Bukit Duri (RW12)			Type: Garden Materials: earth, bamboo fencing, vegetation Function: Private garden and open space used for domestic activities
Bukit Duri (RW12)			Type: Undercroft Materials: Concrete, earth, vegetation Function: Semi-private domestic activities
Bukit Duri (RW12)			Type: Undercroft Materials: Concrete, earth, seating ledge and ground-water pump Function: Semi-private gathering area and domestic activities

Figure 5.2.14: A variety of open spaces were observed within the urban fabric away from the river's edge.

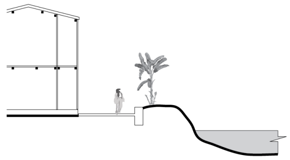
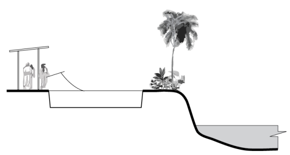
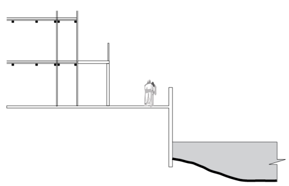
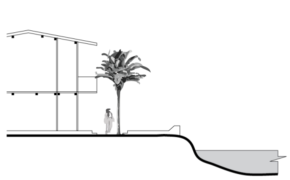
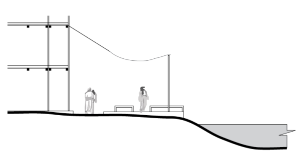
Open Space			
OS	Schematic cross-section	Photo	Description
Bukit Duri (RW#)			Type: Play court and sitting area Facilities: Concrete, vegetation Function: Badminton court, used for public play, and smaller area used for semi-private domestic activities
Kampung Melayu (RW2)			Type: Fishpond Materials: Concrete, bamboo, tarpaulin canopy, vegetation Function: Fishing, public gathering
Bukit Duri (RW12)			Type: Terrace Materials: Concrete Function: Private domestic activities
Bukit Duri (RW12)			Type: Terrace Materials: Concrete, tiles, vegetation Function: Public gathering area, entrance to prayer hall
Bukit Duri (RW12)			Type: Multi-purpose space Materials: earth floor, informal seating and tarpaulin canopy, vegetation Function: Semi-private gathering area, domestic activities

Figure 5.2.15: A variety of open spaces were observed along the river's edge.

Figure 5.2.16: In areas where space is limited drains are often covered to increase street capacity. While concrete drain covers are most commonly used (Left), less durable materials such as timber may also be used to provide coverage to increase space (Centre and Right).

reactive maintenance.

We observed that while some open spaces had clearly defined uses—such as playcourts, drying areas and gardens—, other spaces were less explicit and their use varied over the course of the day or year. Such spaces might be used for vehicle parking and the storage of carts belonging to itinerant traders during the evenings, however during the daytime for more domestic activities such as clothes drying, children's play and animal keeping (See Figure 5.2.11 a. and b.), 5.2.14, and 5.2.15).

c) Environmental (physical) factors affecting open space

Terrain

The resilience of these communities is tested during disasters such as floods and fires. The availability of spaces for refuge is important, and these spaces range from private sector buildings, religious buildings and institutions, to community spaces. Such spaces are necessary for periods

Figure 5.2.17: Open spaces are often found directly adjacent to the river and provide spaces for social interactions and recreation. Some spaces have private overlays, such as this building undercroft (or void-deck) in Bukit Duri (Left), meanwhile others have temporary or permanent structures and canopies to provide respite from the heat (Right).

Figure 5.2.18: Open spaces within the urban fabric away from the river's edge are less common, and where found are often the result of residents moving away from the neighbourhood rather than the direct result of planning. Such spaces may be programmed for specific recreation activities, such as badminton, or may buffer household social and economic activities.

lasting from days to weeks, depending on the impact and duration of disaster events. Typically, residents from Kampung Pulo evacuate during flood events to the grounds of Hermina Hospital and a private company along the main road. There are tents provided in both locations to shelter those requiring assistance. In one pronounced example, residents benefited from multiple evacuation options. Following a fire, which affected households in Kampung Pulo in May 2013, affected residents were first accommodated in tents in an open space along the riverside. When that space was later flooded the residents were relocated to nearby religious buildings.

Frequent flooding has resulted in the generation of open spaces along the river edge and within the densely settled urban fabric. Uses of buildings and spaces that are less resilient to ongoing and destructive impacts of floods may change over time. Often these remain vacant and take on various common- or private uses. For example, the repetitive flooding of a fishpond adjacent to the river led to its being closed in January 2012 (Figure 5.2.19). It proved economically unviable to continue to restock the pond following floods. The community used sediment from flood events to subsequently fill the pond. Now the space contains a permanent community pavilion and gardens, and is used for events such as weddings, and evacuation (see above). In some areas which lack open spaces damaged houses that have been vacated after floods take on public uses. In elevated areas of Kampung Pulo (RW2) and elsewhere in Kampung Melayu (such as RW1) transformations were observed transformations to be more permanent, such as the transformation of a space into a play court (Figure 5.2.18, left).

Figure 5.2.19: Transformation of spaces: Left (2012), A fish pond located on the riverbank was eventually replaced after repeated flooding which caused economic losses. Middle and Right (2014), It was replaced by with a multi-functional space which accommodates community activities.

Density

Spatial limitations lead to households and communities having a variety of strategies to procure access to open space. These included: temporal uses of spaces, shared use between multiple households, and layered use of spaces. Firstly, common-use or unbuilt spaces often take on varying functions throughout a single day, or seasonally. For example, a raised building along the riverside in Bukit Duri leaves space free at ground level (Figure 5.2.17). This space is used for parking food carts and or motorcycles, as well as for repairs and home industry. The rafters and bamboo poles are used to hang bird cages and for drying clothes (Figure 5.2.20 - left). Other examples of these include: use of religious and administration buildings for community meetings and refuge; streets and spaces used for markets, stalls, home industry, and celebrations. The resilience of the community seems reliant on this. Secondly, spatial limitations have lead to the sharing of—often privately owned—space for multiple uses. This was observed in a variety of forms, such neighbouring families sharing an adjacent space for plants and domestic animal keeping.

Thirdly, uses of public areas (such as laneways) and private areas (such as homes and terraces) are often multi-layered, and can be characterised by individuals, households and communities. In the absence of common-use

Figure 5.2.20: (Left) The rafters and bamboo poles of an undercroft space in Bukit Duri are used to hang bird cages and for drying clothes. (Right) Extended house and terrace in Kampung Pulo.

spaces for the community, community gatherings have been observed to occur in terraces and living rooms. These are often informal social gatherings (for chit-chat), but can also be formal gatherings with religious aspects. In some cases, spaces have been designed or modified in such a way that they can more easily accommodate such uses. For example, the veranda and narrow street in front of a home in Kampung Pulo (RT's 2 5) was tiled and enclosed so it could better accommodate community gatherings (See Figure 5.2.20 - Right). It also increased the size of their homes. In this way, the public space of the street becomes more private and the home becomes more public as neighbours and strangers cross through the extended space. The spaces are used privately, as extensions of their living space, as well as for public thoroughfare and spaces for community gatherings. This is perceived as being influenced by spatial limitations experienced within the community, which influences households to consider informal temporary, and even permanent expansions.

River

a) Attributes of the river (as perceived by the community)

Households within the subdistricts observe various contributions of the river within the urban riverine landscape (Figure 5.2.21). These features include: recreational river use, and non-recreational river use (Figure 5.2.21 a. and b.). We have already observed that residents valued the river for the green structure that it provides the densely settled neighbourhoods, as well as the particular value of vegetation species growing along it. The capacity of the river to buffer various shortfalls within the neighbourhoods, such as solid-waste disposal, sewage disposal, and sanitary use is also observed (see also [263, 265]).

b) Socio-cultural factors affecting the river

Recreational and non-recreational river use

Recreational river uses include passive and active activities. Passive activities include sitting beside and walking along the river, meanwhile active activities include fishing and swimming (Figure 5.2.21 a. and 5.2.22). Residents that choose to visit the river for activities such as fishing, see it as a social opportunity.

Non-recreational river uses include collection of water for domestic use (cooking and cleaning), and hygiene uses such as getek rafts for toilet, and bathing (Figure 5.2.21 b. and 5.2.22). Because only a small percentage of the area has access to municipal sewage infrastructure, residents sometimes rely on the river as a 'buffer'. In some cases it was expressed as a necessity, and in others as a preference. The river was still a buffer after emergencies — such as fires — when blackouts made it impossible to do domestic

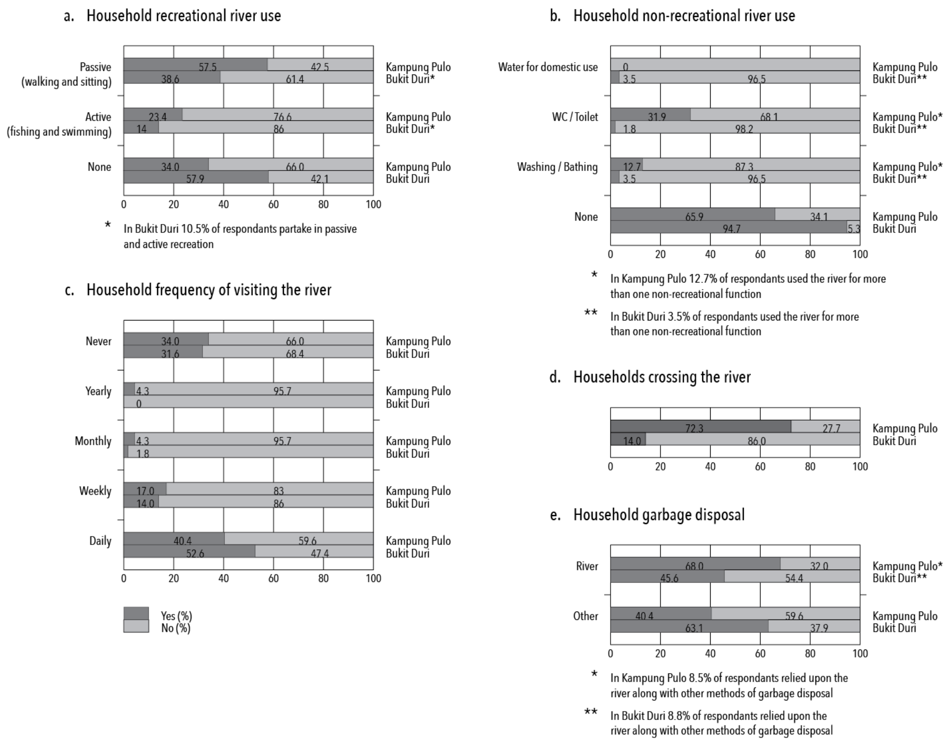


Figure 5.2.21: Use of the river: Significantly more households rely upon the river for recreation, than those who used the river for other functions (such as domestic). [1c] the frequency a household visits the river; [1d] whether a household crosses the river (using the rafts); and [1e] whether a household uses the river for garbage disposal (some households reported disposing garbage in the river and other formal/informal collection/disposal points).

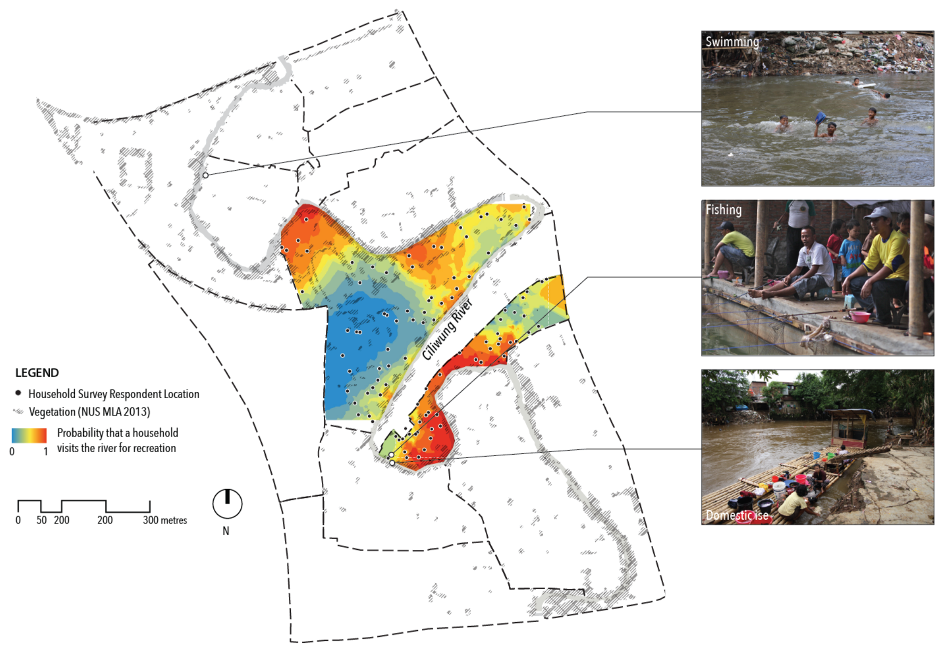


Figure 5.2.22: Probability of a household visiting the river for recreation: Using Indicator Kriging a clear correlation can be seen between a household's proximity to the river and their likelihood of visiting the river for recreation.

activities comfortably within the home. We observed that there was a social aspect to completing domestic tasks outside the home, either at the communal pump (sumur) or on the getek on the river (Figure 5.2.26). In some cases, this was observed to influence residents' behavioural choices. Although some households had built toilet/bathroom facilities in their home, because of the absence of municipal infrastructure, they either plumbed them into pre-existing infrastructures that drained into the river, or used a septic tank. These tanks were typically poorly managed and too densely situated, which could contribute to groundwater pollution in the longer term (ref Derek or Diogo).

Based on the responses of the surveyed and interviewed households, we observe that the perception and use of the river is significantly linked to the physical condition of the river. Residents have reported changing their usage of the river over time. While they disclose that they used the river in the past, including for swimming and washing, this was observed to have been during a time in which it was 'more clean'. Thus, we draw a correlation between reduction in river use and the deterioration of the physical environment. This is elaborated on within the environmental factors.

Responsibility toward the maintenance and monitoring of the river

It seems that particular environmental topics continue to come up in discussion within the communities and administration, particularly that of the condition of the river, not limited to vegetation. Interviewees recall specific programs to have occurred in the 1970s, mid 90s, and mid 2010s. While campaigns have been run locally, these appear to have had little impact on the condition of the river corridor. Government assistance has been enlisted at various times, such as in 2013 when the military were enlisted to clear rubbish from the riverbanks. However, community leaders critiqued their method—which involved dumping the garbage in the river and collecting it downstream at Manggarai — to be at odds with the larger environmental message and was confusing to the communities. The maintenance of the river corridor thus largely falls to the communities. But communities feel that their efforts to maintain and clean have limited impact and are blighted by the ongoing effects of floods and garbage swept in from the upstream areas.

Community leaders and RW and RT staff saw monitoring the river among their responsibilities, and some reported visiting the river daily to monitor its condition. This was to a greater degree motivated by the need to observe the water level; rather than to survey the river's ecological condition.

c) Environmental factors affecting the river

Urban structure

We demonstrated earlier in the dissertation that at a city-scale Jakarta's rivers have been marginalised and considered as the 'back-side' (See Chapter 4). At a neighbourhood scale we attribute the urban structure of neighbourhoods — such as level of access to the river and to major roads, and orientation toward the river — to be a key factor affecting resident perception of the river, use of the river, and garbage disposal. The latter directly affects water quality.

Access: Visiting the river

Facilitated access to the river using timber access-ways such as stairs and ramps, and paved walkways also demonstrates the desire of neighbourhoods to engage with the river (Figures 5.2.23, 5.2.24, and 5.2.25 - access). Surveyed residents reported visiting the river with varying degrees of frequency (Figure 5.2.21 c.) Around half of respondent households in Bukit Duri (52.6%) reported that they visited the river daily,

Figure 5.2.23: Timber access-ways such as stairs and ramps visible along the riverbanks. Neighbourhoods largely facilitate access to the river informally. Throughout the dry season many timber access-ways such as stairs and ramps are visible along the riverbanks.

and just under half of respondent households in Kampung Pulo (40.4%). Cumulatively, more than half of surveyed households visited the river on a weekly or daily frequency. In both Kampung Pulo and Bukit Duri around one-third of households reported that they never visited the river. In Kebon Pala, a getek was washed out in the 2007 flood and was not replaced. Since this time, residents have used other facilities for hygiene and domestic functions.

Garbage Disposal

By synthesising the spatial information collected through the survey (Figure 5.2.21 e.), with our observations of street widths (Figure 5.2.9) and information from interviews with 12 community leaders, we conclude that the access plays a significant role in residents' garbage disposal behaviours. Thus, we understand that convenience plays a key role in decisions about where to dispose solid waste. Some residents report that

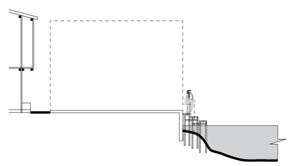
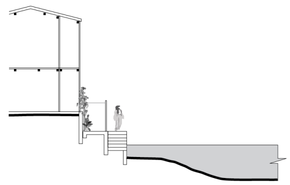
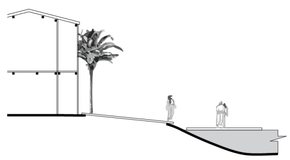
At-grade access			
A	Schematic cross-section	Photo	Description
Kampung Melayu (RW2)			Type: Perpendicular staircase Materials:Timber Function: Provides public access to river for crossing
Bukit Duri (RW12)			Type: Parallel staircase Materials: concrete Function: Formerly provided public access to river for crossing, now used for private domestic activities
Bukit Duri			Type: Ramp and raft Materials: Bamboo Function: Public access to the river for recreation, domestic and hygiene activities

Figure 5.2.24: A variety of access tactics were observed along the river's edge to facilitate access for domestic activities and recreation.

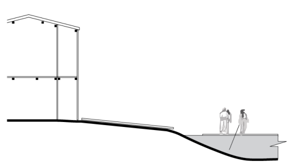
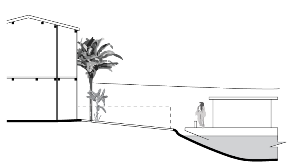
Connection across the river (Boats)			
B	Schematic cross-section	Photo	Description
Kampung Melayu - Bukit Duri			Type: Raft Function: Provides access for pedestrians between two urban neighbourhoods
Kampung Melayu - Bukit Duri			Type: Boat Function: Provides access for pedestrians between two suburban neighbourhoods

Figure 5.2.25: A variety of crossing tactics were observed.

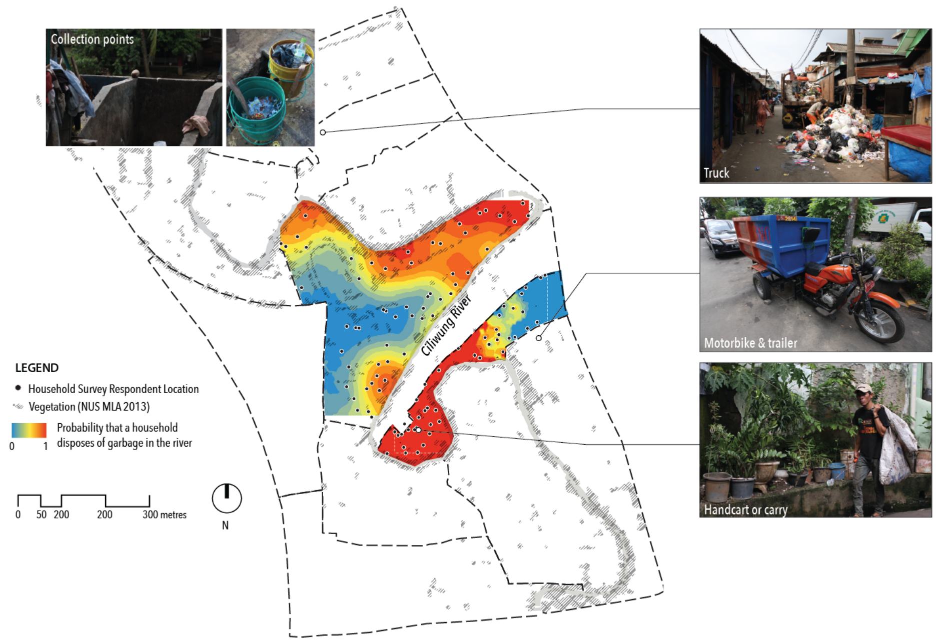


Figure 5.2.26: Probability of disposing garbage in the river: Using Indicator Kriging a clear correlation can be seen between a household's proximity to the river and their likelihood of disposing garbage in the river.

while they solid waste collection services provided by their local administration, they still rely upon the river for solid waste disposal. Those households who did not use the river for disposal consistently lived closer to the main roads (Figure 5.2.26). Those living further in, remarked that while there were collection points at the main roads, this was often 'too far' for them to use. Areas in which residents don't directly dispose of their solid waste in the river typically have localised waste collection services using hand-pulled carts and motorbikes with trailers (Figures 5.2.26 a.). These are generally organised by their neighbourhood administration and are covered by a monthly fee (approx. 2000RP). While the final destination of the waste collected by such services was not always clear, this demonstrates that having access to other options for disposal is important in changing behavioural patterns. Other informal cart-based collection services were more expensive and cost between 1000-2000RP per collection. In Kebon Pala, where wider streets allow vehicle access, a truck collects solid waste from designated points at a local produce market every two-days (Figure 5.2.26 a.). A garbage collector travels into the less accessible areas of the neighbourhood with a cart on corresponding days, providing last-mile linking between households and the truck. This can assist in changing behavioural patterns of community members by association, as well as his own with solid-waste now being taken to the market instead of to the river. However, the informal cart systems are more vulnerable to failure, and in some cases had ceased altogether when the collector had fallen ill resulting in residents returning to disposing waste in the river.

While regulation exists to deter residents from using on the river for garbage disposal, Community leaders can find implementing waste collection services challenging. The wife of one RT leader recounts her husband's frustration at having to constantly remind residents to use the collection services provided. They have tried running seminars to educate the neighbourhood but are still having difficulties implementing the program. This highlights the challenges changing embedded behaviours within the neighbourhood. Alternate solid waste disposal methods employed by residents within the neighbourhoods include recycling, incineration, composting and burying solid waste. However, flooding spoilt both the recycling and composting centres that were set up by NGO's and CSR within Bukit Duri and Kampung Pulo.

Orientation

Of the surveyed communities, we observed that the community (RW1, RT6) which is at least risk from flooding (due to their high elevation) also has the most removed relationship from the river, despite their physical proximity to the river. The river is not publicly accessible as an impermeable line of buildings stretches along the riverbank. In one household, the consideration of the river as the 'backside' is clearly evident. The space adjacent to the river takes on a typical back yard or utility function, while the front courtyard, which connects them to the rest of the neighbourhood, contains the social aspects of their lives (Figure 5.2.6 c.). However, the river is not always perceived as the backside despite its deterioration. In fact, the deliberate orientation of both public and private buildings toward the river illustrates the value of the river corridor. Meanwhile, in lower-lying areas, residents have created terraces, open spaces and seating areas directly adjacent to the river (Figures 5.2.27 and 5.2.24 - access).

Water quality and quantity

The deterioration of the physical condition of the river — including water quantity and quality — was remarked to have affected residents' river use. A clear indication of a change in the perception and use of the river was

Figure 5.2.27: The deliberate orientation of both private and public buildings toward the river-edge illustrates the value of the river corridor—that the river is not always perceived as the 'backside'—despite its degradation. Left - Local men sitting on a bench in an undercroft space along the river corridor (Photo: Azas Tigor Nainggolan). Right – A terrace area facing onto the river adjacent to a prayer hall in Kampung Pulo (Photo: Author).

observed in a survey with a young resident of Kampung Pulo. Since 2009, he observed a clear deterioration in river condition, and had reduced his participation in recreational activities in and along the river. He attributed this to two factors, namely: 1) the physical experience of being in the space, and 2) health concerns. Both of these related to the pollution of the river, and since this time he prefers to fish at the fishpond with his friends (Figure 5.2.19). We observed that other reductions in river use were related to the perception of the river to be dangerous, based on its unpredictability and high flows. Several children have been swept away while swimming off the riverbank, which causes concern for parents and community members. There have also been several deaths caused by drowning in the flood waters. One resident remarked that she had forbidden her children from visiting the river, meanwhile a retired resident has built a fence adjacent to the river to prevent playing children from falling into it. Despite the observed poor condition of the river, residents expressed hope and aspiration for a cleaner river in the future.

5.3 Constraints and Opportunities for Local Landscape Design

Based on the findings of Contemporary Positions (Ch3), Practices Revisited (Ch4) and Explorations and Speculations (Ch 5.2) mutual dependencies and interactions, and barriers for change have been identified. This follows on from the Literature Review (Ch 1.3) that describes these as important tools in the design and maintenance of multifunctional riverine landscapes.

Looking forward I conclude that the information gathered can contribute meaningfully to ecological design because it *exemplifies the inherent contradictions and potentials of urban riverine landscapes*. These contradictions and potentials were revealed through a range of tactics and behaviours of those producing the built environment. These are particularly relevant, when considered relative to the ecosystem and landscape services that communities obtain from the urban riverine landscape.

I observe that the condition of the riverine landscape and these vernacular urban settlements was degraded and requiring significant amelioration. On the one hand, our study revealed that while there are a variety of spatial relationships to the river that illustrated positive aspects of the river's services, some elements of the *urban structure* of these communities were contributing to negative environmental *behaviour*. On the other hand, *ecological knowledge*, regarding the socio-environmental aspects of the urban riverine landscape, contributed to the development of *tactics* that resulted in more resilient communities and landscapes. These two aspects are summarised in the following sections.

5.3.1 Ecological Knowledge

- *River quality*: A parallel between the changing condition and frequency of flooding of the river and decreased use of the river corridor, for both passive and active recreation as well as in regard to harvesting from the vegetation along the river.
- *Vegetation function*: Other authors have considered the biological richness of home gardens (pekarangan) within the region [13]. Chapter 5.2, on the other hand, extrapolates vegetation function (ecosystem service) within the urban landscape. Information of vegetation species was informally collected in interviews, which were conducted within the framework of the survey. The residents interviewed were not perceived to be expert gardeners, with precise knowledge of plant species. Essentially, due to the spatial constraints residents grew plants in an informal manner and often their knowledge of these plants was similarly informal. For example, some households were only able to identify the plants by common name, or not at all, and referred to their daily uses as their primary identifying characteristics. Additionally, their knowledge is limited based on their experiences taking care of the plants on site, which built from their experiences of environmental variability (such as floods). Thus, although I've considered which vegetation species are planted and used by households, I see the greatest value for ecological knowledge to be held within the aspect of vegetation function.

  Based on household information I know that most interviewed residents have lived in this area for several decades already, and thus do not have other meaningful experiences of plant cultivation from other areas to transfer. Largely their knowledge of vegetation is derived from their own experiences and that of those around them. The exception to this is the CSR contributions by companies, which often introduce other plants to these neighbourhoods. As learnt from a neighbourhood in Bukit Duri, various strategies have been implemented variable to the neighbourhood unit, in the distribution of these. Some community units (RW) distribute simply to households, whereas others use a process of judging robustness of plants to determine whether they should be planted along the river or within the urban fabric. Within the former these donated plants are seen as a private resource, whereas in the latter they become community resources.

From this study I conclude that the most revealing patterns are largely generated from the spatial aspect of the site, rather than household background. I attribute this to spatial constraints as well as accessibility to plant material. So far I see no compelling evidence that there has been a transfer of knowledge based on ethnic background. This could be an area for further study.

- *Plant species selection*: I conclude that the choice of plant species is not limited to riverine landscape amelioration, but rather the plant's function in the overall improvement of the environment and daily life. These are viewed as mitigating individual factors, which may or may not contribute to the amelioration of the riverine landscape The examples below detail the main driving factors for plant species selection and their extended value of function.
- *Spatial constraints*: In terms of vegetation function, I observe that ornamental, cooking and medicinal aspects of vegetation were valued most highly. Their value, based on Kampung Pulo and Bukit Duri neighbourhoods interviewed, follows this order. In Bukit Duri, shade was next ranked highest. Comparatively, shade from vegetation was an ecosystem service remarked to be of lesser value to residents in Kampung Pulo. I attribute this disparity to the difference in urban fabric between these areas, as the streets of Kampung Pulo

are narrower and resultantly more shaded.

– *Robustness*: Residents were reasonably concerned with plant durability. I see that vegetation function in response to environmental variability has largely informed plant species choice amongst householders. Factors such as flooding, and the susceptibility of plants to pests such as rats, and damage from children's play influenced species selection.

– *Proximity*: Specifically regarding those areas directly along the river and in low-lying areas, plants that are grown tend to address a cultural factor, and have well developed or rhizome-type root systems are grown. For example, bamboo has been historically found along the river and was seen to have an economic value in the past. Its root system and compact nature have seen that it is well able to withstand flood events and to prevent erosion.

5.3.2 Urban structure

Lively and cared-for riverfronts illustrated the role of spatial orientation, accessibility and scaling of spaces in establishing connections between neighbourhoods and rivers. While I observed a number of positive relationships to the river, which were expressed through both the articulation of the river edge as well as behaviour and tactics, the quality of urban structure contributed to a number of different issues within the communities:

– *Limitations to street width* and *access to the main road* affected garbage collection, increased fire risk, and reduced connectivity between the river and the main road. Additionally, the efforts of residents to increase the accommodation of the street (through the closure of drainage channels) increased stormwater run-off. Efforts to manage run-off (like biopori) were inadequate and difficult to maintain.

- *Restricted access to - and visibility of - the river* meant that only those residents living in close proximity to the river appeared to have close ties to the river. This was illustrated by the use of river for recreation and maintenance of common spaces. While various cues to human care [159] were observed throughout the urban environment, I found that stewardship behaviour—toward the riverine landscape and urban public space—could be correlated to access and availability of these.
- *Limitations to the availability and size of open space* meant that residents developed a variety of strategies to procure open space. These included temporal uses of spaces, shared use of spaces between multiple households, and layered uses of spaces.
- *Orientation* of spaces and buildings toward the river illustrated positive engagements with the river that already exist. Other authors have considered the relationship between types of riverside spaces and children's play within the region [222]. The heterogeneity of spaces observed along the Ciliwung River also showed the variety of interactions that households and communities have with the river.

5.4 Catalogue of Observations

The catalogue presented in this section is a catalogue of edge conditions found in rivers in Indonesia (Figure 5.4.1). 37 unique edge conditions are illustrated as cross-sections which synthesises the observed examples of design interventions observed in the mainland Indonesia case studies (Ch3) and those observed in Kampung Melayu and Bukit Duri (Ch5.2) has been compiled. The cross-section has been used as a device throughout the work and within this section is operationalised as a propositional tool. Through the process of classification, the schematic cross-sections were compiled according to the following types:

– At-grade access;

– Connections across the river;

– Walls and embankments;

– Foreshores;

– Continuous walkways;

– Open space; and

– Internal open space.

While generally the types were derived from [195] typological study from European projects, as I observed within chapter 3; first, not all of Prominski's types were identified within the sites visited, and second, I found that a simpler classification which identified the types of spaces and activities along the river edge—rather than just river edge profiles—was valuable in demonstrating the socio-cultural overlays to these spaces. While this listing is not exhaustive, the types identified were directly observed and commonly used by the local communities who were surveyed and interviewed during the fieldwork process. These were synthesised into a catalogue as a synoptic overview of the observations made.

Method for constructing the catalogue

Although the appearance of these landscapes is raw, I approach these landscapes from the perspective that it is less the formal characteristics of landscape, and more the *agency of landscape* that is critically important for intervening in cultural convention [51]. The focus here is on *how a landscape works and what it does, rather than what it looks like*, as Corner argues in his seminal text, Recovering Landscape. With this logic I have extracted the positive engagements with the river that already exist, capturing the heterogeneity of spaces.

Figure 5.4.1: Catalogue integrating observed configurations from Contemporary Positions (Ch3) and Explorations (Ch5.2).

Limitations

The catalogue was limited by the following: Only one representative cross-section of each category was drawn within the original study of contemporary cases in mainland Indonesia (Ch3). In comparison, a range of interesting and unique cross-sections were drawn in the detailed case study of Jakarta's Kampung Melayu and Bukit Duri. While this meant that it was not possible to identify quantitative differences among the case studies based on the prevalence of particular types of spaces, I was able to observe some differences. These demonstrate the influence of the cross-section (spatial) on the relationship (socio-cultural) which was exemplified through the catalogue.

Findings

From the synthesis of the information I draw the following findings:

First, the more spatially demanding interventions which created vibrant riverside spaces for communities (eg. F1, F3, F2) were primarily located in sites which were: a) less constrained by urban development and physical characteristics of sites—such as terrain; and/or b) typically involved NGO or government involvement.

Second, at-grade access and river crossings (pedestrian or small vehicle) were not among the most common interventions, these were only four instances which occurred in three of the six- case-study sites. Among those sites which did feature these interventions, the interventions were either community instigated (cross-sections B3, B4), or had involved communities and NGO's (cross-sections B1, B2). From observations, and supported by the surveys and interviews (Ch5.2), crossings were facilitated for the purpose of accessing schools, medical clinics, markets, to have greater access to the surrounding neighbourhoods, and for employment.

Third, interventions which resulted in the most physical separation between communities and rivers were driven by governments (cross-sections F4, E4, E5). While such separation could reduce the degree of flood risk to communities, it often limited other types of daily interaction which communities had with the river. Additionally, the creation of physical obstructions—such as walls and dikes—also results in a visual separation which can affect a community's resilience, education, and awareness of ecological changes [195].

Following the framework proposed (see Figure 5.1.1), and other similar work in the categorisation of river edges [195], the usefulness of the catalogue in the generation of design propositions is limited. While Nassauer argues that an 'adequate understanding of nature before intelligent intervention' is required for ecological design [159], the creation of the catalogue loses the layer of site-specific information that the sections had been coded with during the discussion of the fieldwork (Ch5.2). In order to use the large amount of information acquired and its function as a design tool, an abstraction of cross section through categorically placing them based on design requirements laid out can be achieved. The act of using existing situations provides a critical contribution in improving the 'intelligence' of design intervention. It establishes a representative understanding of transformations within the broader geographic context. A representative understanding of geographically bounded transformations can be a valuable support for those designers coming in from outside these communities. For example, locally selected examples of design interventions could have helped students involved in a Design Research Studio which was run by the Landscape Ecology team during 2013 to understand how challenges experienced within the site — such as erosion — were tackled in other sites in Indonesia which had similar environmental and cultural characteristics. Such examples can also demonstrate how existing cultural dimensions of sites can be used to conceive new design solutions. These ‘outsider designers’ [78] can therefore use such a tool to develop an ‘understanding of a place that will enable them to act wisely and knowledgeably’. The catalogue of spatial tactics that results forms a toolkit for designers, which builds from local wisdom and its resultant resilience.

5.5 Charting Design Interventions

An alternative way of thinking about the information can be to compare the different approaches based upon other criteria. While it addressed one of the earlier reflected challenges in terms of reflecting the locally derived examples, it can still be still be challenging for a designer to know what to propose where. In order to overcome this challenge and operationalise the information compiled, the cross-sections were plotted against a two-axis chart. The horizontal, or x-, axis demonstrates the degree of intervention by actors. The instances plotted closest to the origin indicate community driven changes. Those plotted toward the centre of the axis represent projects that were implemented with moderate physical transformation and with external involvement by either NGOs and/or local government. Those plotted toward the right of the axis represent projects that involved significant intervention by the government and had significant transformation. The vertical, or y-, axis was interchangeably used to represent the degree of “access”, “vegetation”, and “flood tolerance”. As I have acknowledged earlier within the thesis (Ch2.2) cross-checks are an important part of the grounded theory method. In this instance, I described and reviewed each chart with a colleague—a landscape architect, who is working on a similar research topic—to verify the choices that were made along the way.

Chart 1: Access vs Level of Intervention

In a Un-Habitat document that proposes streets as tools for urban transformation in slums, Joan Clos, Un-Habitat, observes that "The virtual absence of the most basic urban common good, which is public space, disrupts the liveability, safety, security, mobility and local development of urban areas" [259]. Case studies of river improvement within urban settlements — such as Kampung Code, Yogyakarta (Ch3), and Kali Mas, Surabaya, provide valuable examples of varied ways in which access can be afforded to neighbourhoods in an incisive manner. This directly affects the relationship between the neighbourhood and the river.

In the context of Indonesia, the GR Rivers 38/2011 [185] mandated riverbank areas to be cleared of all functions (outside of those deemed relevant by the ministry) (Ch4), meanwhile in Jakarta the government proposal for the Ciliwung channellisation requires the clearance of the riverbanks and the insertion of an access road for servicing of the the river by the Ministry of Public Works.

Un-Habitat's strategy uses streets "not only as a physical entity for mobility and accessibility – through which water and sewerage pipes, power lines, and drainage systems are laid – but as the common good and the public domain where social, cultural and economic activities are articulated, reinforced and facilitated" [259]. I argue that this approach is also necessary within the context of design scenarios for river improvement in urban vernacular settlements, and discuss this in the following paragraphs on vehicular access and river frontage.

From the detailed fieldwork, qualitative and quantitative studies (Ch5.2), I observed that vehicular access to communities and river frontage plays a role in the provision of informal garbage collection services, emergency response, and sewage. Furthermore, familiarity with the river—with its temperament and how it changed and affected the surrounding environment—helped communities be resilient to flooding. Therefore, it is important that access is considered as an integral component within early phases of design. The following observations can be useful premising the inclusion of access as a design driver: 1) Pedestrian walkways, open spaces, and building orientation to the river provide visual connections to the river that support familiarity with the temperament of the river produces resilient communities and landscapes; 2) stewardship behaviour can be supported by the provision of a variety of different spaces for recreation and social activities; 3) Finally, although an access road is a key component of the government proposal for the channelization of the Ciliwing none of the case studies from elsewhere in the region involved continuous vehicular access (Ch3.4.1). While I agree that access is a vital design action for these neighbourhoods, from my study of a range of heterogeneous riverside settlements; I argue that 'access' can take a variety of forms, and that continuous and permanent vehicular access along the river is not necessary to improve the relationship between settlements and the river.

In the first chart 5.5.1 I plotted cross-sections across the x- and y- axis in regard to the amount of *access to the river* and *level of intervention* respectively. The chart is not intended to be a measure of whether the cross-sections are 'good' or 'bad', nor is it a measure of whether the tactics and behaviours which they facilitate are good or bad. Furthermore, it was not the outward connection between another settlement—which was external to the riverside neighbourhood—and the river that was studied. Instead, it was the amount of access *to* the river that was of interest. Specifically, each cross-section was examined based upon the degree of potential for interaction with the river which it facilitated.

As a result of the placement exercise, given the parameters above, I observed that the greatest provision of access to the river was provided by slighter interventions, rather than those requiring a great degree of

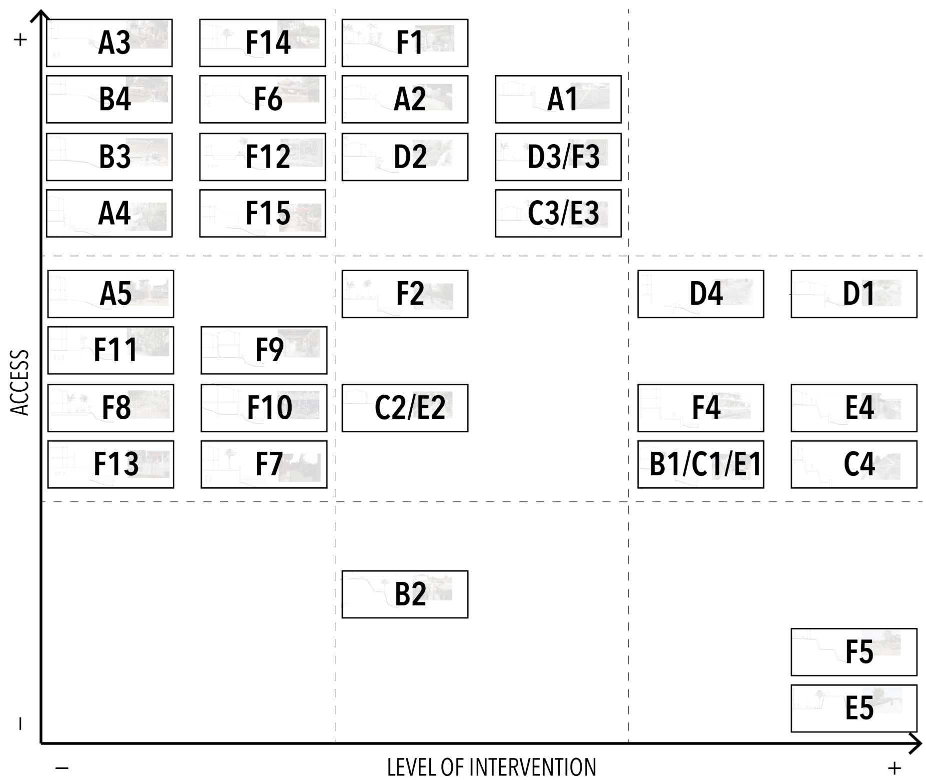


Figure 5.5.1: Chart of access to the river.

interruption to the urban settlement. This can be seen in the clustering of cross-sections within the top-left portion of the chart. Those low-level interventions included open spaces for community gathering and recreation (eg. A3, F14, F6, F12, F15), and direct river access through either staircase (eg. A3, A4) or ramp (eg. B3, B4). Moderate level interventions with high accessibility included open spaces (eg. F1, D3/F3), stepped riverbank profiles and foreshores (eg. D2, D3/F3, C3/E3) and direct river access via staircase (eg. A1, A2). While overhead bridges provided connection *across* the river, while a visual connection was enabled, this did not facilitate a direct physical connection. As such, these were ranked lower on the chart (eg. B1, B2). In contrast, those interventions plotted in the lower-right portion of the chart enacted the greatest degree of interruption on the urban settlement, and had significant loss of physical and visual (line of sight) connection with the river (eg. E5 and F5).

The trend from the placement reveals that within these case studies there were no significant examples which provided little access through little intervention, or great access through great intervention. Interventions plotted in the top- left and -middle provided the greatest access with little to moderate interruption to the urban settlement. Given these observations, the results from the construction of the chart will be considered in the development of design strategies for the site.

Chart 2: Vegetation vs Level of Intervention

Academics and activists have prompted discussion in mainstream media on the potential of river corridors as greenbelt areas, highlighting the need to preserve and strengthen existing greenbelts along river corridors [154]. The value of green spaces within urban areas for productive use has also been discussed, and was raised by then governor Jokowi Widodo in regard to the development of the Marunda housing estate, to the east of Jakarta

[190]. The cultural heritage site of Condet, along the Ciliwung River, provides physical evidence of the melding of these two proposals (see also Ch4).

The role of vegetation within the context of flooding, based on the research established by the Landscape Ecology Module, is understood as being largely ineffectual for reducing the impacts of flooding at the local landscape scale [126]. An approach that involves changes at the catchment and corridor scales, is required to mitigate flooding. However, as the complex but direct influence of vegetation on bank stability is established [49], and the findings from Ch5.2 demonstrate a variety of other factors, it is important to continue to investigate the inclusion of vegetation within design scenarios. [1]

From the detailed fieldwork, qualitative and quantitative studies (Ch5.2) I observed that vegetation plays a role in the daily life of residents and the neighbourhood's relationship with the river. Furthermore, as function, robustness, and proximity (to the river) were viewed to be significant factors in relation to the prevalence of vegetation along the river within the studied neighbourhoods, it is important that vegetation is considered as an integral component within early phases of design. The following observations can be useful premising the inclusion of vegetation as a design driver: 1) plant species selection was observed to be focused on the plant's function in the overall improvement of the environment and daily life, rather than limited to riverine landscape amelioration; 2) communities can offer insights to plant suitability for river edges based on robustness to floods and pests, based on their knowledge of vegetation is largely derived from their own experiences and that of those around them; 3) This is also important as vegetation can also be used instigate stewardship, in that plants located adjacent to homes are seen as a private

[1] Lin and Shaad recommend that, as their study was not exhaustive, a more complex numerical model is required to fully simulate the effects of vegetation at the corridor scale on flood attenuation[126].

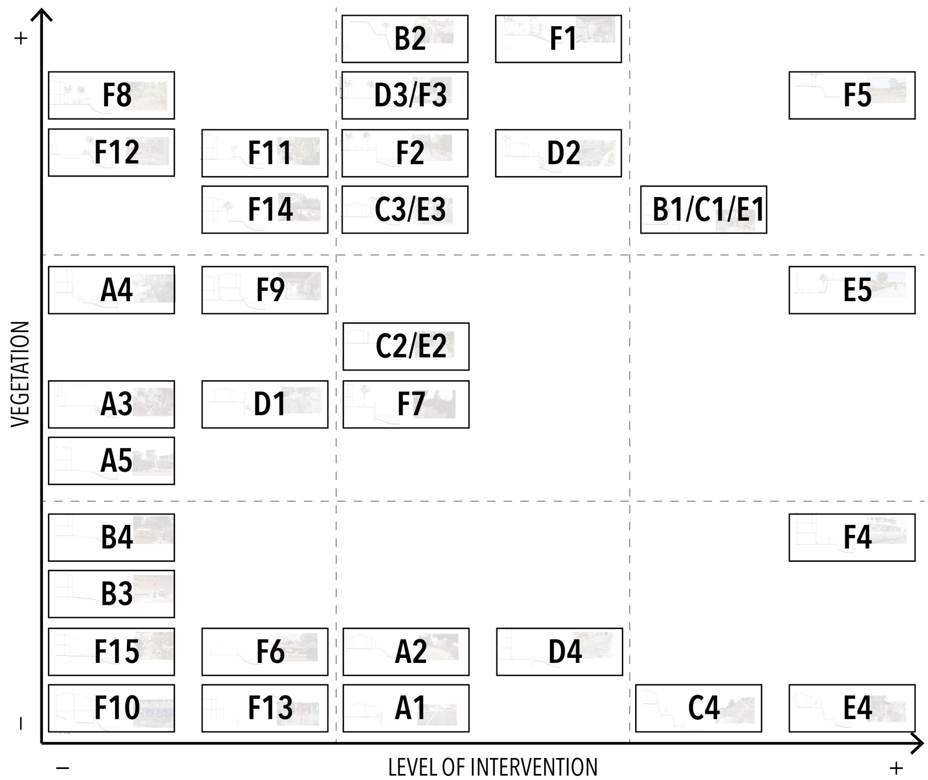


Figure 5.5.2: Chart of riverside vegetation.

resource, while those planted along the river are viewed as community resources. Thus, through maximising the amount of vegetation along the river edge, stewardship within such areas can be encouraged.

In the second chart 5.5.2 I plotted cross-sections across the x- and y- axis in regard to the amount of *vegetation* and *level of intervention* respectively. The chart is not intended to be a measure of the durability of particular types of plantings. Nor is it concerned with the types of plants which were planted. Instead, it was the amount of vegetation *adjacent to* the river that was of interest. Specifically, each cross-section was examined based upon the amount of vegetation that was observed within it.

As a result of the placement exercise, given the parameters above, I observed firstly that there was a significant variety of ways in which vegetation was integrated within cross-sections. This included a gradient of low-, moderate-, and high intervention, and low-, moderate-, and high vegetation provision. This can be seen in the distribution of cross-sections within each portion of the chart. Secondly, I observed that there were few instances seen within my study of cross-sections which facilitated moderate vegetation with moderate to high intervention.

To focus on the first observation, instances which had a low level of intervention with high vegetation included private gardens (eg. F8) and vegetated embankments (eg. F11, F12). Instances which displayed a moderate level of intervention and high vegetation included agricultural pockets (eg. B2), vegetated river corridors (eg. F1), treed public spaces (eg. D3, F2) and walkways (eg. C3/E3), and planted foreshore areas (eg. D2, D3/F3, C3/E3). Finally, instances which displayed a high level of intervention and high vegetation included a parkland within the floodway (eg. F5) and a private garden (eg. B1, C1, E1).

Instances which had a low level of intervention with moderate vegetation included hanging vegetation from higher levels (eg A4) and moveable potplants (eg. F9), and remnant wild vegetation within the corridor (eg. A3, D1, A5). Instances which displayed a moderate level of intervention and moderate vegetation included hanging vegetation from higher levels (eg C2/E2) and trees within open spaces (eg. F7). Finally, instances which displayed a high level of intervention and moderate vegetation included a grassed dike which was set back from the river (eg. E5).

In contrast, those instances which had a low level of intervention with low vegetation were observed to be cleared areas providing river access (eg. B4, B3), and public- and private open spaces for community gathering and recreation (eg. public - F15, F6, private - F10, F13). Instances which displayed a moderate level of intervention and low vegetation included cleared areas providing river access and walkways along the river (eg. A2, A1), and a foreshore which was used for animal keeping (eg. D4). Finally, instances which displayed a high level of intervention and low vegetation were those where the river had been channelised — with either a rectangular or trapezoidal cross-section (eg. F4, C4, E4).

The trend from the placement reveals that vegetation was absent — or lessened — within transformations: a) by locals and NGOs where access to the river and community open spaces were the design-driver, and b) by government where increased capacity and management through control of the riverbank area was the design-driver (eg. interventions involving channelisation). As I observed within the interviews, surveys and field observations (Ch5.2) the matter of vegetation function was important, in terms of plant selection and prevalence, and often played a social and cultural role. Apart from wild plantings which were undisturbed along the river, areas where vegetation was high were often linked to communities and their perceived value of vegetation. Given these observations, the results from the construction of the chart will be considered in the development of design strategies for the site.

Chart 3: Mitigate flood impact

Since lasting change within communities was often inhibited by a household's ability to progress itself as a result of recurrent floods, it is important that flood impacts are mitigated. The integrated work of the Landscape Ecology Module has demonstrated that flooding must be addressed at the catchment and corridor scales, and that isolated interventions within the river corridor — such as those at the local landscape scale — will largely be ineffective in reducing flooding. An approach, which involves changes at the catchment and corridor scales, is required [126, 264]. At the same time, improvements can be made at the local landscape scale to improve quality of life and the relationship with the river, including increasing the tolerance of households through design strategies.

It is increasingly acknowledged that top-down Disaster Risk Reduction measures often don't address the particular local needs and priorities of vulnerable communities, overlook the potential of local resources and capacities, and may even increase people's vulnerability [1]. Through engaging with local communities it is possible to "understand local problems and priorities better", and also increase the effectiveness of the undertaken measures, and improve sustainability of their outcomes [105].

From the detailed fieldwork, qualitative and quantitative studies (Ch5.2) I observed that resilience to flood plays a role in the daily life of residents and the neighbourhood's relationship with the river. Furthermore, as the frequency of flooding—and a household's resilience to it—affected behaviours such as growth of plants and environmental stewardship, and tactics such as the development of open space, flood tolerance is viewed to be a significant factor in terms of the relationship between communities and households to the river. Therefore, it is important that flood tolerance is considered as an integral component within early phases of design. The following observations can be useful premising the inclusion of flood tolerance as a design driver: 1) based on my observations of the challenges of repeated flooding to the development of positive environmental behaviour, reducing flood vulnerability is key to supporting environmental stewardship within riverside neighbourhoods; and 2) the socio-economic stability and safety of households can be increased by reducing the regularity of flood events.

In the third chart 5.5.3 I plotted cross-sections across the x- and y- axis in regard to the amount of *flood tolerance* and *level of intervention* respectively. The chart is not intended to be a quantitave measure of the tolerance of particular types of configurations, since these were not measured

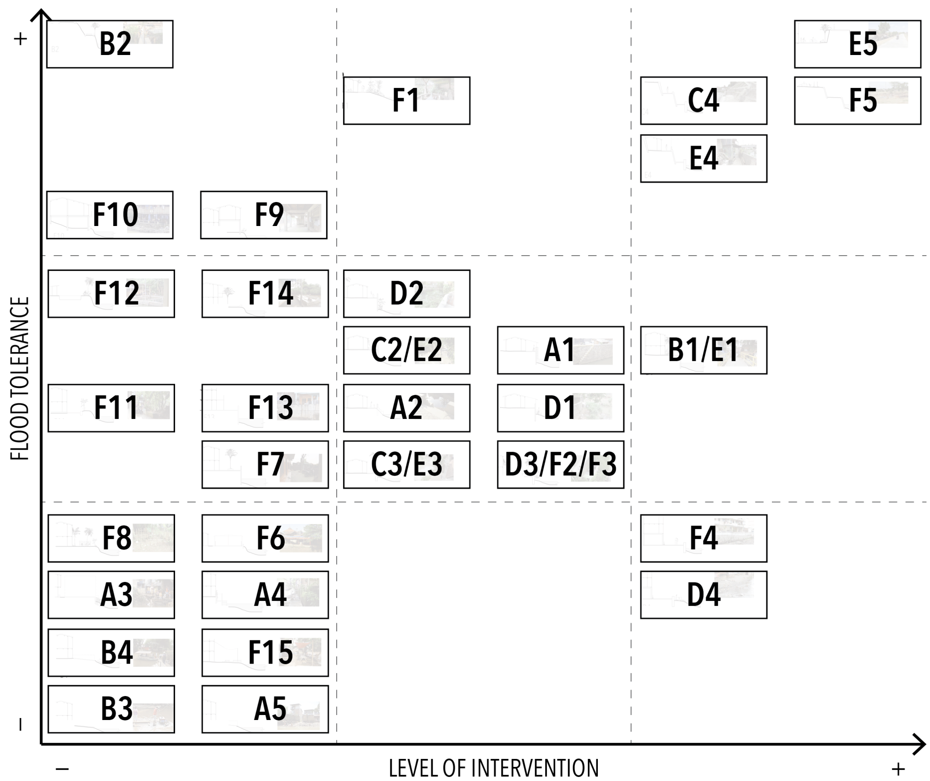


Figure 5.5.3: Chart of flood tolerance.

volumetrically. It considers the conditions which were observed within the case studies, specifically adjacent to the river. While there are other coping mechanisms employed by communities to facilitate flood tolerance [138], this study was particularly concerned with those strategies that affected the landscape and were enacted at the river edge. Each cross-section was examined based upon the configuration of the river edge — in terms of vertical and horizontal differentiation — , and the perceived degree of tolerance of residential buildings to flood.

As a result of the placement exercise, given the parameters above, I observed firstly that there was a significant variety of ways in which vertical and horizontal differentiation was integrated within cross-sections (ref Figure 5.5.3). This included a gradient of low-, moderate-, and high intervention, and low-, moderate-, and high flood tolerance. This can be seen in the distribution of cross-sections within most portions of the chart. However, based on my placement, I observed that moderate interventions which had been observed typically only provided moderate flood tolerance. This commonly included the addition of walkways along the river edge and low walls (eg. C2, A1, A2). The vertical differentiation between the river and the neighbourhood was usually based upon the existing terrain and was not noticeably altered. In some cases, foreshores within the line of the river remained (eg. D1, D2, D3, C3) and were colonised by residents for domestic functions, such as vegetation and animal keeping. Such activities were perceived to be able to tolerate-, be relocated-, or replaced after flood events. One instance was observed with high flood tolerance and moderate intervention—a vegetated area within the floodplain, in the naturally low terrain of a valley (eg. F1). The area was free of settlement, but was accessed by a trail and had structures for shelter. The vegetation included remnant forest, as well as restorations made by volunteers with an environmental NGO.

In comparison, several examples of strategies with high tolerance/low intervention and high tolerance/high intervention were observed. Areas which had a natural valley or moderate terrain variation were the most resilient with the least intervention (eg. B2). Architectural strategies, such as raised floor levels and multi-storey buildings (eg. F10, F9), were used on their own as well as in addition to to terrain. These helped to increase the resilience of households and communities to flood. Placed in the upper end of moderate tolerance, were community buildings and facilities (eg. F12, F14) located directly adjacent to the river. Instances with high tolerance and high intervention involved relocation behind dikes (eg. E5), and embankments (eg. C4, E4, F5).

I observed one intervention with low tolerance and high intervention, which seemed counter-intuitive. A neighbourhood had been replaced with walk-up apartments and was seemingly still at reasonable risk from flood, particularly when compared to those other neighbourhoods across the river which were on naturally steep embankments.

The trend from the placement reveals that high- moderate- and low level interventions follow different paradigms. The paradigm of moderate level interventions is to improve the tolerance of local neighbourhoods — which this research (Ch5.2) has linked to quality of life — through interventions which do not have significant negative impacts on communities as a result of disruptions. The paradigm of high level interventions is to mitigate the flood risk of extended areas. Meanwhile, the paradigm of low level interventions is to improve tolerance incrementally. Since these are largely driven by households and communities, adaptions to buildings and landscapes are typically staged over time relative to economic stability (revealed by fieldwork, and supported by [138]). Given these observations, the results from the construction of the chart will be considered in the development of design strategies for the site.

5.5.1 Limitations and findings

It is important to note that the cross-sections were positioned on the charts based on the author's direct physical experience, knowledge of the site, and intuition. Only through the prior acts of observation, coding environmental and spatial information into the schematic cross-section, and an understanding of the strategies and interventions which are enacted by the actors — local communities, NGOs, and government bodies — can the designer carefully and intelligently assess the relationship of the cross-section to the two values.

The trend from both the catalogue and the charts demonstrated that sustaining connections, both physical and visual, between communities and rivers is not a priority within high impact interventions, typically undertaken by governments. The interruption that this causes has a range of impacts upon the socio-cultural connection — and relationship — between communities and rivers.

5.6 Transforming Urban Riverine Landscapes

The value of the charting exercise is demonstrated within the investigation below. Returning to the two focus sites which were identified within the fieldwork, I took two particular cross-sections as examples. The investigation followed two phases: 1) I examined the cumulative result of the cataloguing and charting exercise; and 2) I demonstrated how the knowledge acquired from these investigations could be brought into design scenarios for the transformation of urban riverine landscapes.

5.6.1 Logic for selection of cross-sections

I use the information I gathered at the larger geographic context to contextualise and also select interventions that can be enacted at the local landscape scale. In this way, the exercise is a sounding board for a selection of approaches that are more likely to be relevant given the physical and also the cultural context of these rivers (Ch1.3). This was discerned within a two-round ranking process. First, I considered the cumulative result from the charting exercise, and discerned the cross-sections which were consistently placed within the 'high' band along the y-axis within the three charts. Only one cross-section, F1, placed in the 'high' band on the y-axis in all three charts, meanwhile a further seven and 16 cross-sections which placed high in one or two charts. As this produced a relatively large set of 24 cross-sections — from the original 37 observed sections —, I then considered the cross-sections which placed in the 'moderate' band on the y-axis. Within this second round, cross-sections which had placed in the high band either one- or two- times in the previous exercise reappeared. To discern the cross-sections which had recurrently placed in either high- or moderate categories, I allocated points based on the number of times which a cross-section ranked. For example, a cross-section which placed high in all three charts was awarded 6-points, one which placed high twice received 5-points, and one which placed high in one chart received 4-points, sections which placed moderate in all three charts received 3-points, and so on. Figure 5.6.1 demonstrates this process. While the first round ranking — of high placed cross-sections — had only revealed F1 as a preferred section, based upon the selected design drivers. While the vegetated parkland within the river valley had placed high within all three charts (F1), its general applicability was limited as it would require significant spatial interruption to implement. Additionally, a heterogeneous solution to the river edge was not desired. The accumulation of moderately placed cross-sections within the ranking added a further seven cross-sections, to the original 24. At the same time, through the accumulation of points across the two-bands, it revealed that there were eight cross-sections in total which consistently placed moderate-high (6-points total) when charted in relation to the design

Part 1															
Cross-Section	**F1**	F3/ D3	**C3/ E3**	**D2**	B2	F5	**F12**	**F14**	**B1/ C1/ E1**	A1	A2	A3	A4	B3	B4
R1 Ranking	**6**	5	**5**	**5**	5	5	**5**	**5**	**4**	4	4	4	4	4	4
R2 Ranking	**0**	0	**1**	**1**	0	0	**1**	**1**	**2**	1	1	1	1	0	0
Cumulative points	**6**	5	**6**	**6**	5	5	**6**	**6**	**6**	5	5	5	5	4	4

Part 2																
Cross-Section	C4	E4	E5	F2	F8	**F9**	F10	**F11**	F15	F7	C2/ E2	F13	A5	F4	D3/ F3	D4
R1 Ranking	4	4	4	4	4	**4**	4	**4**	4	0	0	0	0	0	0	0
R2 Ranking	1	1	1	1	1	**2**	1	**2**	0	3	3	2	2	1	1	1
Cumulative points	5	5	5	5	5	**6**	5	**6**	4	3	3	2	2	1	1	1

Figure 5.6.1: Cumulative result from the charting exercise to uncover the logic for the selection of cross-sections

drivers of access, vegetation and flood tolerance.

In addition to their inclusion of vegetation, access to the river, and tolerance of flood, I made the following observations from the eight cross-sections (Figure 5.6.2): 1) all of the cross-sections had some provision for community activities and gathering, and 2) the cross-sections had placed varyingly across the x-axis, in relation to level of intervention. This indicated that tactics of communities, NGO's and governments had the potential to be used as valuable precedents within design generation.

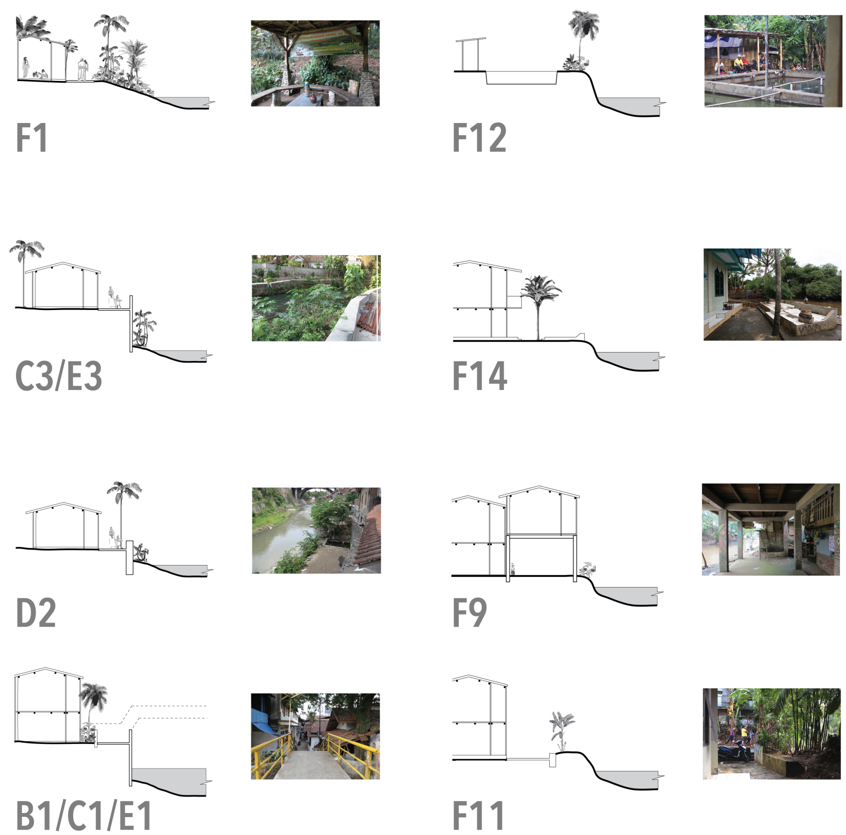


Figure 5.6.2: Eight cross-sections were consistently placed moderate — high on the charts. This illustrated that they performed well in relation to several aspects.

5.6.2 Landscape architectural design tactics for the local landscape

Although the original cataloguing of design interventions resulted in the loss of a certain complexity, through the charting exercise a logic for the use of these cross-sections within design was produced. Now, by returning to the spatially explicit information that I acquired at the local landscape scale (the information acquired from the terrestrial laser scanner, interviews and field observations) the socio-spatial information is spatialised in the following cross-sections, and a landscape architectural design proposition is made.

Two scenarios are used to demonstrate how the cumulative knowledge from the fieldwork, the catalogue and charts might be implemented in the Kampung Melayu and Bukit Duri site. The scenarios are illustrated through two cross-sections, which are positioned in relation to both the existing condition and the proposed government intervention. The images are structured in three parts:

- The existing situation — 'Local Intervention' — is taken as baseline for the two scenarios.
- The 'Government Intervention', involving channelization and dredging, is compared to the existing situation and the minimum level of interruption is indicated with a dashed red line. The dashed red line marks the extent of information which was typically provided to communities.
- Building from the existing situation, and taking into account provision for the expansion of the river cross-section through dredging and incremental widening, the 'Design Intervention' is proposed. The design couples the precise environmental and socio-spatial information from the local landscape study (Ch5.2) with the eight cross-sections which consistently placed

> moderate-high (6-points total) when charted in relation to the design drivers of access, vegetation and flood tolerance (Figure 5.6.2).

The cross-section for the first site (refer Figure 5.6.3 'Local Intervention') is taken looking northwards down the river. The riverine landscape is characterised by moderately steep riverbanks on either side and dense, low-rise settlement of mostly one-to-two storeys. The neighbourhood is compressed between the railway siding and the river and has limited river access and open space, houses backing onto the river, and minimal vegetation. The fieldwork and collaborations with NGO Ciliwung Merdeka — whose community building called the 'Sanggar' is located on the left bank of the river — have provided significant context to the scenario. The cross-section for the second site (refer to Figure 5.6.4 'Local Intervention') is taken looking southwards up the river. The riverine landscape is characterised by gentle sloping riverbanks on either side and dense, low-rise settlement of mostly one-to-two storeys. While the neighbourhood's location on a peninsula of land called Kampung Pulo means that it is largely isolated from its surroundings, it has several distinctive elements such as open spaces along the riverside, and communal and private plantings. The fieldwork, which included extensive interviews with community leaders, has provided significant context to the scenario.

The Government Intervention (refer Figure 5.6.3 and 5.6.4 'Government Intervention') would see the river channelised as it passes through these neighbourhoods. Although research within the team has demonstrated that this approach would typically contain the flood waters [126], this — like other interventions which have been implemented by governments in Indonesia, such as E4, E5, F5 — it will physically separate the river from the city, which will likely further distance the relationship between the city

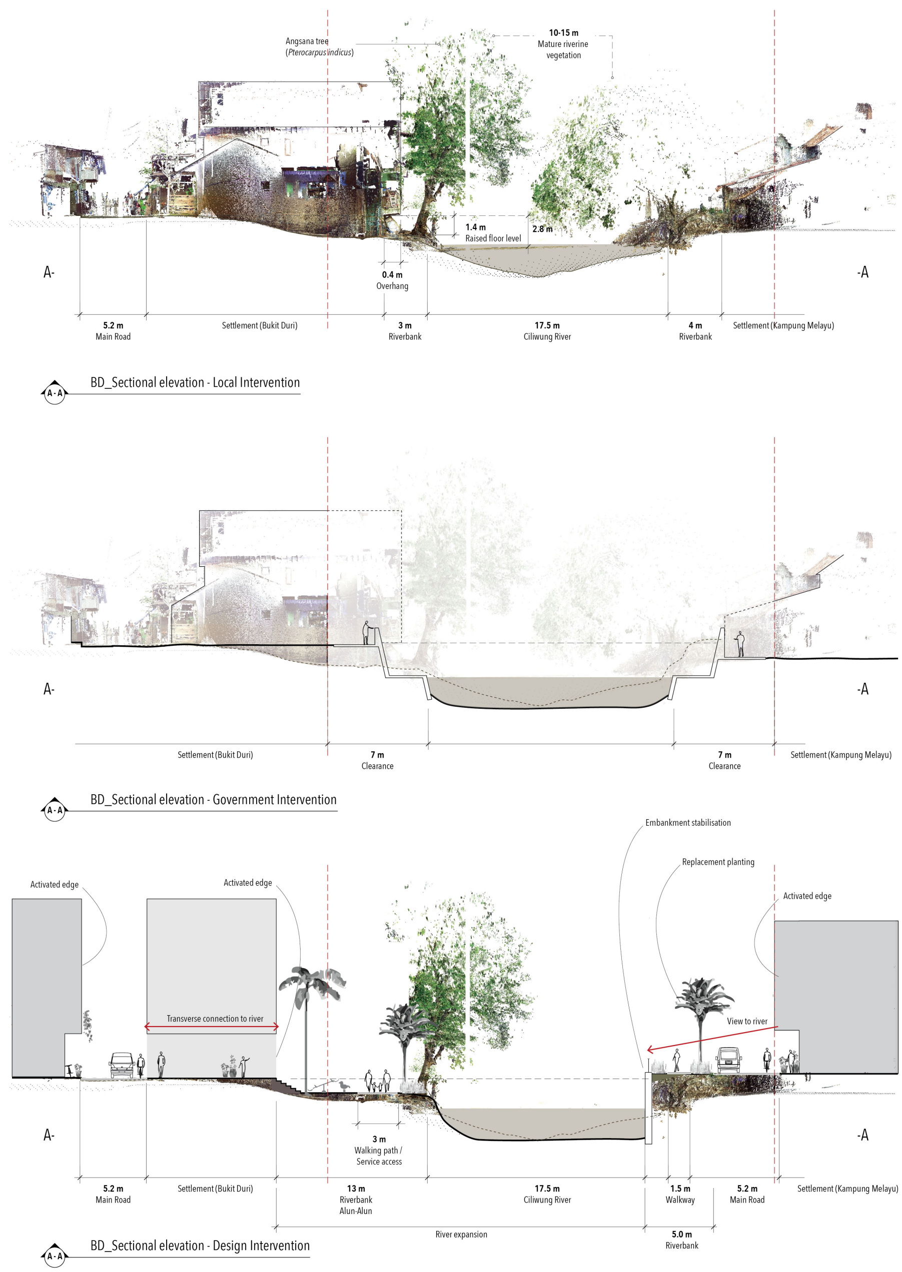


Figure 5.6.3: The design tactic for the left bank draws on cross-sections F3, F12 and F5, providing river access, a new densified built form and a defined public open space within the site of the NGO. The design tactic for the right bank draws on cross-sections B1/C1/E1, strengthening the existing bank with a gabion-lined edge. Both configurations include provision of access for pedestrians and vehicles. The river is widened and deepened.

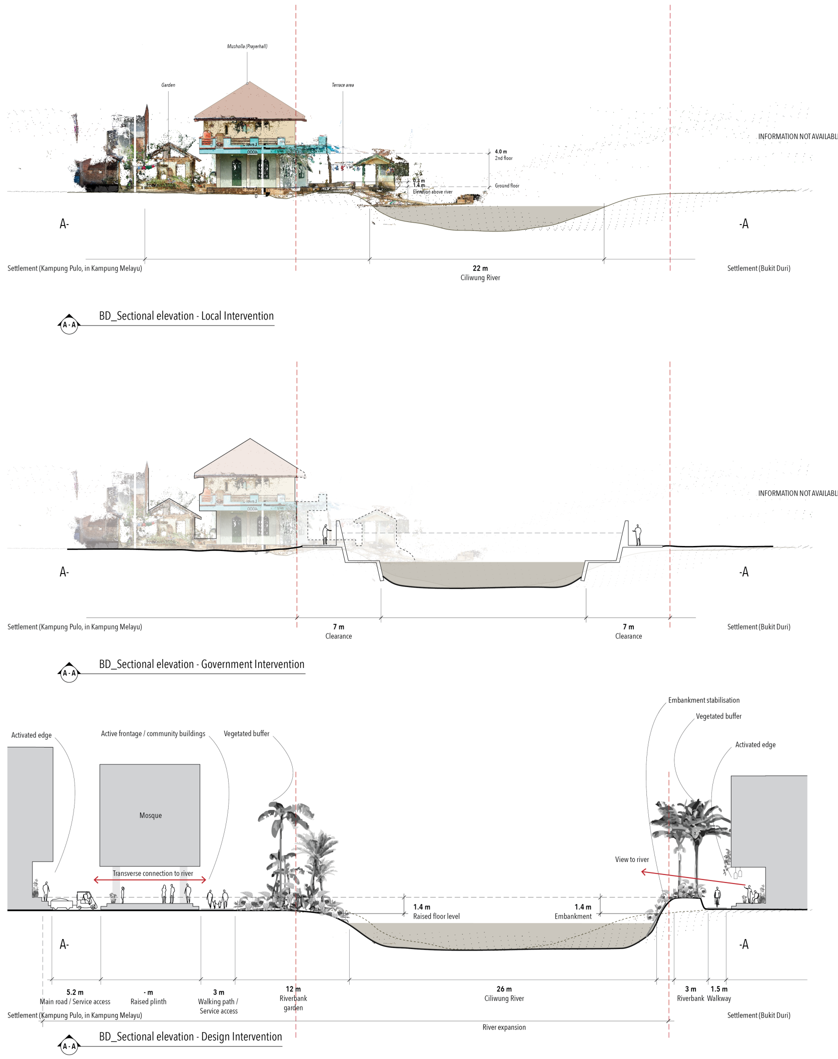


Figure 5.6.4: The design tactic for the left bank draws on cross-sections F1 and F9, providing river access, a garden of resilient plant species and transverse connections between the neighbourhood and river's edge. Buildings proximal to the river's edge incorporate coping mechanisms, with plinths and multiple levels. The design tactic for the right bank draws on cross-section F11, strengthening the flood resilience of the low-lying area with a vegetated berm. Both configurations include provision of access for pedestrians and vehicles. The river is widened and deepened.

and the river. Additionally, the intervention will have a range of other impacts upon the vernacular neighbourhoods and their communities which are documented elsewhere [110, 200, 230, 259]).

5.6.3 Bukit Duri: Design for a constricted site

The design tactic for the left bank draws on cross-sections F3, F12 and F5 (refer Figure 5.6.3 'Design Intervention'). The role that mature vegetation plays within ecological and social processes is clear from the interviews (Ch5.2). First, the retention of the mature Angsana tree on the left bank is recommended as it provides slope stabilisation and adds significantly to the amenity and character of the neighbourhood. Cross-sections F3 and F12 inform the definition of an open space for recreational or community use along the riverbank, as a way to activate the riverside. Since the existing building has a strong role within the community, this location is ideal to demonstrate a densified built form, and a defined public open space for the community which is sorely needed in this constricted site. To address the sloping terrain and provide increased capacity for the river, a stepped approach is taken with certain portions of the riverbank are allowed to flood during wet periods and expand the capacity of the river (from F5). While this neighbourhood can already be accessed via a 5.2-metre wide road (which is within 15-metres from the river), access to the river can be increased through the addition of a continuous walkway along the river and a clear transverse connection to the river from the road. This connection already exists, but is only accessible to pedestrians and small bikes. Additionally, buildings can be set-back at the ground floor to allow for storage of motorcycles and pot plants and reduce conflict of the road.

The design tactic for the right bank draw on cross-sections B1/C1/E1, which provided examples of a hard edge to the river bank with a continuous walkway. While presently a large cluster of bamboo lines the river edge, this extends significantly into the river corridor. Since the right riverbank has already accumulated higher, which provides some safety from flooding, the bank can be contained using a wall or gabions. A shaded continuous walkway can provide pedestrian access along the riverside, and — since there is little access to this area for vehicles — a 5.2-metre roadway should be introduced to facilitate the provision of services and maintenance of the river by the Ministry for Public Works. The buildings along the riverside should be orientated toward the river, and — following the same approach as the left bank — buildings can be set-back at the ground floor to allow for storage of motorcycles and pot plants and reduce conflict of the road.

5.6.4 Kampung Pulo: Design for a low-lying site

The design tactic for the left bank draws on cross-sections F1 and F9 (refer Figure 5.6.4 'Design Intervention'). In Chapter 5.2 I understood the role that vegetation plays in promoting environmental stewardship behaviour. Thus, vegetated buffers such as those seen in F1 are used as a key strategy for this scenario. first, as resource and amenity for the local communities; second, to increase biodiversity; and third, to slow the passage of water. On the left bank a vegetated buffer provides opportunity for a garden of resilient plant species which can be cared for by the local community. A walking path along the river provides access for pedestrians and vehicles such as bicycles. Transverse connections are facilitated between the neighbourhood and the riverside by freeing up the ground levels of public buildings. As F9 demonstrated, community buildings can be alternated with residential buildings along the river's edge. This can help improve the flood tolerance of communities. To address the low-lying terrain, buildings within close proximity to the river should be designed with various coping mechanisms [138] with plinths and multiple levels. These can follow positive examples of inward densification which were observed in Ch 5.2. The introduction of a 5.2-metre roadway can facilitate the provision of services and maintenance of the river by the Ministry for Public Works.

The design tactic for the right bank draws on cross-section F11, which provided an example of a vegetated berm along the river bank with a continuous walkway. This tactic has two functions: first, it provides additional protection from flooding; and second, the vegetation can provide soft stabilisation of the riverbank, such as with fascines [177]. The river-edge can be activated by using a walkway and by re-orientating buildings. A large terrace can provide space for informal community gathering, vehicle storage and pot plants.

In closing, based on the findings of the thesis, I argue that in order to positively affect the existing neighbourhood's relationship to the river, a range of socio-environmental aspects need to be considered in conjunction with widening and deepening the river. Three aspects — access, vegetation and flood tolerance — were taken to demonstrate the way that site-specific knowledge of local landscapes and communities can support sustaining change. Through the two scenarios, moderate design adjustments make the river a feature of the community, not a barrier, and the neighbourhood-level design responds to opportunities of its location.

The design of landscapes enables social routines and spatial practices... [and] translates cultural values into memorable landscape forms and spaces.

Elizabeth Meyer, 2008

6

Discussion and Conclusions

6.1 Overview

I would like to conclude my dissertation by resuming the initial discussion on the paradigm of river amelioration in Indonesia. I have found that this paradigm desperately needs to become responsive to local human communities and local contexts, to first secure project durability and second instigate a process of cultural adaptation [182]. Within the city of Jakarta, the disjunct between government directed river improvement and local communities and contexts is extreme and is viewed as a demonstration of these trends on the regional and national level. The urban areas along the riverbanks may be considered as the point at which these improvements take local forms. The residents of vernacular urban settlements are the most vulnerable to transformations occurring both within the larger catchment, and the river corridor. The theoretical discourse on river amelioration indicates a similar trend, however, contemporary dialogues on riverbank communities attempt to bring communities into the discussion.

River amelioration in Jakarta serves as an ideal example to illustrate the complexity of Southeast Asia's fast developing cities and the challenges involved in securing rivers as valued and vibrant spaces within the city. If we focus only on how global trends are translated into specific local forms, we run the risk of creating spaces that are based upon outsider perspectives, rather than the everyday reality of the landscape as the city's residents experience it (see also Wilhelm [278]).

The final chapter thus breaks the discussion into several sections. The first three sections discuss the research questions separately, addressing the findings of each.

- How is riverine landscape transformation conceptualised in the context of urban settlements in mainland Indonesia? (Ch6.2)
- What kind of tactics and behaviours of those producing the built environment emerge in urban riverine neighbourhoods? (Ch6.3)
- What is the relation between riverine landscapes, tactics and behaviours, and socio-spatial change? What theoretical and practical lessons can be drawn? (Ch6.4)

Secondly, I will conclude the chapter — and the thesis — with a summary of the contributions of this thesis, in regard to: lessons for local community, designers and policy-makers; the contribution of the thesis to the literature on 'landscape as medium and method' and to literature on river amelioration issues; and the limitations. I will conclude the thesis with a brief reflection on the prospects for the Ciliwung.

The following chart Figure 6.1.1, which describes the thesis approach, is used to guide the chapter.

6.2 Conceptualising Riverine Landscape Transformation in the Context of Vernacular Urban Settlements

6.2.1 Historical Riverine Landscape Transformation

The research builds on the water urbanism approaches of Putri and Rahmanti [197] and De Meulder [57], which study the evolution of the Jakarta territory in relation to its water narrative. Its key contribution is an extension of the narrative to include the 4th century and the present day, going beyond the colonial and immediate post-colonial periods that were emphasised in the earlier studies, which have been undertaken by geographers, urbanists and architects. This historical approach to the study of river transformation in Jakarta reveals three interesting points pertaining to the conceptualisation of water, water landscapes, and tactics and behaviours (practices).

First, prior to 1616 a persistent link can be drawn between water and spirituality. Prior to the Dutch colonial period, settlements, royal residences and places of spiritual focus were established in relation to waterways. Water was tied to the dead and the living, the immortality of the spirit and the fertility of the soil [45]. The Ciliwung River was revealed through the narratives and stories of the time, as well as physical artefacts, to have been the heart of the precolonial kingdoms of West Java. During this period, the swampy lowlands were avoided and linked to un-healthiness. This may have been the result of human experience and meant that historically settlements were located on the higher depositions

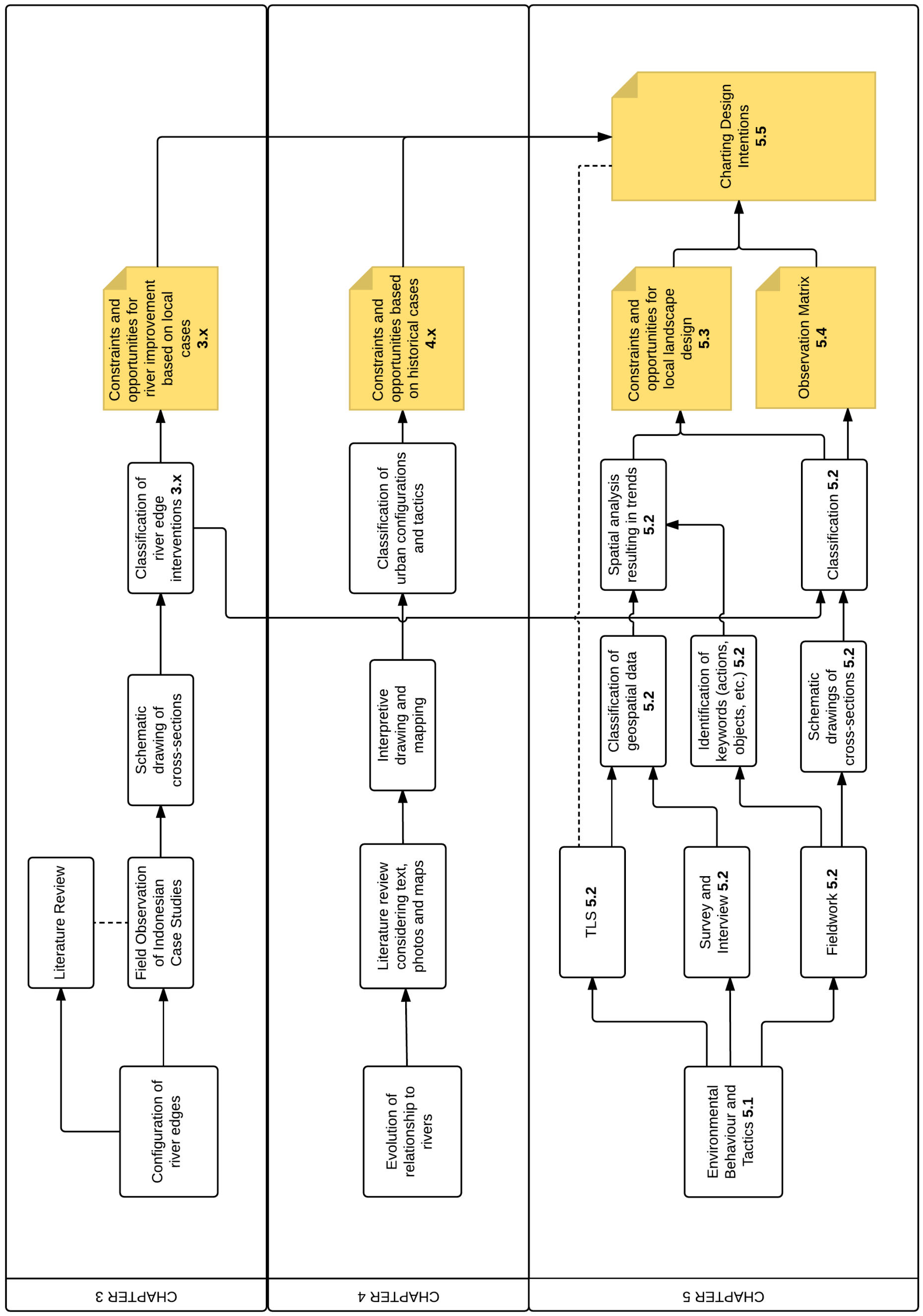


Figure 6.1.1: Diagram of the approach to the chapters following the adapted Grounded Theory method.

on riverbanks and in the upland areas.

Second, the Dutch colonial period (1616-1645) may be largely viewed to be the origin of Jakarta's problematic waterscape. The imposition of the Dutch canal-scape marked the beginning of an era of 'borrowed visions' [226] which still continues to the present day. While floods were a regular phenomenon throughout Jakarta's precolonial and colonial history, the severity and frequency of floods has been increasing over the past decennia. This has been attributed to geographical, environmental and infrastructural causes [208]. The increasing problems of the low-lying city (disease, flooding, death) — not in part due to the lack of consideration for the site's spatial logics — resulted in a shift from the river as the main economic artery, to the road. This triggered a larger orthogonal transition from front-facing to back-facing urban configurations.

Third, the postcolonial 'nation-building' period (>1945) was marked by large-scale infrastructural works with efforts made to legitimise proposals through local technologies and knowledge to promote national heritage. The Betawi-inspired greenbelts of the 1970s, and the more recent sea wall project which resembles Indonesia's national emblem, the mythical Garuda, are two such examples. While these top-down tactics consistently draw on 'cultural' inspiration, the human-scale and final delivery of these projects sorely miss it.

The above highlights the need to understand not only 'the historical context and the temporal scale' [278], but also the overarching socio-cultural and physical context, if our intention is to understand and improve a particular place. Though this might seem to be commonly accepted, the discourse on river amelioration globally has raised the challenges of bringing different types of information together (such as social and environmental). At the same time, the discourse on transformation and river amelioration in Indonesia indicates that there is an inconsistency between how vernacular culture and heritage is approached within the context of urban rivers. While on the one hand vernacular heritage in Jakarta has been used to legitimise national policies, on the other hand that same indigenous culture and urban form has been blamed for the ill health of the city's rivers and flooding. As Wilhelm observes, though the kampung areas had been an 'integral part of the colonial city', the evolving politics and dynamic urbanisation of the 20th century resulted in these areas being viewed as 'illegal squatter settlements, or slums'. Thus, the kampung came to be recognised as a problem that ought to be eliminated [278]. Yet with the historical study I argued that the particular socio-cultural and physical context of a place has a direct effect upon the relationship of a city to its river, including the durability of interventions, and cultural adaptation.

6.2.2 Contemporary Riverine Landscape Transformation

Across Indonesia, the rivers of the late 80's and early 90's were marred with habitual environmental pollution, despite policies to the contrary. Contemporary water management approaches on the whole continue in the same way as those of the later colonial and post-colonial period — primarily infrastructural — and have been largely unsuccessful in mitigating the massive flooding. Indeed, urban riverine amelioration practice undertaken by governments and NGO's has largely fore fronted perceived civic aesthetics, housing, and river engineering, over locally embedded social and cultural concerns.

The findings of my comparative approach to the study of riverine transformation in Indonesia reveal that the number of case studies demonstrating the potential of projects centred on neighbourhoods and the local scale is increasing. Consistent with the observations on river improvement in the extended region detailed in my literature review (Ch1), I found that these positive examples of riverine neighbourhood improvement programs in Indonesia focused upon *community* *empowerment and involvement* (Ch3). This clearly reflects a new development paradigm in relation to the improvement of riverine landscapes, which is in line with the Tahir et al's observations of community improvement programs in Indonesia that are centred on community-based management. Tahir et al observe that these programs are 'people-centred, participatory, empowering, and sustainable, placing emphasis on local autonomy in the decision-making, self-reliance, direct participation, and social learning' [248]. Using a comparative study to review the state of riverine landscape transformation in mainland Indonesia, I further demonstrated the relationship between physical characteristics and socio-cultural aspects of riverine landscapes. However, for the most part, communities and NGO's enacted these examples of river improvement which illustrated ongoing socio-cultural interactions between the neighbourhood and the river and that an attitude of stewardship existed. I view this as a demonstration of community aspiration toward an improved environment. The lively and cared-for riverfronts that I observed illustrated the role of spatial orientation, accessibility and scaling of spaces in establishing connections between neighbourhoods and rivers. I believe that these findings begin to illustrate a relationship between that design interventions which create physical connections between neighbourhoods and rivers and positive socio-cultural interactions and aspirations. This supports the original hypothesis that spatial design of local landscapes can instigate a sense of or a culture of stewardship towards urban rivers in Indonesia.

The cumulative knowledge of the thesis demonstrated that sustaining connections, both physical and visual, between communities and rivers is not a priority within the interventions that are typically undertaken by the Indonesian government. The work begun in Chapter 3 was further exemplified and explored through the catalogue and the charts in Chapter 5. Such high impact interventions cause physical interruptions to the physical environment that have a range of impacts upon the sociocultural connection—and relationship—between communities and rivers.

Such aspects have been highlighted within literature on river amelioration within the global discourse[195]. Within Indonesia government-directed projects with such an approach in mind were observed to be lacking—and direct imitation of European strategies without local contextualisation should be avoided (see Chapter 2). Fortunately, there are positive examples of amelioration projects elsewhere in Asia, including China, Korea, Singapore, Thailand and the Phillippines (see Chapter 1). The former, demonstrate top-down, government driven scenarios, while the latter two are mixed approaches requiring community, NGO and governments to work together toward a common goal. Programs have been initiated in both Malaysia and Singapore that operate on the premise that if you bring people closer to the water they will take care of it.

Although Singapore's river systems were heavily polluted at the time of its national independence in 1965, the government successfully carried out a national clean-up program and then implemented strategies, policies and programs to diversify Singapore's water resources [256]. Because more than half of Singapore's land functions as a water catchment area, the national water agency (Public Utilities Board, PUB) felt that it was crucial to make the population aware that they were living within water catchment areas[255]. This meant that PUB needed to increase people's responsibility and knowledge regarding the local water cycle, as well as to engage the public in keeping the water clean and water conservation [249, 254]. While historically they had sought to protect water resources by making lakes, reservoirs and waterways difficult to access[174], in a clear paradigm shift, such spaces were made open to the public. On the premise that if the public were involved in water activities they would not pollute the water, PUB initiated plans to develop a *personal relationship* between the public and water bodies—to bring people *closer* to water ([196, 249, 255] own emphasis). In 2004 public access was granted to

Figure 6.2.1: In Singapore Bishan park has become a benchmark project for the Active Beautiful and Clean waters program, and provides a variety of opportunities for communities to get closer to the water. Source: URA

reservoirs for water related activities, meanwhile the ABC Waters Program was later launched in 2006 and wedded green and grey water infrastructure approaches. ABC stands for 'Active, Beautiful, Clean', and includes measures such as sustainable storm water management, enhancement of biodiversity, and increasing aesthetics and recreation [29]. More than 100 potential sites were identified for ABC Waters implementation by 2030. Now, 10 years into the 20-year program, under PUB's administration more than 54 projects have been implemented across two development phases (2007-2011 and 2012-2016). Fundamental elements of Singapore's water resource management strategies have included education, information and communication campaigns, along with partnerships between the 3P's—People, Public and Private sectors. The US$56.5 million Bishan River project (see chapter 1) was a benchmark of this program (Figure 6.2.1).

Figure 6.2.2: In Kuala Lumpur, Malaysia, the Klang River is being rejuvenated to bring Malaysia into developed country status and to improve attitudes toward the river. Source: AECOM

In Malaysia, the US$1.3 billion River of Life project (ROL) [95] began in 2012 as one of the high-impact initiatives to bring Malaysia to developed country status by 2020 (Figure 6.2.2). Overseen by the government's reform agency Pemandu, it focuses upon the Klang River, which is one of the city's most prominent landmarks, on whose banks were built iconic structures like the Sultan Abdul Samad Building. The ROL-Public Outreach Program is a program to foster partnerships and to improve attitudes and behaviours of target groups to reduce pollution[172]. The main objective of ROL-POP is to generate evidential improvement in attitudes and behaviours of target groups within the Project Area towards river care and preservation in order to improve water quality and reduce pollution within project area. Furthermore, it seeks to promote a sense of ownership towards the river and initiating long term and sustainable change in behaviour towards preserving the river.

Thus far, despite the aim of the ABC program in Singapore to affect the relationship between communities and waterways, most reporting on the program has been focused on environmental benefits and the program concepts. At the same time, the River of Life program is still underway and is due to be completed by 2020. Although the ROL program does have an evidential analysis component designed to measure the improvement of attitudes and improvements towards river care; this will be need to be measured for some years following completion of the project since education over several generations is required to change behaviours and attitudes[99, 257]

Measured alongside the environmental condition of waterways, more information on the intrinsic link between the health of our waterways and our lives is necessary. By understanding and communicating the condition of the waterways, future targets, policy and actions can be driven and influenced. Existing programs such as the The Green City Clean Water (GCCW) program in Philadelphia, USA, and Healthy Waterways in Queensland, Australia, have instituted web platforms for knowledge and capacity building and link information on individual watersheds to communities in an accessible way[73, 269]. Links have also been drawn between the improvement of waterways and the jobs sector. Such reporting mechanisms are valuable not only in assessing the success of improvement programs, but also in continuing to engage public in policy and planning.

The above discussion of the conceptualisation of contemporary riverine landscape transformation highlights the need to continue to advance: 1) programs that engage local communities in the stewardship of riverine landscapes; and 2) design interventions that unite communities with waterways. At the same time, evidential research into the ability of design interventions to affect attitudes and behaviours needs to be carried out throughout the improvement process. Such an approach can begin to address the challenges identified in the global discourse by Pahl-wostl et al to secure project durability and instigate a cultural adaptation[182].

6.3 Tactics and Behaviours for the Transformation of Riverine Landscapes in Vernacular Urban Settlements

Previous studies demonstrate the value of Environment-Behaviour (E-B) research in terms of contributing new knowledge on riverine landscapes in Indonesia [122, 222]. This research explored this further using first a comparative study of riverine landscape transformation to establish a baseline, and second an in depth study in Jakarta. The empirical studies that were undertaken explored the role of environmental behaviours and tactics in the transformation of riverine landscapes.

6.3.1 Contributions to local environment of behaviours and tactics

Instead of finding that residents of the vernacular urban settlements disregard the local environment, which has often been described by the media and government, I found that socio-economic, domestic and recreational functions of riverine landscapes for communities could positively contribute to the maintenance of the river corridor (Ch 3 and 5). In such cases where behaviours and tactics were observed to negatively affect the local environment, this can be the result of an insufficiency or lack elsewhere [263], rather than disregard for the environment. For example, in Jakarta's Kampung Melayu, where the municipal infrastructure lags behind growth, communities compensated by relying on local waterways to meet basic needs for sanitation [263, 265]. Conversely, I found that residents acted independently and within groups to manage environmental problems such as flooding, sedimentation and erosion of the river. Although urban settlements may have some affect on these phenomena, it has been clearly demonstrated that such problems are largely caused by external factors—not limited to land use change within the extended urban area[91, 187]. The strategies of residents in Bandung and Jakarta to manage sediment and erosion can be seen as positive contributions to the management of the river corridor. Observations included a resident along the Cikapundung River, Bandung, who was observed collecting sediment from a channelised section of the river, and residents along the Ciliwung River, Jakarta, clear the sediment washed into neighbourhoods during floods and use it to sand-bag riverbanks vulnerable to erosion. 'Care-taker' activities such as these have even been documented in historical reports from the colonial period, and demonstrate the ongoing commitment of communities to the maintenance of the riverine landscape.

Traces of activities along- and in- the river were more prevalent among less urban areas, which typically had higher capacity for adapted uses and transformations of the riverfront (Ch 3). For example, local residents within several neighbourhoods in Yogyakarta were observed to colonise the foreshores, which formed naturally within the river channel with plants and fishponds. Meanwhile, open spaces and agriculture were also more common along the riverside.

The involvement of NGO's and environmental groups was observed to be an important part of facilitating environmental activities. Stewardship, green infrastructure and environmental campaigns – or respect for environment – was revealed through physical signs of care and ownership at the household level, and through environmental programs and campaigns at the neighbourhood scale (Ch3). While the municipality established some environmental programs, these were often out of touch with the issues on the ground and did not last (Ch5). In line with [182], this demonstrates the importance of local involvement to ensure the relevance of programs and secure the programs' sustainability.

The heterogeneity of spaces observed along the studied Indonesian rivers demonstrated the variety of interactions that households and communities have with rivers. The development of a *catalogue*, specific to the local context is a valuable resource for communities, designers, and policy makers, which improves the 'intelligence' of design intervention. It establishes a representative understanding of transformations within the broader geographic context and forms a toolkit for designers, which builds from local wisdom and its resultant resilience. The subsequent charting of the tactics—relative to different variables and different levels of intervention 'low', 'moderate' and 'high' (broadly equated to community-driven, assisted, and government-driven interventions)—helped present a logic for the use of these cross-sections within design.

6.4 Riverine Landscapes, Tactics and Behaviours, and Socio-Spatial change: Practical and Theoretical Lessons

6.4.1 Lessons for policy makers

Although riverside settlements and their close proximity to the river's margin have been addressed in Indonesia since the mid-1980s, these upgrading and improvement programs were not riverside habitat-specific and did not often include transformations to the river edge or waterfront [285]. Meanwhile, Indonesian policies on rivers, such as GR 38/2011, promote singular-functional river corridors and generalise the characteristics of rivers. The evictions and channelisation which occurred along the Ciliwung River at the end of this research is not in-line with the contemporary paradigm, which seeks to transform rivers into multifunctional landscapes that can enhance environmental quality for both humans and wildlife populations [82].

For the last two decades, research in a range of fields has called for the integration of the physical landscape with human dimensions through designs that connect human environments [12, 125]. Nassauer[159] recommends that landscape change instigated by professionals should become more vernacular, which she defines as being informed by the actions of local stakeholders and therefore more resilient to future changes. Although the government regulation leaves room for 'socialisation', we understood that in the research site this was mostly limited to the posting of technical plans and schematic visualisations within neighbourhoods, and official visits in the lead up to the 2014 presidential election. In the end, the violent evictions that occurred through 2015 and 2016 during the writing of this thesis, demonstrated that the socialisation was an empty promise.

The benefits of community engagement in planning and design include enhancing citizens' level of commitment, increased satisfaction with and more realistic expectations of outcomes, and building trust [3]. Engagement also facilitates professionals' access to community expertise and local knowledge, and conversely community members' access to professional expertise [141]. Community involvement throughout the planning process can bring about more successful and durable interventions within urban landscapes[128].

As the research has demonstrated, the involvement of communities in the larger process of research, design, and transformation is integral to the sense of ownership, stewardship, and larger success of projects. Within the comparative case study four types of community involvement were observed: i) neighbourhood- driven improvement; ii) involvement in design generation; iii) involvement in relocation process; and iv) involvement in maintenance. These can be valuable examples for project planning to ensure longer-term sustainability of design interventions.

One of the lessons this study brings forward for policy makers is the benefit of engaging at the local landscape scale in order to make river amelioration policies more appropriate and self-sustaining. The case of service provision and vehicular access in Kampung Pulo (Ch 5) is a good example of how policy could benefit from careful consideration of the relationship between the *local landscape* (lacking adequate service provision, narrow streets) and the *behaviours* (throwing garbage in the river) of the community. While the community had developed *tactics* (cart-based collection system, incineration, composting) to address this, the repeated socio-environmental stresses (floods, illness of collectors) resulted in inconsistent provision which meant that the river was still relied upon as a buffer. Therefore, this analysis of the the river at the local landscape scale — reaching beyond its banks into the community — offers the potential to assist in policy making that responds to local realities, and/or facilitates appropriate and sustainable implementation of existing policies.

6.4.2 Lessons for communities

One of the lessons this study brings forward for communities is the need for communication *between* communities, rather than considering their own problems in isolation. Research undertaken by other researchers, has demonstrated that residents, NGO's and professionals are increasingly trying to 'work collaboratively towards common goals' of making communities more resilient[179]. While good communication systems existed in relation to flooding within the neighbourhoods [138, 180], other issues — which could have been partially addressed through inter-neighbourhood discussion — remained unaddressed. For example, the community in Kampung Pulo were no longer able to compost their garbage after their 'compost house' was destroyed by floods. However, a neighbouring community had a composting machine which they were not using. In another example, plants being distributed to communities by companies for CSR were dying because of exposure to floods. One community had a clear strategy for plant allocation within their neighbourhood during these campaigns: more durable plants were planted along the riverbanks, while less durable plants were planted along the streets. In so far that communities can identify common knowledge, goals, and potential shared they may conceivably be able to join together in mutually supporting ways, as Padawangi and Douglass discuss[179]. They observe that 'floods, urban land-use changes, spatial marginalization, and community mobilization are all coming together to create new political dynamics that can assist neighbourhoods to gain resilience not just at the time of flooding, but by building communities for their long-term social and economic vitality'.

6.4.3 Lessons for Design and Science

While Nassauer introduced the concepts of 'Landscape as Medium' and 'Landscape as Method' as possible solutions to bridging the gap between design and science [160], most examples of research wherein similar approaches have been applied have been conducted at the ecosystem scale, rather than the scale of the local landscape. The methodology developed within this research answers the call for trans-disciplinary approaches, namely between science and design, to contribute to landscape scholarship [237]. It seeks to unite design research and practice through the integration of social and behavioural aspects, resulting in actual strategies for policy and design. Weaving in methods from other disciplines, such as geography, which have a strong discourse on landscape, place and space can deepen our understanding of our environment. As Knigge and Cope observe in their chapter 'Grounded Visualisation and Scale: A Recursive Analysis of Community Spaces', while the advantage of mixed methods in research is partially in the deliberate use of different aspects or questions during the progress of a research project, it is also in the '*productive tensions* that can arise in allowing data from different methods to rub up against each other, conflict, complement, or even raise new questions' [108].

Through the fieldwork, interviews and surveys the integration of tools such as GIS and terrestrial laser scanning were integrated with mappings and drawings, surveys, and interviews to investigate the interrelated human and physical processes. This approach finds commonality with such research methods as qualitative GIS [48], and ethnography in architecture [24], and architectural fieldwork [43, 68, 274]. However, I believe that the important differentiator of this work is that it sought to enter from the perspective of a designer, looking for signifiers to the human-environment relationship that could be used for the creative projection of landscapes. The methodological approach and the research findings demonstrate the value of the skills of Landscape Architects and designers to better understand and influence design and planning within complex sites.

Social science tools, such as survey and interview, and the grounded theory approach helped surface linkages between the local landscape and the community. This supported the linking of the local landscape (environment), the community, and their tactics and behaviours, and facilitated the shift from analytical modes of working to design thinking.

Various researchers have observed the challenges in communication between stakeholders, experts and others [132, 161, 267]. In a 1997 study of ordinary peoples' perception of the Indonesian clean rivers program, Prokasih, researchers concluded that people registered different factors when observing the changes to the river's quality. While scientists recorded a drop in water pollution (such as coliform, BOD and COD), residents believed that conditions had worsened based upon their perception of physical characteristics such as odor, colour, mud (sediments), turbidity, suds (foam), garbage and flow [203]. This example demonstrates that different groups had different perceptions of a single reference point [96, 144].

Within this research project on the Ciliwung River, the use of 'landscape as medium and method', as an investigative tool gave rise to the development of a representational approach integrating socio-cultural and spatial information:

1. Environment-Behaviour research was a valuable tool within the enactment of 'landscape as medium and method' for Landscape Architects. To identify the 'cues to care' which Nassauer describes[158], careful observation and grounding within a local context is required. Such integration helps to ensure that findings on attitudes and behaviours are more true and more accurate [21]. Questions were included within the interviews to understand the nuanced knowledge of residents about the vegetation within the river corridor to support the sustainable selection and application of plant species within design scenarios [7].
2. To understand the significance of riverine landscape transformation within the context of vernacular urban settlements, interpretive-historical research was used to describe, understand and interpret the processes conditioning riverine landscapes[83]. This follows on from the descriptive urbanism approach and interpretive mapping approach, which involve drawing, mapping and describing urban forms and lay the groundwork for 'designerly investigations of potentials' [226].
3. The understanding of riverine landscape transformation was enriched and informed by observing several case studies [74] within the context of riverine landscape transformation in mainland Indonesia, and then focusing specifically on one case study.

By representing information collected from historical studies, field observations, surveys and interviews using visual approaches from landscape architecture, knowledge from diverse stakeholders, experts and others could be synthesised in such a way that it could be communicated to each group and facilitate discussions between them at forums and exhibitions[67].

One of the challenges of this approach is the cost implication of this methodology in terms of both time and money. It took a considerable length of time to synthesise the themes and information, to result in projective scenarios. While geographer Carl Sauer promoted an iterative fieldtrips, covering landscapes multiple times and in different seasons [65], in this case I found that the research that I was doing—in its protracted form—wasn't able to keep up with the rate of change on the ground. This suggests that a streamlining process ought to occur, to identify which aspects of the process can be shortened or omitted entirely, whilst still generating a strong body of knowledge about the neighbourhoods, including how they were using the local landscape in their daily lives, what they were taking from it and what they were benefiting from, and how the landscape was actually benefiting from their stewardship, management and behaviours.

The improved understanding (qualifiedly and quantifiably) which is gained of the riverine landscape allows for better design decision-making from designers who want to tackle local interventions while considering their relativity to other issues and the impact on people's lives. It also facilitates better partnering with other disciplines (within the Landscape Ecology module, refer to [180, 265]) and helps the designer build on collective intelligence already existing within the settlement.

6.5 Limitations

6.5.1 Limited integration with local actors as a result of the speed of transformation occurring on the ground

In light of the events unfolding parallel to this research within the neighbourhoods of Bukit Duri and Kampung Melayu, interaction became limited at points of critical change. The topic of river improvement became sensitised and this affected the perception of interviews and fieldwork undertaken. While the research was always carefully framed (as described in Ch1) to residents, the sensitive nature of land ownership, and the looming threat of relocation may have coloured responses. Knowledge and information on such topics emerged through informal conversations where we perceived that residents were open to talk. Concurrently to this, the physicality of the site was also quickly being affected. Based on this, interactions such as workshops, which were initially planned, would have been highly politicised as a result of these imminent events, and resultantly were removed from the study. A follow-up to this study could work to deliver the knowledge of transformations that has been acquired to local and government actors to inform the details of future transformations.

Amidst the platform of the work of the Landscape Ecology module, the research sought to inform the decisions of the Jakarta government and communities surrounding the future of the Ciliwung. Throughout the research, the module facilitated exhibitions, workshops and produced publications for the purpose of local (Indonesia and Singapore) and international dissemination. The exhibitions typically involved an interactive exhibition piece [67] which included printed panels, physical milled models, and videos, animations, slideshows, maps, and diagrams. The interactive installation demonstrated the breadth of the work carried out by the team and was found to be a digestible format from which team members could explain the project and concepts to a diverse audience.

6.5.2 Production of knowledge at the local landscape scale

Given the variability in landscapes and spatial scales within the research site, and coupled with our research methods (including probability and purposive sampling, and detailed spatial mapping), It was necessary for us to repeatedly concentrate our study, starting from the scale of the subdistrict (RW), and cross-referencing this with the community unit (RT), and the specific spatial model of each site. While on the one hand this method allows us to understand trends within the area, and the link between particular spatial and socio-cultural attributes, within our study we were not able to capture beyond the immediate urban context. As such, it is important that this study has been embedded within larger multidisciplinary work at the corridor scale (see [126, 223], which places it within its broader context.

6.5.3 Production of situated knowledge

Guntur Soeharjanto's fictional film 'Brandal-Brandal Ciliwung' (Ciliwung Troops, 2012) portrays life in an upstream neighbourhood along the Ciliwung River. In a minor scene, as the protagonists—a group of young boys—travel into the city to visit a friend, where upon catching a glimpse of the Ciliwung they observe that the river they know is barely recognisable due its deterioration. It is important to mention that each of the cross-sections within the case studies represents a particular moment in time; and should thus be considered as *situated knowledge*, and not a depiction of absolute reality across all times.

The extreme vulnerability to these sites means that individual sites may transform on a daily basis subject to environmental and human induced change (Ch 5). One such example is the influence of flood within neighbourhoods, whereby buildings that are destroyed may give way to open spaces and sediment washed downstream is used to create embankments. Another example that might be drawn on here are the evictions and land clearance in Kampung Melayu subdistrict, the socio-spatial impact of government induced transformation. These occurred during the writing of this thesis in August 2015 and have not been discussed within the study. While the knowledge created from these events would already need to be added to again to provide a holistic understanding of the effects of the evictions and land clearance, the wealth of information on tactics, behaviours and the effects of riverine landscape transformation within communities can provide valuable materials and methods for future transformations either within this site, in Indonesia, or elsewhere in Southeast Asia.

6.6 Conclusion and Outlook for the Ciliwung River

Traditionally in social science research the intention should never be to change the community or its members in any way. In this mixed-methods research, based on the complex political conditions and the extreme degradation of the site change was both inevitable and impending. In the early days of the research there had been little opportunity for community feedback on the government's proposal. Although the regulation leaves room for 'socialisation', in the research site this was mostly limited to the posting of technical plans and schematic visualisations within neighbourhoods, and official visits in the lead up to the 2014 presidential election. This research sought to be reciprocal, providing a platform for the communities surrounding the river to be involved in the discussion of an improved river, not only on an ecological level, but also on a cultural one.

Unfortunately, although multiple workshops and seminars were carried out over the course of the project, our hope to be able to positively affect the development trajectory of the Ciliwung River was unrealised because of the limitations described above.

The premise of the research, and its development and testing of methodological tools generated within the research investigations, provides rationale for ongoing research into regionally specific riverine amelioration practice in Indonesia and also Southeast Asia. There is the potential to explore the operational aspect of this approach in a number of ways. The first, is to continue to extend the research by adding in more case studies and working generatively toward design scenarios for sites. Communities, NGO's and local governments could be involved within this. The second, is to couple the methodology — which was heavily based on qualitative research — with quantitative methods in order to understand the impact of particular tactics on the carrying capacity of the river [265].

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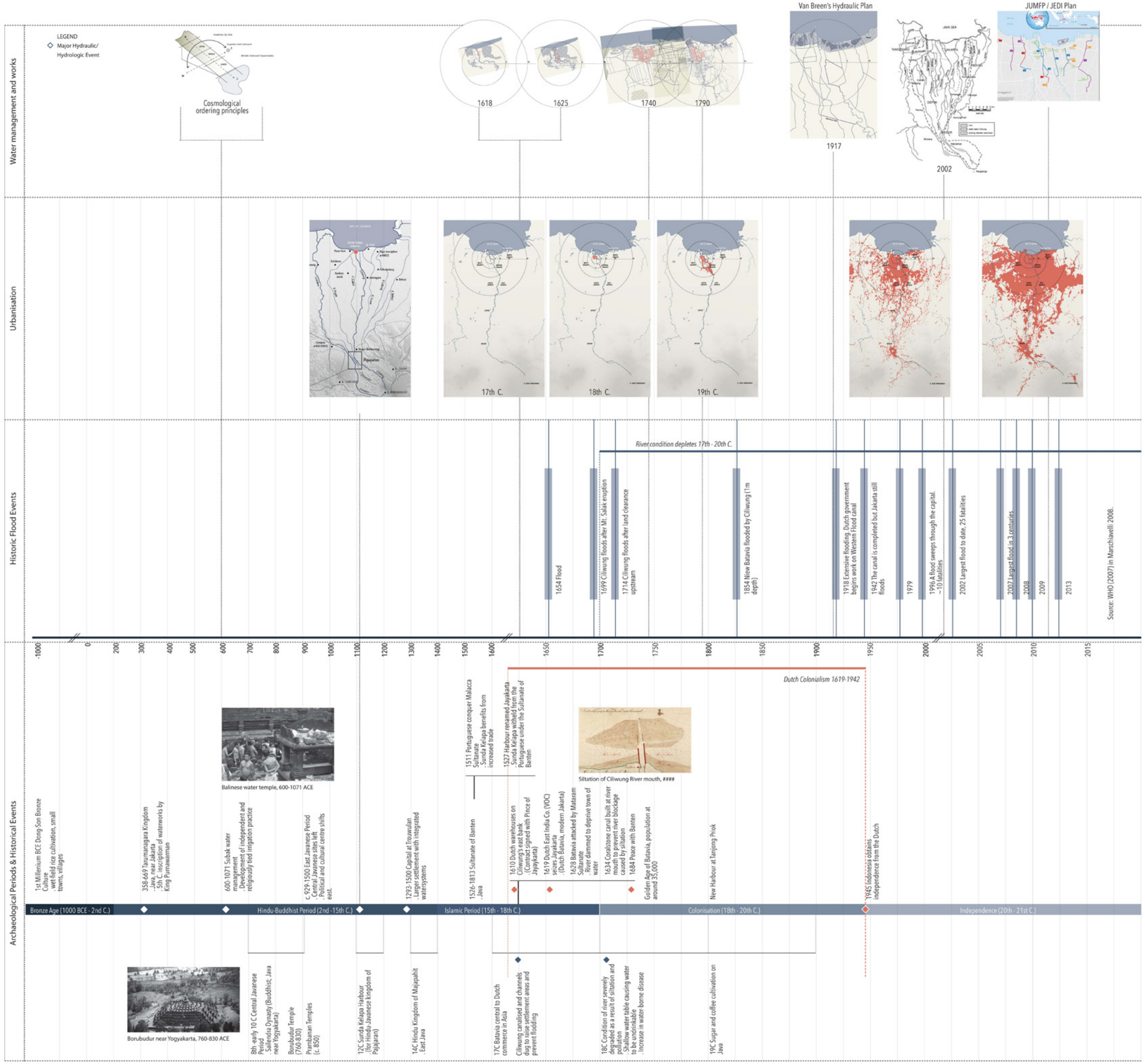
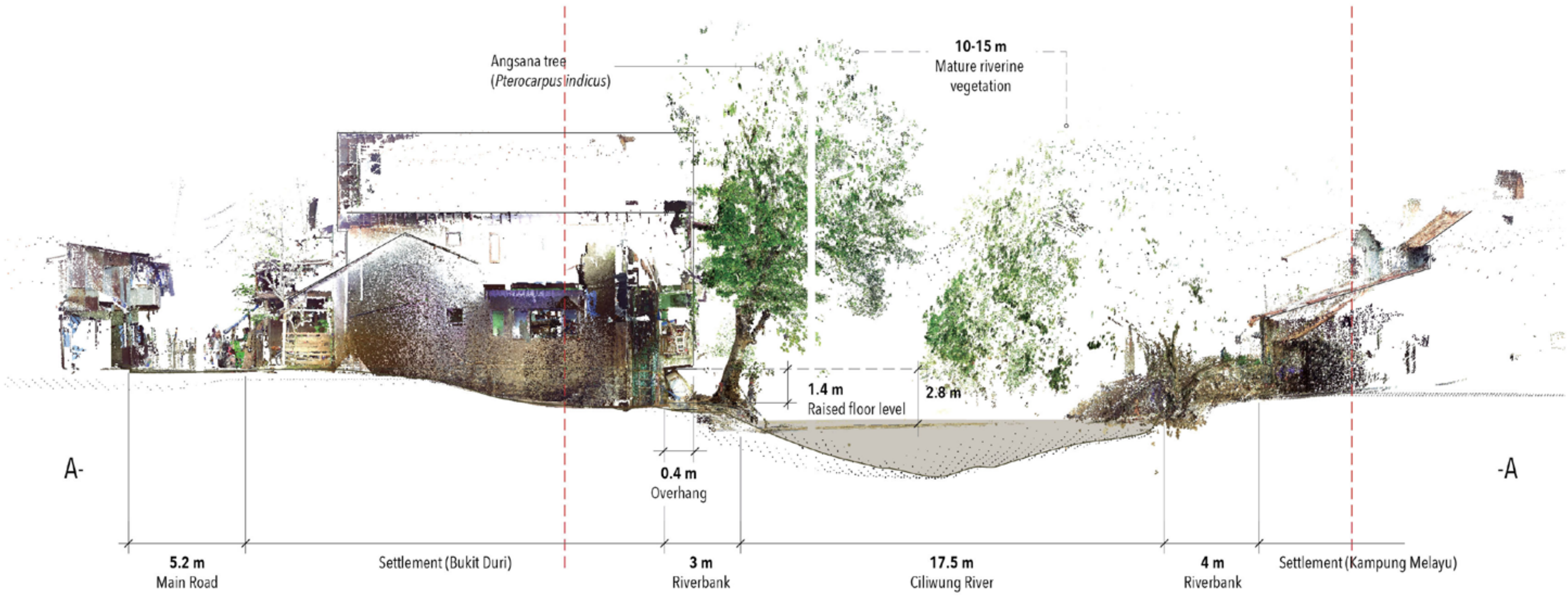
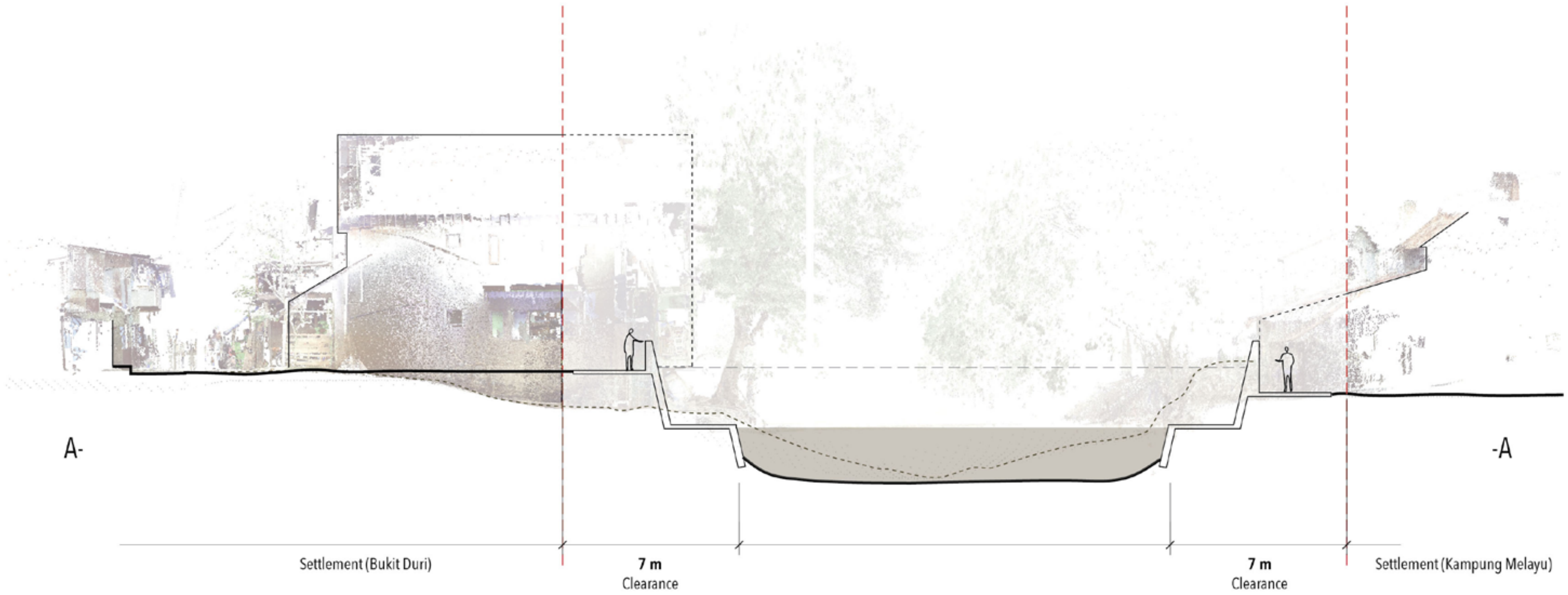
Appendix

WATER & SETTLEMENT: A select history of Indonesia centred on the Ciliwung, Jakarta

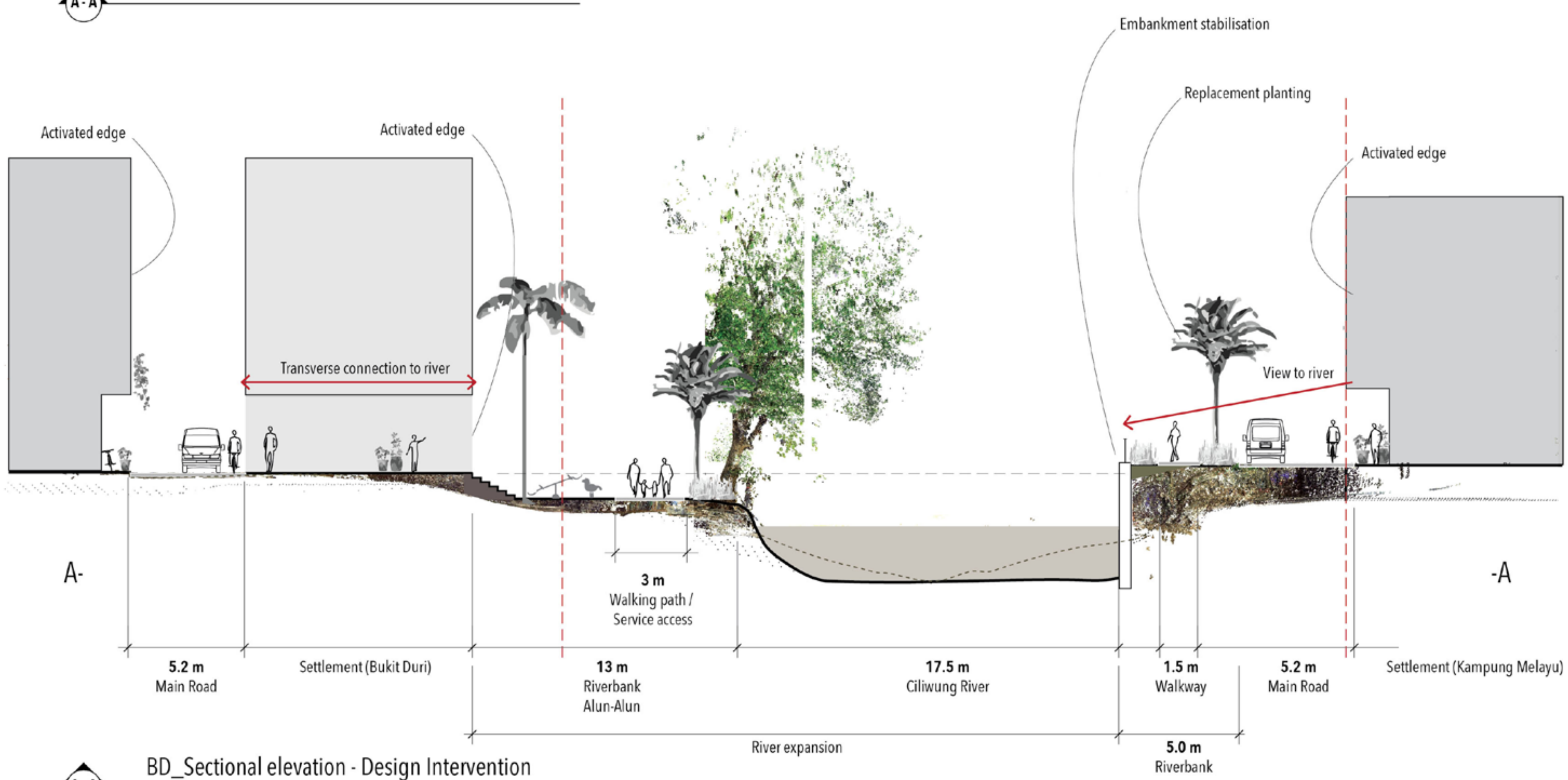




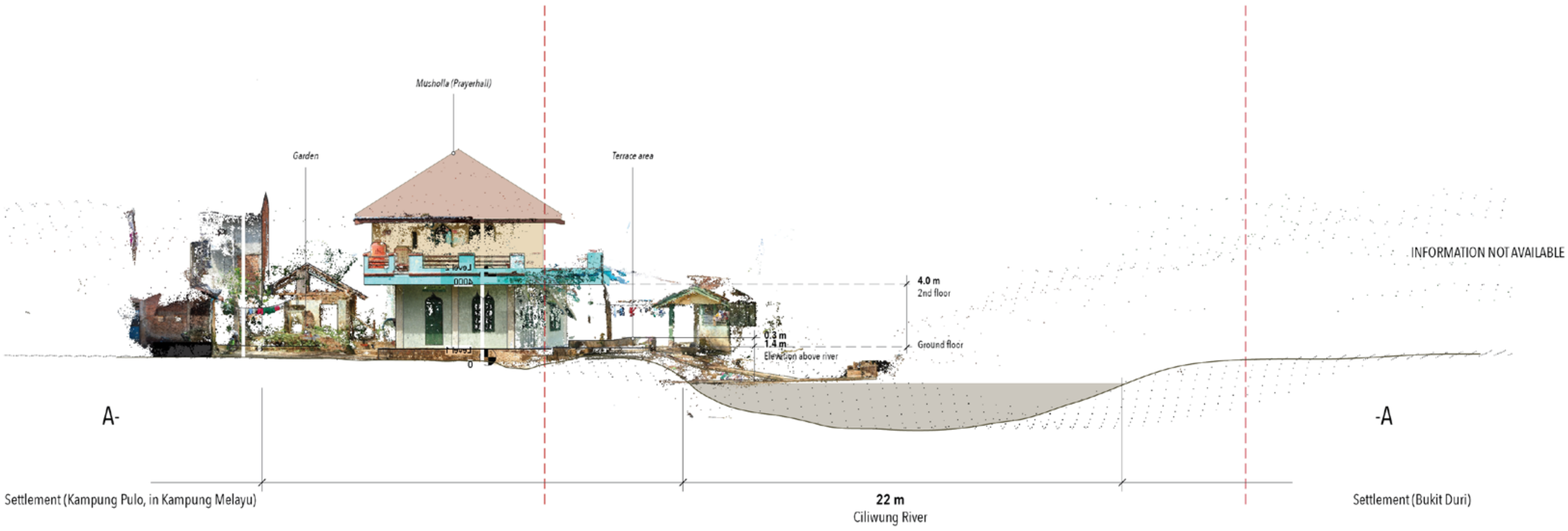
A-A BD_Sectional elevation - Local Intervention



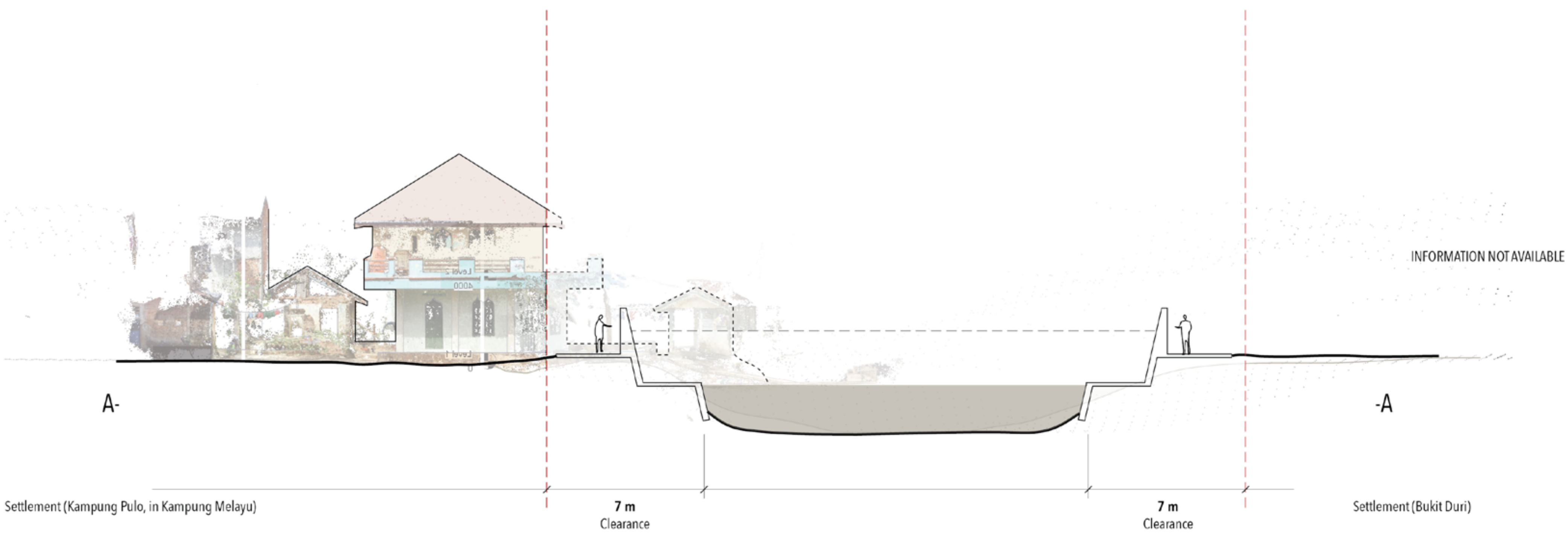
A-A BD_Sectional elevation - Government Intervention



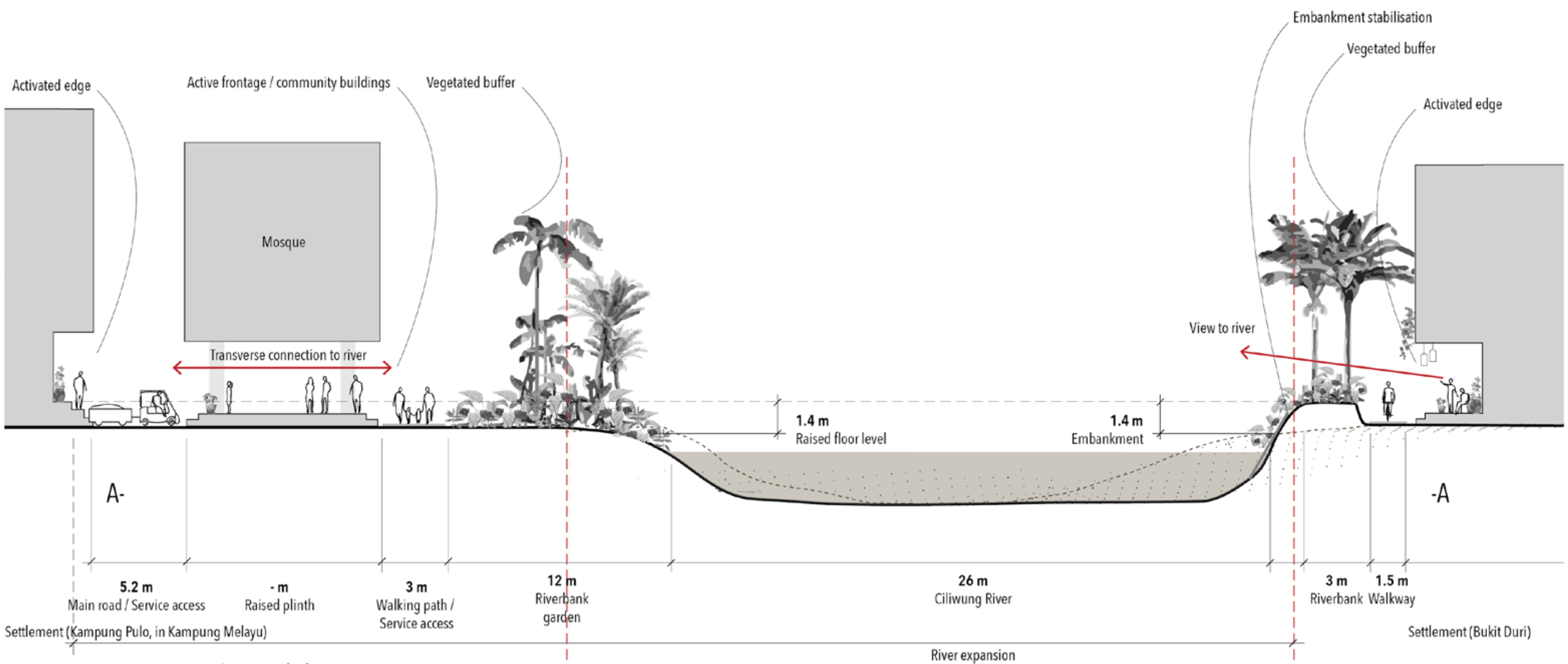
A-A BD_Sectional elevation - Design Intervention



A-A BD_Sectional elevation - Local Intervention



A-A BD_Sectional elevation - Government Intervention



A-A BD_Sectional elevation - Design Intervention

Local name	Common (English) name	*Botanical name*	Consumption	Medicinal	Shade	Ornamental	Superstition	Bank stabilisation	Bukit Duri (RW12)	Kampung Pulo (RW2)	Kebon Pala (var.)	
Plant type			**Plant use**						**Location**			**Count**
Adenium	Desert Rose	*Adenium Obesum*	○	●	○	○	○	○	●	○	○	1
Alpukat	Avocado	*Persia Americana*	●	○	○	○	○	○	○	●	○	1
Anggur	Grape	*Vitis Vinifera*	●	○	○	○	○	○	○	○	●	1
Angsana	Angsana tree	*Pterocarpus indicus*	○	●	○	○	○	●	●	●	●	4
Bambu	Bamboo	*Bambusa sp.*	○	○	○	○	○	●	○	●	○	1
Bangle	Cassumunar Ginger	*Zingiber Cassumunar*	○	●	○	○	○	○	●	○	○	3
Bawang	Spring Onion	*Allium fistulosum*	●	○	○	○	○	○	●	○	○	1
Bayam	Amaranth	*Amaranthus sp.*	○	○	○	○	○	○	●	○	○	1
Beruka Kamboja	Frangipani	*Plumeria sp.*	○	●	○	○	○	○	●	○	○	1
Bilimbik / Belimbing	Starfruit	*Averrhoa carambola*	●	○	●	●	○	●	●	●	●	5
Binahong	Heartleaf Maderavine	*Bassela Rubra*	○	●	○	○	○	○	●	○	○	2
Cabe	Chili Peppers	*Capsicum Annum*	●	○	○	○	○	○	●	○	○	1
Chilli	Chilli	*Capsicum sp.*	●	○	○	○	○	○	●	○	○	1
Delima	Pomegranate	*Punica Granatum*	●	○	○	○	○	○	●	○	○	2
Mahkota Dewa	God's Tree	*Macrocarpa phaleria*	○	○	○	○	●	○	○	○	●	1
Gambas / Oyong	Ridged Gourd	*Cucumis acutangulus*	●	○	●	○	○	○	○	●	●	2
Gelombang Cinta	Flamingo Lily	*Anthurium andraeanum*	○	○	○	●	○	○	○	○	●	1
Jahe	Ginger	*Zingiber officinale*	●	●	○	○	○	○	●	●	○	3
Jambu Air/ - Merah	Watery Rose Apple	*Syzygium aqueum*	●	○	○	○	○	○	●	●	○	4
Jambu Klutuk/ - Biji	Guava	*Psidium guajava*	●	○	○	○	○	○	●	○	○	2
Jarak	Castrobean	*Ricinus communis*	○	●	○	○	○	○	●	○	○	1
Jeruk	Orange	*Citrus Sinensis*	●	○	○	○	○	○	○	●	○	1
Kangkung	Water Spinach	*Ipomoea Aquatica Forsk.*	●	○	○	○	○	○	●	○	○	1
Kelapa	Coconut	*Cocos nucifera*	●	○	○	○	○	○	○	○	●	1
Kencur	Aromatic ginger	*Kaempferia galangal*	●	●	○	○	○	○	○	●	○	1
Kumis kucing	Cat's whiskers	*Orthosiphon aristatus*	○	●	○	○	○	○	●	●	○	2
Kunyit	Turmeric	*Curcuma longa*	●	●	○	○	○	○	●	●	●	7
Lidah buaya	Aloe vera	*Aloe vera L.*	○	●	○	○	○	○	●	●	●	4
Limau	Lime	*Citrus aurantifolia*	●	○	○	○	○	○	○	●	○	1
Lo / Elo	Cluster fig	*Ficus racemosa*	●	●	●	○	○	●	●	○	○	1
Mangga	Mango	*Mangifera indica*	●	○	●	○	○	○	●	●	●	6
Mayana	Coleus	*Coleus blumei*	○	●	○	○	○	○	●	●	●	5
Melati	Jasmine	*Jasminum sp.*	○	○	○	●	○	○	●	○	○	1
Nangka	Jackfruit	*Artocarpus heterophyllus*	●	○	○	○	○	●	●	○	●	2
Pace	Noni / Indian Mulberry	*Morinda Citrifolia*	●	○	○	○	○	○	●	○	○	1
Pandan	Screw pine	*Pandanus sp.*	●	○	○	○	○	○	●	○	○	4
Pepaya / Betik	Papaya	*Carica papaya*	●	○	○	○	○	○	○	○	●	2
Pisang Batu/ - Klutuk	Wild Banana	*Musa balbisiana*	●	○	○	○	○	○	○	●	○	3
Rambutan	Rambutan	*Nephelium lappaceum*	●	○	○	○	○	○	○	●	○	1
Salam	Indonesian Bay-Leaf	*Syzygium polyanthum*	○	●	○	○	○	○	●	○	○	1
Sawi hijau	Mustard Greens	*Brassica juncea*	●	○	○	○	○	○	○	●	○	1
Serai	Lemongrass	*Cymbopogon citratus*	○	○	○	○	○	○	●	○	○	1
Sirih kuning	Betel (Green)	*Piper betel*	○	●	○	○	○	○	●	○	○	2
Sirih merah	Celebes Pepper (Red)	*Piper ornatum*	○	●	○	○	○	○	●	○	○	3
Sirsak	Soursop	*Annona muricata*	●	●	○	○	○	○	●	○	○	3
Sisanya	-	-	○	○	●	●	○	○	●	○	○	1
Sugusugu	Node Weed	*Syndrella nodiflora*	○	●	○	○	○	○	○	●	○	1
Suji	Pleomele	*Dracaena angustifolia*	●	●	○	○	○	○	●	●	○	2
Temu kunci	Fingerroot	*Boesenbergia rotunda*	●	○	○	○	○	○	●	○	○	1
Temulawak	Java Ginger	*Curcuma xanthorrhiza*	○	●	○	○	○	○	●	○	○	1
Terong	Eggplant	*Solanum melongena*	●	○	○	○	○	○	○	●	○	1
Timun / Mentimun	Cucumber	*Cucumis sativus*	●	●	○	○	○	○	●	●	○	1
Timun mas	Lemon Cucumber	*Cucumis melo.*	●	●	○	○	○	○	●	●	○	1
Tomat	Tomato	*Solanum lycopersicum*	●	○	○	○	○	○	○	○	●	1
Ubi ungi	Purple Yam	*Dioscorea alata*	●	○	○	○	○	○	○	○	●	2
Plant type			**Plant use**						**Location**			**Count**
Local name	Common (English) name	*Botanical name*	Consumption	Medicinal	Shade	Ornamental	Superstition	Erosion control	Bukit Duri (RW12)	Kampung Pulo (RW2)	Kebon Pala (var.)	

A
B
C
D
E
F
G
A1
A2
A3
A4
A5
B1
B2
B3
B4
C1
C2
C3
C4
D1
D2
D3
D4
E1
E2
E3
E4
E5
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
F13
F14
F15
G1
G2
G3
G4

Michaela F. Prescott <prescott@arch.ethz.ch>
Module VII: Landscape Ecology
Singapore ETH Centre – Future Cities Laboratory

Kehidupan sehari-hari di Ciliwung

Introduction
Survei ini adalah bagian dari penelitian mahasiswa mengenai kehidupan sehari-hari masyarakat tepi sungai di Jakarta. Hasil dari survei ini akan digunakan untuk merancang ruang publik bagi masyarakat sepanjang Kali Ciliwung. Karena itu, pendapat para penduduk sepanjang sungai sangat penting untuk menghasilkan desain yang berarti.
Terima Kasih telah berpartisipasi dalam survei ini.

This survey is part of a student study of the daily life of riverbank communities in Jakarta. The results of the survey will be used to develop landscape designs for community spaces along the Kali Ciliwung. The opinions of the ordinary people, living along the river, are viewed as important.
Thank-you for participating.

Survey Questions:

1. Jenis kelamin (Gender)
    - Laki-laki (male)
    - Perempuan (female)

2. Umur (Age)
    - 18-34
    - 35-44
    - 45-54
    - 55-64
    - 65+

3. Jumlah anggota rumah tangga (Household size)
    - Type number

4. Kelompok etnis (Ethnicity)
    - Betawi
    - Jawa (Javanese)
    - Sunda (Sundanese)
    - Dan Lain-lain (other)

5. Sudah berapa lama anda tinggal di rumah ini? (How long have you lived in this house?)
    - Type number

6. Apakah ini rumah milik atau sewa? (Do you rent or own this property?)
    - milik (Own)
    - Sewa (Rent)

7. Apakah anda memiliki tanah di dekat sini? (Do you own other land near here?)
    - Ya (Yes)
    - Tidak (No)

8. Apakah tanah tersebut digunakan untuk keperluan sebagai berikut? (Is the land used for the following purposes?)
    - Rumah (house)
    - Ruang terbuka (open space)
    - Area bermain/Lapangan (playcourt)
    - WC/Toilet umum (public toilet)
    - Dan Lain-lain (other)

9. Bagaimanakah keluarga anda memanfaatkan area yang berada tepat di luar rumah anda? (Boleh menjawab lebih dari satu) (How does your family use the area right outside of your home?)
    - Untuk berjualan makanan/barang (To vend food / goods)
    - Usaha kerajinan/produksi (Handicraft / production and cooking)
    - Bermain (Play)
    - Pemancingan (Fishing)
    - Tempat duduk-duduk (Place to sit)
    - Tempat memelihara burung (Place an aviary (bird keeping))
    - Memasak (Cooking)
    - Mencuci baju (Washing clothes)
    - Mencuci piring (Washing dishes)
    - Mengurus anak (Childcare)
    - Tidur (Sleep)
    - Gudang/tempat menaruh barang-barang (Storage)
    - Tempat parker gerobak (Parking of cart)
    - Tempat parker kendaran (Parking of vehicle)
    - Bercocok tanam (Garden / cultivation)

10. Siapakah yang merawat rumah anda? (Who maintains your home?)
    - Saya dan keluarga saya (I maintain my home)
    - Yang lainnya (Another person maintains my home)

11. Apakah anda memelihara jalanan di luar rumah anda? (Misalnya: mebersihkan, memperbaiki) (Do you maintain the street outside your house? (For example: cleaning, repair))
    - Ya (Yes)
    - Tidak (No)

12. Apakah anda memelihara ruang lain atau fasilitas masyarakat lainnya? (Misalnya: membersihkan, memperbaiki) (Do you maintain any other spaces or other public facilities? (For example: cleaning, repair))
    - Ya (Yes)
    - Tidak (No)

13. Apakah tipe ruang atau fasilitas yang anda rawat tersebut? (What are the types of spaces or facilities you care for?)
    - Ruang terbuka (open space)
    - Lapangan bermain (playcourt)
    - WC/Toilet umum (public toilet)
    - Dan lain-lain (other)

14. Apakah anda memelihara tanaman? (Do you keep any plants?)
    - Ya (Yes)
    - Tidak (No)

15. Di manakah tanaman tersebut ditanam? (Where are they planted?)
    - Rumah (Home)
    - Pinggir kali (Alongside the river)
    - Ruang terbuka (Open space)

16. Seberapa sering anda memelihara/merawat tanaman tersebut? (How frequently do you care for your plants?)
    - Kurang dari satu kali seminggu (Less than once a week)
    - Satu kali seminggu (Once a week)
    - Satu kali sehari (Once a day)

Lebih dari satu kali sehari (More than once a day)

17. Untuk apa anda menanam tanaman tersebut? (For what uses do you keep vegetation?)
    Sebagai tanaman obat (As a medicinal plant)
    Untuk dimasak (For cooking and food preparation)
    Sebagai hiasan (As ornamental)
    Sebagai sumber pendapatan (As a source of revenue)
    Sebagai material bangunan (As a building material)
    Sebagai pencegah longsor pinggir kali (As erosion protection on the riverbank)
    Sebagai peneduh (For shade)

18. Apakah ada tanaman tertentu yang penting bagi keluarga anda? (Is any of your vegetation of particular importance to your family?)
    Ya (Yes)
    Tidak (No)

19. Apakah anda menanam dan memetik hasil dari tanaman-tanaman atau pohon sepanjang sungai? (Do you harvest from vegetation growing along the river?)
    Ya (Yes)
    Tidak (No)

20. Untuk apa anda menanam di sepanjang sungai? (For what uses do you harvest from the vegetation?)
    Sebagai tanaman obat (As a medicinal plant)
    Untuk dimasak (For cooking and food preparation)
    Sebagai sumber pendapatan (As a source of revenue)
    Sebagai material bangunan (As a building material)

21. Seberapa sering anda pergi ke sungai? (How often do you go to the river?)
    Tidak pernah (Never)
    Tiap tahun (Every year)
    Tiap bulan (Every month)
    Tiap minggu (Every week)

22. Apakah anda menyeberangi sungai dengan rakit/getek/perahu? (Do you cross the river by raft / getek / boat?)
    Ya (Yes)
    Tidak (No)

23. Apakah anda menggunakan sungai untuk kegiatan non-rekreasi? (Do you use the river for non-recreation functions?)
Air untuk keperluan rumah (Water for domestic use)
Sebagai WC/toilet (Toilet)
Mencuci/mandi (Washing)
Tidak (None)

24. Apakah anda menggunakan sungai untuk kegiatan rekreasi? (Do you use the river for recreation functions?)
    Pasif (Misalnya jalan-jalan atau duduk-duduk) (Passive (including walking and sitting))
    Aktif (Misalnya memancing atau berenang) (Active (including fishing and swimming))
    Tidak (None)

25. Ke manakah anda membuang sampah? (Where do you dispose of waste?)
    Sungai (river)
    Lainnya (other)