City of Water:
Architecture, Urbanism and the Floods of Phnom Penh

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ABSTRACT

The following is a summary of ongoing research conducted in 2011-2012, funded in part by the Fulbright Program and entitled *City of Water: Architecture, Urbanism and the Floods of Phnom Penh.* This work documents the relationships between water, architecture, and infrastructure in Phnom Penh, Cambodia. The objective of the project is to record the architectural and urban conditions sustained by and subject to the cyclical floods of the city's rivers and the challenges faced by Phnom Penh as it rapidly urbanizes in a flood plain.

1. INTRODUCTION

This research is an ongoing project to document the relationships between water, architecture and infrastructure in Phnom Penh, Cambodia. The objective of this work is to record the architectural and urban conditions sustained by and subject to the cyclical floods of the city's rivers and the challenges faced by Phnom Penh as it rapidly urbanizes in a flood plain. This work began several years ago, inspired by a quote from Cambodian architect Vann Molyvann:

> "...the privatization and decentralization of the last 15 years threaten to scar Phnom Penh's landmarks and wreak havoc with its water management... in the event of a major flood three hundred thousand people would lose their homes… you can't imagine what could happen here.'' (Steinglass, 2005)

The aftermath of Hurricane Katrina, gave context to the questions that would eventually become City of Water. In 1718, the French explorer Jean Baptiste Le Moyne, Sieur de Bienville, located the city of New Orleans "thirty leagues above the entrance to the Mississippi." He selected the site on behalf of the future French colony's commercial interests. As Raymond Campanella notes in *Bienvielle's Dilemma,* locating New Orleans on a swamp was counterintuitive yet geographically logical. "Indeed, this is a challenging site for a major city," he writes. "Yet Bienville acted wisely in selecting it because he knew what makes a city great is not its site, but its situation." For Campanella, 'site' refers to the city's actual physical footing; 'situation' to its historical and cultural context and how it connects with the world. (Campanella, 2008).

Phnom Penh's 'site' at the confluence of the Mekong, Tonlé Sap, and Basaac rivers is precariously balanced with its rapid development and linked to its 'situation' – the traces of its history as a French Protectorate, the era of independence and prosperity which followed, the Khmer Rouge occupation, and the contemporary conditions which define the present day city and anticipate its future.

Thank you to the Fulbright U.S. Student Program for funding this project, to Khmer Architecture Tours

for their support, and especially thank you to the countless architects and students who shared their thoughts, resources and time during my time in Cambodia.

2. RESEARCH METHODS + ACCESS TO INFORMATION

The nature of hyper-contemporary documentation and the question of how to successfully document a rapidly developing city as it is changing are ongoing challenges for this research. Here the hyper-contemporary is defined by temporal immediacy and necessitated by the speed of continuous urban transformation. This work benefits neither from the passage of time nor a collection of available academic resources. The realties of obtaining data and conducting academic research in a developing country result in the larger question: what is design's agency to operate in this environment?

For these reasons this work necessarily inhabits a space between journalism and formal academic writing. As the speed of global urban development continues to increase, these strategies of hyper-contemporary documentation and analysis will become increasingly valuable methods for reading the city.

Cambodia is a post-conflict country with a very opaque government. Much original archival material has been moved to collections in the United States and France, the local universities do not have a coherent library system, and Non-Governmental Organizations (NGOs) often do not coordinate or share their data. Government municipalities are difficult to gain access to and often do not have or will not share documents.

Available and accurate urban data for Phnom Penh are almost non-existent. Much of this data does not exist or is not in the public domain. This includes, contemporary, verifiable and publicly available digital maps of Phnom Penh to describe land use, building footprints, roads, building heights, and topography. A dedicated group of mapmakers and Geographic Information System (GIS) users, known as the Open Development Cambodia and Phnom Penh Mapping Meet-Up, has worked to collect and disseminate open source map data for Cambodia, including most notably an ongoing effort to increase the accuracy of Open Street Map.

Consequently, much of this research was conducted through observation, photographs, analytic drawings, video, informal conversations and interviews. Where available, historic maps and archival material supplement this work. Many of the maps, documents and data came without citation or sources from friends and colleagues here in Phnom Penh. Several people provided data on the condition that I neither distribute it yet nor source it. The goal of sharing: to have it in the public domain but not at the cost of relationships or employment.

For example, an AutoCAD map of the city has been in circulation since 1996 among architecture students, yet the original author and intent of the map are long forgotten. A seven-month search for a high-resolution topographic map of Phnom Penh ended with an anonymous Dropbox folder link.

As a result, a tenet of this research is to share all of the documents, drawings and data I have gathered or produced through this work. These documents can be found at www.cityofwater.wordpress.com. I began the website as a tool for gathering research and it has evolved into an effective resource for urban scholars of Phnom Penh.

While the intent of this work is to convey the contemporary conditions of the city, its historic context is crucial to understanding these conditions. French planning decisions in the 19th century and decades of war combined to create the physical and conceptual framework that defines the challenges facing Phnom Penh today. My discussion of the historical context is not intended to be comprehensive but to provide a sense of how history has defined the options available. While little design literature exists about Phnom Penh, the resources I relied upon are: Vann Molyvann's *Modern Khmer Cities*, Helen Grant Ross and Darryl Leon Collins' *Building Cambodia: 'New Khmer Architecture' 1953-1970*, and Penny Edwards's *Cambodge: The Cultivation of a Nation 1860-1945*.

3. SITE: PHYSICAL CONTEXT

3.1 Mekong Delta

Cambodia's capital, Phnom Penh, is located at the confluence of the Mekong, Tonlé Sap, and Basaac rivers, an intersection known as the 'Four Faces' or 'Chaktomuk'. (Figure 2) The city is home to 1.5 million people, many of whom live and work along its riverbanks. Millions more Cambodians are sustained by these rivers, their flood cycles, and the accompanying deltaic landscape. The result is a topography defined by an intense interdependence between the inhabitants of the region and its rivers.

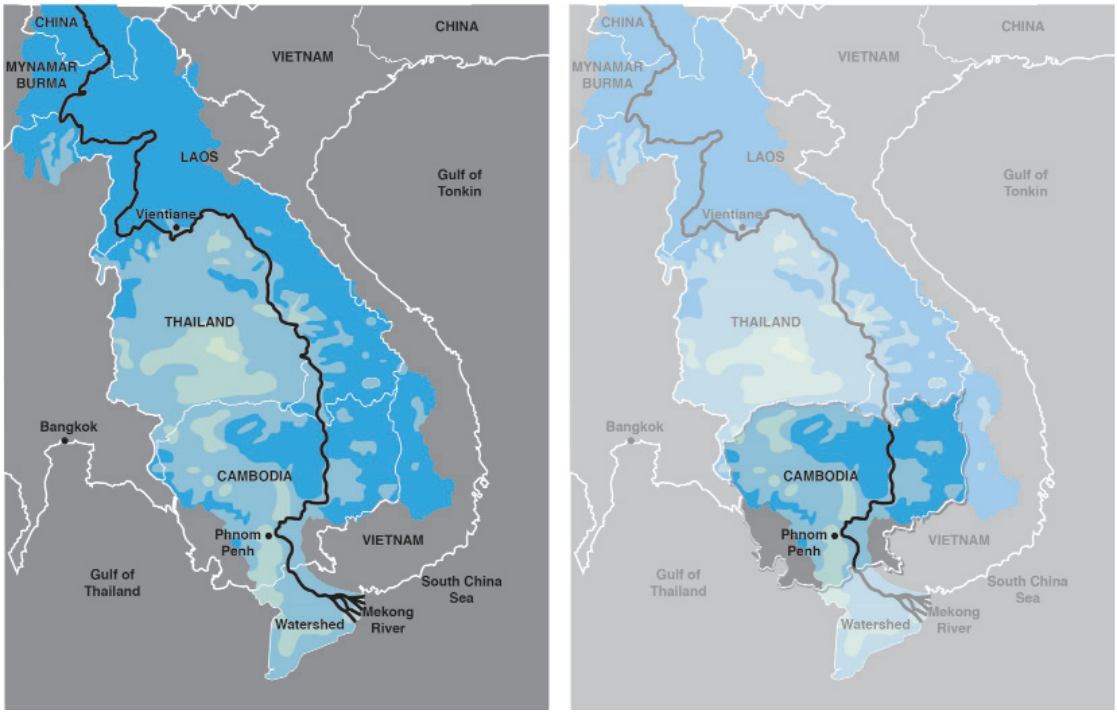

Figure 1:
The Mekong River begins in the hills of Tibet and flows down through China, Myanmar, Laos, Thailand, Cambodia, and Vietnam and into the South China Sea. River is shown in black, the areas in blue indicate the flood plain and tributaries.

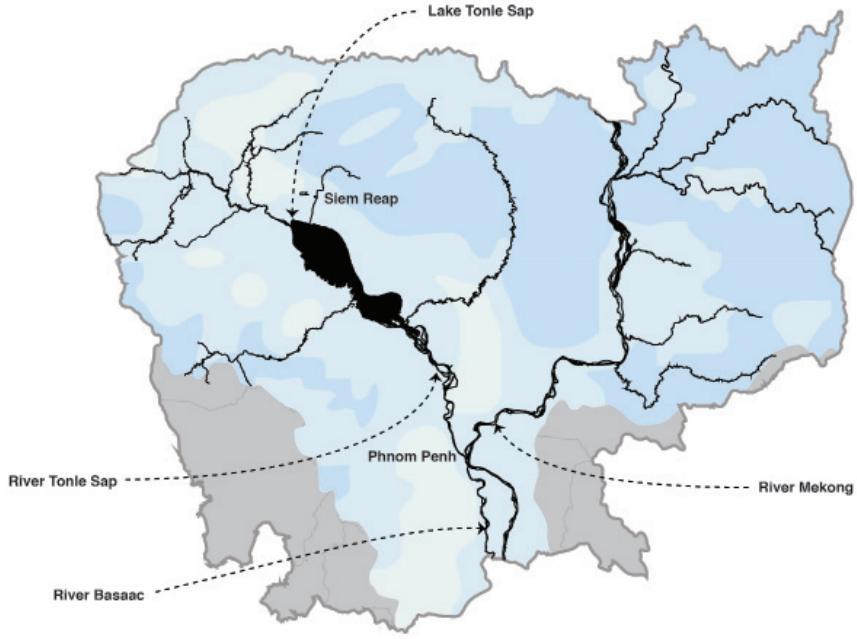

Figure 2:
Cambodia's capital, Phnom Penh, is located at the confluence of the Mekong, Tonlé Sap, and Basaac rivers, an intersection known as the 'Four Faces' or 'Chaktomuk'.

More than a third of the population of Cambodia, Laos, Thailand and Vietnam – nearly 60 million people – live in the Lower Mekong Basin, using the river for drinking water, food, irrigation, transportation and commerce. Additionally, millions more in China, Myanmar and beyond the Basin benefit from Mekong River hydroelectric power production. Beyond these human connections the river also powerfully demonstrates the scope for shared interest and competition. The Mekong has influenced political boundaries and conflicts for thousands of years including the Angkorian Empire, which once included the entire Lower Mekong Basin. (Figure 1)

Most notably, the 12th century Khmer capital of Angkor was home to approximately one million people and to an elaborate water management network, including flood-control infrastructure. Although there is no consensus among scholars regarding the reasons for Angkor's demise, one argument is that the Empire's collapse was brought on by the economic consequences of substantial modifications to the landscape, and unpredictable events such as flooding and warfare.

3.2 The Flood Pulse

Each year, monsoons and snowmelt cause the Mekong River to flow into the Tonlé Sap with such force at their intersection in Phnom Penh, that the Tonlé Sap reverses flow and floods the surrounding region to roughly four times its dry season area and depth, resulting in one of the most delicate and diverse ecosystems in the world (Figure 3).

This seasonal flood pulse sustains the region. The Basin's fisheries are replenished, floodwater is stored for use in the dry season, flood-deposited sediments improve soil fertility across the Mekong flood plains, and groundwater aquifers are recharged. Conversely, severe flooding results in the loss of life, damage to agriculture, property and infrastructure, and can cause the disruption of social and economic activities throughout the Lower Mekong Basin.

According to the Mekong River Commission the economic benefits of this flood pulse far outweigh its consequences. Average annual flooding costs range from $60-70 million while the benefits of the flood annually range from $8-10 billion (Mekong River Commission, 2012). Therefore, flood management must achieve a delicate balance: to preserve the benefits of the flooding while reducing the costs and impacts to life and property. As Phnom Penh rapidly urbanizes in the flood plain, achieving this balance becomes increasingly urgent.

3.3 2011 Floods

The 2011 floods were the worst Cambodia has seen since 2000 and far exceeded their typical reach. The flooding displaced more than a million Cambodians, leaving hundreds dead, destroying thousands of acres of crops and stranding many without aid for weeks due to lack of governmental and NGO coordination (Figure 3).

The 2012 rainy season began in May and heavy rains and flooding have already caused damage. According to the National Committee for Disaster Management, recent storms killed 10 people, injured 60 people, destroyed almost 700 houses and damaged many more (Yuthana and Freeman, 2012). With several months of rainy season storms

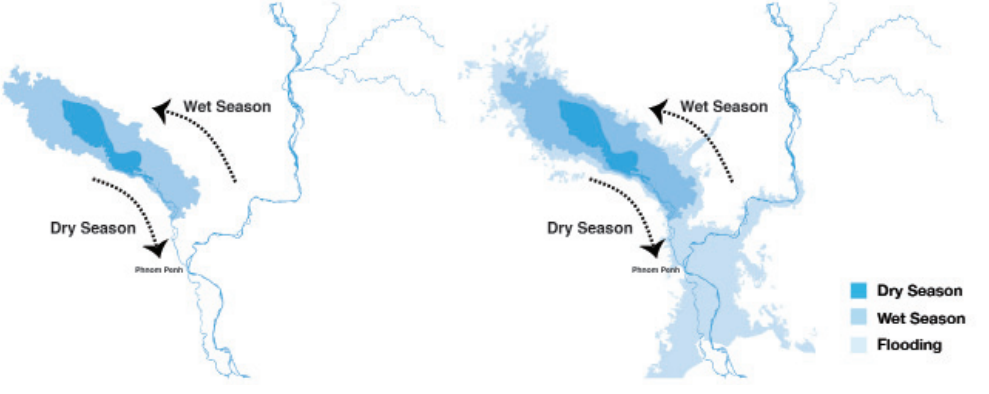

Figure 3:
Left: Map of a typical Tonlé Sap Flood Surge. Right: Map of the 2011 floods redrawn by author from a United Nations Map

remaining, these numbers present an important question: Are floods of this magnitude increasing in frequency and does Cambodia have the emergency infrastructure to respond?

3.4 Climate Change

According to the World Wildlife Federation, "The Greater Mekong is one of the most vulnerable places on Earth to the impacts of climate change." For the Mekong, climate change compounds existing and projected threats affecting the region's people, biodiversity and natural resources. This is likely to have cascading effects, such as water scarcity leading to reduced agricultural productivity, leading to food scarcity, unemployment and poverty (World Wildlife Fund, 2009a).

Among lower Mekong Basin countries, Laos and Cambodia are identified as the most vulnerable in part because of their limited capacity to cope with climate related risks. In all countries, climate change complicates existing problems such as poverty and lack of infrastructure.

According to a recent United Nations report, "Warming temperatures and changes in precipitation patterns will significantly impact Cambodia and, specifically, Phnom Penh. A recent mapping assessment identified Cambodia as being particularly vulnerable to climate change because of climate impacts such as droughts, floods, and sea level rise and the country's relatively low adaptive capacity. While Phnom Penh has slightly more financial capacity to respond to climate change impacts, its relatively low elevation, proximity to the ocean and the Mekong River make it particularly vulnerable" (World Wildlife Fund, 2009b).

Unfortunately, flooding is not the only threat to Phnom Penh and its residents. Changing precipitation patterns may also adversely affect the quantity and quality of water supplies to the city and result in negative consequences for millions of people. Other threats include the impact of tropical cyclones, which have increased over the last few decades and are projected to further increase in frequency and intensity. Rising sea levels will also affect Phnom Penh's fresh water availability by increasing saltwater inundation of low-lying areas

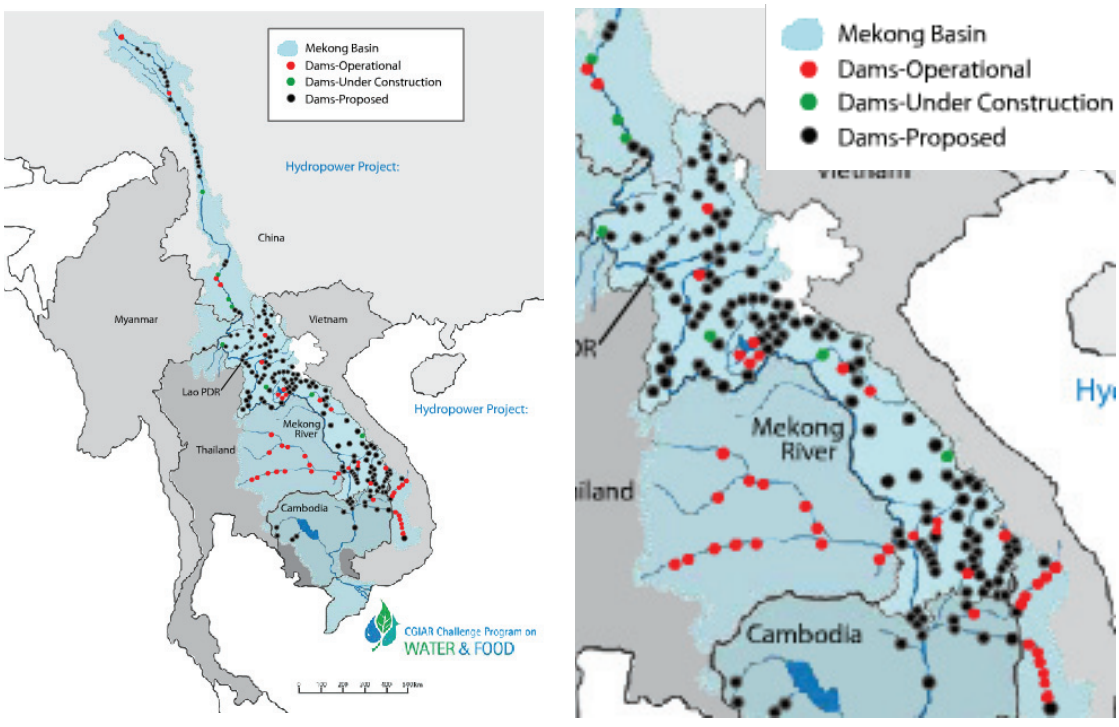

Figure 4:
Map showing Existing, Under Construction and Proposed Mekong Dams. Source: CGIR Water & Food Conference

Figure 5:
Kampong Khleang a floating and stilted village on the Tonlé Sap Lake during dry season. These villages are dependent upon the Tonlé Sap flood surge for food production, primarily fishing and agriculture. Photo by author.

and contributing to coastal erosion. Unfortunately, loss of natural coastal land, including mangrove forests, will lead to further erosion and damage as mangroves provide a buffer against storms and storm surges (World Wildlife Fund, 2009b).

3.5 Upstream Damming

Another pressure on the development of Phnom Penh is upstream damming of the Mekong River. While hydropower presents great economic and energy gains, concerns have intensified over the potential cumulative impacts that proposed schemes have on the environment, fisheries and people's livelihoods in the Lower Mekong Basin (Figure 4).

The debate is a divisive topic. An increase in power demand, volatile prices in international energy markets, and concerns over carbon emissions have intensified interest in renewable energy technologies and hydropower development. Some large hydropower projects in the Lower Mekong export their electricity at a profit; governments see these potential earnings from hydropower development as a means for reducing poverty, lowering national debts, as well as achieving regional economic prosperity and energy security.

Additionally, there is no conclusive research on how dams will impact the region's flood cycles. While damming may exacerbate flooding, there is greater concern that dams could reduce the flow of the Mekong and reduce the volume of water reversed into the Tonlé Sap, which would have devastating consequences on the livelihoods of millions of Cambodians (Figure 5).

4. SITUATION: HISTORIC CONTEXT

4.1 French Protectorate

Following the fall of the Angkor Empire, the Cambodian capital moved first to Phnom Penh (1432 to 1505) then several times over the centuries between Tuol Basan, Pursat, Longvek, Lavear Em and Udong (Figure 6). In 1863, Cambodia became

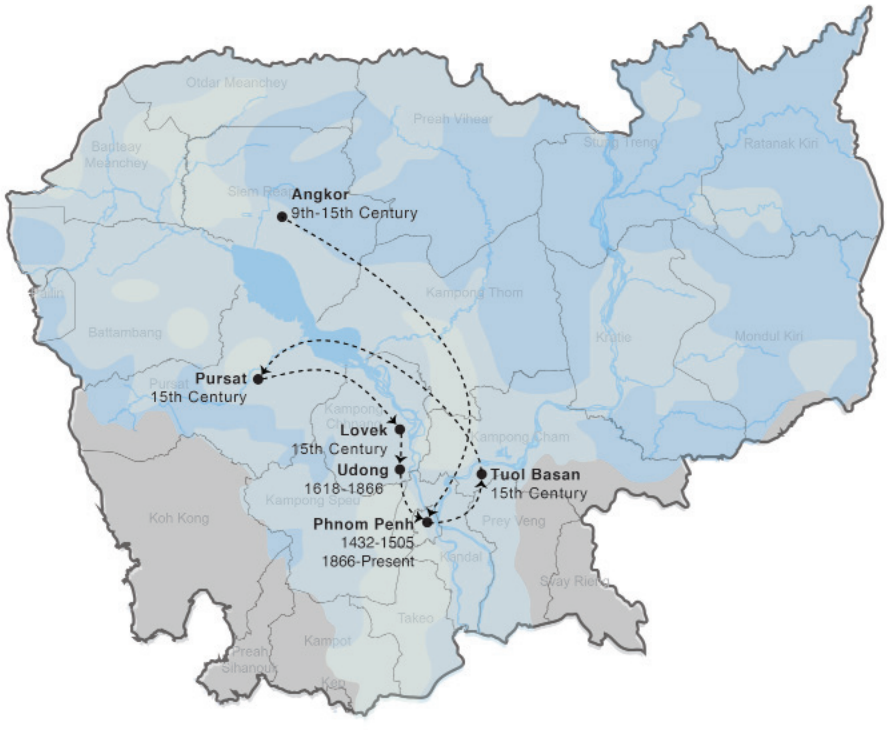

Figure 6:
The location and dates of the Cambodian capital city. Map redrawn by author from historic maps.

a protectorate of France and Phnom Penh was reinstated as the capital. This was an important move as it not only positioned Phnom Penh as an international trading hub but also placed the Cambodian capital within the Mekong flood plain.

Penny Edwards writes in *Cambodge:* In the early years of the Protectorate, "the city was best known for its vast tracts of mosquito-infested swampland, the stench of stagnant water and human waste, and frequent outbreaks of cholera. In the wet season, boat travel was necessary between different sections of Phnom Penh" (Edwards, 2007).

According to architectural historian Helen Grant Ross (2005), one of the most significant changes introduced by the French was the authorization of construction on land only. This policy contradicted both Khmer law and tradition, which posited that the King owned all of the land and that construction required his consent, which was typically granted only for palaces, temples and monasteries. Therefore at the time of French arrival in 1863, Phnom Penh's building pattern reflected this tradition: the city had grown linearly along the banks of the river, stilted above the water or floating upon the water itself. The architecture was constructed primarily of wood, thatch and lightweight materials that could be seasonally repaired and replaced as necessary (Figure 7). This construction model also protected the city from floodwaters by capitalizing on the riverbank's natural berm as well as a series of *preks* - constructed earthworks that control flooding and produce intentional dry season ponds.

The decision to move all construction inland had radical implications upon the future development of the city. The French colonists began the task of transforming the riverside village into a geometric cityscape that paid tribute to Rene Descartes' vision of a "well-ordered town laid out on a vacant plane as suits (the engineer's) fancy" (Edwards, 2007). They began this process by projecting a rectilinear street grid of concrete and stone onto the marshy wetland and perpendicular to the river. During the early years of the protectorate the colonial administration made various attempts to resolve the recurrent problem of flooding by filling in several small natural lakes and digging a series of interlinked canals to provide better drainage. These canals also served to physically segregate Phnom Penh into quartiers, based primarily on the ethnicity of residents. These

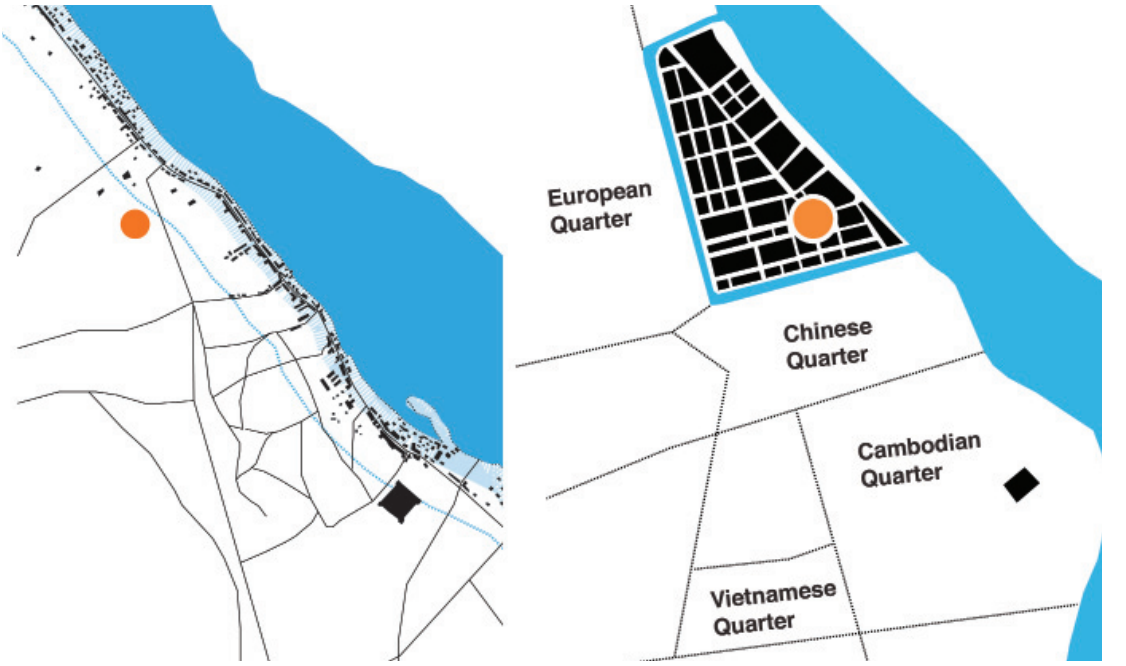

Figure 7:
Left: 1867, before the French Protectorate Phnom Penh was developed linearly along riverbank and over the water. Right: 1890, after the French Protectorate the city became gridded and developed using French planning methods. The orange circle denotes Wat Phnom. Both maps redrawn by author from historic maps.

comprised a quartier Cambodgienne, *a quartier Annamite, a quartier Chinoise and a quartier Européen* (Figure 7).

The most important canal was built in 1894, effectively encircling the quartier Européen, and partially separating it from the rest of the city. This canal began at the Tonlé Sap, ran east to west along Quai Vernéville (now Street 106) and ran north to south along boulevard Monsignor Miche (now Monivong Boulevard), before curving eastwards again to flow into the Tonlé Sap at the end of boulevard Charles Thomson (now France Street 47) at the site of a former bridge, the Pont de Vernéville.

Through the 1890s the development of French Phnom Penh grew under the direction of architect and town planner Daniel Fabre (1850-1904) whose work also included several buildings, most notably the Central Post Office, and the renovation of Wat Phnom. In 1925, architect and town-planner Ernest Hébrard drew up a plan for the extended urbanization of Phnom Penh, which was published in the same year in l'Éveil économique de l'Indochine, an economic publication of French Indochina. Thereafter, the Indochina Town Planning Service (Service de l 'architecture et de l'urbanisme de *l'Indochine*, founded by Hébrard two years earlier in Hà Nội) was responsible for overseeing the systematic development and rationalization of much of Phnom Penh.

4.2 The Golden Age

In 1940, the French Vichy government allowed Japanese troops to enter Indochina, which then became an autonomous province of the Japanese empire and was eventually annexed by the Japanese Empire in 1945. Consequently, H.M. King Norodom Sihanouk declared an end to the French protectorate. However, with the defeat of Japan and the arrival of allied forces, French colonial rule was reinstated until November 1953, when Cambodia at last gained its independence.

In 1955, Norodom Sihanouk abdicated the throne to his father H.M. King Norodom Suramarit. No longer a monarch, Norodom Sihanouk began to build his vision of a new nation. Norodom Sihanouk was a composer, writer, poet and lyricist, filmmaker, interior designer, and patron of the arts. His independent Cambodia was open to international ideas and eager to emerge from its French colonial past.

Figure 8:
Top Left to Right: 1867, 1890, 1910
Middle Left to Right: 1922, 1947, 1953
Bottom Left to Right: 1958, 1963, 1993

This series of maps describes the urban growth of downtown Phnom Penh (inner four kahns or districts) from the beginning of the French Protectorate until the UNTAC period. The outlined blocks denote present day blocks and the black infill the time of their construction. Green lines demonstrate roads which served as levees and demarcated the edge of infilled areas.

Redrawn by author from Bureau of Urbanism maps.

The city of Phnom Penh became a physical manifestation of independent Cambodia through a movement known as New Khmer Architecture, which blended modern architecture principles with Cambodian tradition. This period of innovative architecture and urban planning made Phnom Penh known as the 'Pearl of the Asia'.

This period is best known through the designs of Cambodian architect Vann Molyvann. In 1926, Vann Molyvann obtained a scholarship to pursue his studies in Paris, France, and completed an architecture degree at the School of Fine Arts in Paris (Ecole Nationale Supérieure des Beaux-Arts). He studied in the Arretche studio and returned to Cambodia in 1956, the first fully western-trained Cambodian architect. Upon his return he was appointed Head of Public Works and State Architect by Norodom Sihanouk.

The Vann Molyvann Project, which aims to preserve and disseminate his work, says of Vann Molyvann: he "adapted a modern vocabulary to Cambodia's culture, climate, geography and its vernacular and ancient architectural traditions. In particular, the buildings elevate what we now call 'green' technologies—double roofs, cross-ventilation, brise-soleils, indirect lighting, evaporative cooling, use of local materials—into exquisite architectural form" (The Vann Molyvann Project, 2012).

Building characteristics of New Khmer Architecture include sloped roofs, tapered columns, and raised first floors. These buildings recall traditional Khmer forms and living practices but are constructed using modern materials such as steel and concrete, and embody new programmatic types, such as libraries, concert halls, and stadiums. The New Khmer Architecture movement came abruptly to an end in 1970 with the overthrow of Norodom Sihanouk by General Lon Nol and the subsequent civil war.

Well known New Khmer Architecture projects include: the Olympic Stadium, Chaktomuk Conference Hall, several buildings at the Royal University of Phnom Penh, most notably the round Library and the hyperbolic parabaloid roof shelled Exhibition Hall. Additionally, larger scale projects such as the Basaac riverfront redevelopment included the now crumbling 'White Building', which is under threat of demolition and redevelopment. Like many other New Khmer Architecture projects which survived civil war, American bombings, the Khmer Rouge and the Vietnamese occupation, the 'White Building' is now a victim of the rapid and chaotic development of Phnom Penh and the lack of available preservation opportunities (Figure 9).

Figure 9:
Top to Bottom: The White Building Basaac Riverfront, Library Royal University of Phnom Penh, Exhibition Hall Royal University of Phnom Penh, National Sports Complex 'Olympic Stadium'. All located in Phnom Penh. Photos by author.

4.3 The Khmer Rouge

Everything in Phnom Penh changed on April 19, 1975. The Khmer Rouge waged war upon the city and its population as emblems of capitalism and corruption.

Figure 10:
Evacuation routes from Phnom Penh. Redrawn by author from images provided at Choeung Ek also known as 'The Killing Fields'.

David Chandler writes in Pol Pot: Brother Number One that: "within twenty-four hours the young combatants ordered everyone in Phnom Penh to evacuate the city... the forced evacuation of the cities was the most far-reaching decision any modern Cambodian government ever took" (Chandler, 2009) (Figure 10).

By 1975, just prior to the city's fall to the Khmer Rouge, Phnom Penh's population had swollen to 2 million people as rural Cambodians fled American bombing and Lon Nol's civil war in the countryside. Following the forced evacuation of the population by the Khmer Rouge in April 1975, approximately 50,000 people remained in Phnom Penh as the new government set about to radically reorganize Cambodia in their utopian vision of a rural, agriculture-based communal society. Property ownership was eliminated and the urban development of Phnom Penh ceased.

Estimates of the total number of deaths resulting from Khmer Rouge policies, including disease and starvation, range from 1.7 to 2.5 million, approximately one quarter of the country's population of 8 million. The list of those purged was long and arbitrary. Although Vann Molyvann escaped the Khmer Rouge by fleeing to Switzerland, not everyone in the design community was so fortunate. Their loss created a void in the education and continuity of the profession, severing contemporary practice from the time of New Khmer Architecture. The ramifications of this lost generation have far-reaching and still developing impacts on contemporary architecture and planning practice within Cambodia.

5. SITUATION: CONTEMPORARY PHNOM PENH

5.1 Rapid Population Growth

In 1979, communist Vietnam invaded Democratic Kampuchea and toppled the Khmer Rouge regime. Vietnamese occupation continued until peace talks began in Paris in 1989 under the State of Cambodia, culminating two years later in October 1991 in a comprehensive peace settlement. The United Nations Transitional Authority in Cambodia (UNTAC) mandated to enforce a ceasefire, address refugees and disarmament. A new Cambodian government was installed in 1993, a constitutional monarchy operated as a parliamentary representative democracy (Figure 11).

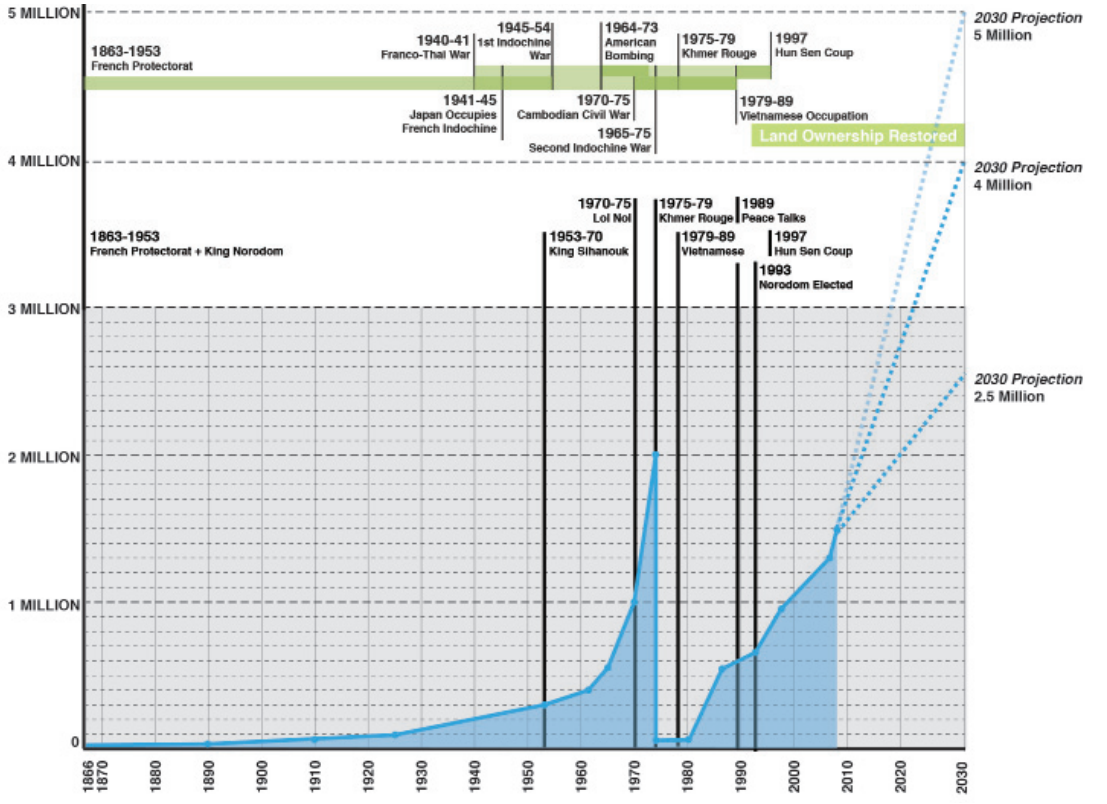

Figure 11:
Y Axis: Population of Phnom Penh 0-5 million X Axis Top: Armed Conflict and Occupation in Cambodia by Year X Axis Middle: Governmental Administrations in Cambodia by Year X Axis Bottom: Dates 1866-Present Dates. Graph drawn by author from the following sources:

1866: No known source.

1911: 30,000
Source: Source: 'The South-East Asian Water-bound Tradition versus a Colonial Earth-bound Society the case of Phnom Penh, Cambodia'Helen Grant Ross

1926: 76,000
Source: Pavie, Auguste, 1879-1895, Mission Exploration Work Vol 1 of the Indochina papers,

1953: 300,000
Source: 'The South-East Asian Water-bound Tradition versus a Colonial Earth-bound Society the case of Phnom Penh, Cambodia'Helen Grant Ross

1962: 393,995
Source: Census figured quoted in the Mekong Committee Handbook of Statistics and the Atlas of Physical, Economic and Social Indicators of the Mekong, 1970

1966: 550,000
Source: Area Handbook for Cambodia, US Government Pamphlet 550.50, October 1968, p. 33.

1970: 1,000,000
Source: 'The South-East Asian Water-bound Tradition versus a Colonial Earth-bound Society the case of Phnom Penh, Cambodia'Helen Grant Ross

1974/5: 1.2-2,000,000
Source: Estimates by UNICEF in 1975, including refugee populations

1975-1979: 50,000
Source: Rough estimate from Year Zero, Brother Number One and Phnom Penh: A Cultural History

1987: 584,000
Source: Kampuchea Needs Assessment Study (for UNDP), August 1989

1992: 667,814
Source: UNCHS Needs Assessment Mission, May 1992.

1998: 1,000,000
Source: UNFPA Cambodia population census, 1998 (estimated population in actual urban areas).

2004: 1.38 Million
Source: JICA report, October 2006

2007: 1,466,000
Source: www.nationsonline.org

2008: 1,325,681
Source: General Population Census of Cambodia 2008, National Institute of Statistics, Ministry of Planning Phnom Penh

2009: 1,519,000
Source: UN Country Profile

2009: 14% (2 million) of Cambodia's population
Source: WWF Mega-Stress for Mega-Cities: A Climate Vulnerability Ranking of Major Coastal Cities in Asia

2010: 1,573,544
Source: http://www.geonames.org/

2010: 2,234,566
Source: Wikipedia which cites: http://www.nationsonline.org/oneworld/map/google_map_Phnom_Penh.htm

In a 1997 coup Hun Sen seized full control of the government from Co-Prime Minister Prince Norodom Ranariddh, and remains Prime Minister of Cambodia and leader of the Cambodian People's Party (CPP). As of May 2012 Hun Sen has been in power for more than 10,000 days making him one of the longest-serving political leaders in the world.

During the 1990s land ownership rights were gradually restored to Cambodians thereby releasing Phnom Penh from the evolutionary stasis of the previous 20 years. Since the 1975 evacuation, development of the city was hindered, and nearly halted, by war and occupation. As Cambodia began to politically stabilize the people of Phnom Penh began to physically and economically rebuild. Since 1997 Phnom Penh has grown from a city of 500,000 to 1.5 million. If current or even accelerated growth rates continue and as people migrate from the provinces seeking economic opportunities, the city could double or triple in size by 2030.

5.2 Lack of Master Plan

In 2005, the French Bureau of Urban Affairs proposed a Master Plan for Phnom Penh: a 330-page document entitled the "Livre blanc du développement et de l'aménagement de Phnom Penh" commonly referred to as "The White Book". The document provides a comprehensive description of both historical and current characteristics of the capital, ending with a strategic master plan leading up to year 2020. However, as 2020 approaches the master plan has yet to be formally adopted by the government and therefore remains a set of suggestions and recommendations rather than a force guiding the city's development.

The result is rapid uncontrolled development characterized by a lack of building code, no zoning enforcement, and few development laws and regulations (Figure 14). The suburbs in particular are experiencing sweeping changes in land use, as former agricultural land is bought up and rapidly developed into built projects.

For example, there is no required flood mitigation for individual buildings. While in the surrounding provinces, buildings are still being built in response to the floods - raised, floating and stilted homes - such constructions, though once common in the city as well, have nearly disappeared from Phnom Penh (Figure 12). Rather, the ground floor, often enclosed, has become a valuable economic space for selling goods. Sidewalks have become parking space and nearly the entire city is paved, with few existing or planned parks to absorb seasonal rains (Figure 13).

Figure 12:
Traditional stilted house in Kandal Province, which geographically surrounds Phnom Penh. Photo by author.

Figure 13:
Typical shop houses with ground floor parking and shops and housing above. Interior living and sleeping quarters have no access to direct daylight and fresh air. Photo by author.

Figure 14:
A welding shop beneath a wooden house. Photo by author.

Figure 15:
Boeung Kak Lake infilled with sand in August 2012. Photo by author.

As the city changes, its most vulnerable residents are being displaced by development. Rights groups report over ten percent of Phnom Penh's population has been displaced in the past decade. These evictions, both legal and illegal, are extremely disruptive to the lives and livelihoods of the evictees and their families. (Sahmakum Teang Tnaut Website, 2012) Since a full cadastre map of the city does not exist, evictees often do not hold 'hard title' and have little if any political or judicial recourse. Often they are relocated to sites without economic opportunity or basic infrastructure and inadequately compensated for their lost property.

5.3 Lake Infilling

A network of wetlands, streams and ponds, which are currently being filled with earth to create developable land, surrounds Phnom Penh. This process raises both human rights and environmental concerns. One motivation for this infilling is that water is not a constructible area since it belongs to the State. Therefore, developers in partnership with officials fill in waterways, thereby transforming them into land that is physically and legally suitable for construction (Law On Water Resources Management Of The Kingdom Of Cambodia) (Figure 15).

A recent and politically contentious example is Boeung Kak Lake, a lake of nearly 133 hectares, filled in by Shukaku Incorporated, owned by Cambodian People's Party Senator Lao Meng Khin, to create a site for a "multi-purpose living and recreation center." Nearly 4,000 people were evicted to make room for the development. In a recent protest 13 former residents attempted to rebuild their homes on the Boeung Kak site. They were subsequently arrested, held without charge, tried without due process, sentenced to 2 ½ years in prison and only released after pressure from the international human rights community. (Yuthana and Freeman 2012).

According to the Boeung Kak Area Drainage and Flooding Assessment by Sally Benham and Ben Caddis (2008), following the infill of the lake "…the anticipated increase in peak flood levels and flood frequency that would result without mitigation is considered unacceptable. …This runoff has potential to cause significant impacts on property and hazard to life downstream."

5.4 Public Parks + Open Space

Compounding the issues of lake infilling is the lack of park space or open space to absorb rainy season waters. The inner *kahns* (districts) are home to a series of formal parks and gardens but they are often hardscaped, formally planted and home to decorative, rather than functional water features (Figure 16 and 17).

Figure 16:
Phnom Penh 4 inner kahns. Public Parks and green space shown in green. Map drawn by author through survey.

Figure 17:
Parks in Phnom Penh. Top to Bottom: Sihanouk Boulevard, Sisowath, Russian Boulevard, Monivong Boulevard. Photos by author.

5.5 Wastewater Treatment

A network of wetlands, streams and ponds into which over 1 million cubic meters of the city's household wastewater and storm water are discharged daily surrounds Phnom Penh. There is no formal wastewater treatment in the city. Instead, sewage and other wastewaters from households, businesses and industries combine in a series of covered and open canals that flow through the city and combine with seasonal rainwater and floods (van der Hoek, 2005) (Figures 18-22).

Boeung Cheung Ek (BCE) Lake is the largest of these water bodies, covering 3,400 hectares of land, 5 kilometers south of the city center. The lake receives 80% of the wastewater from the city along with untreated effluent from 3,000 small and large-scale industrial enterprises. The lake is an effective, low cost means of biological treatment of the city's wastewater through its aquatic vegetable production (van der Hoek, 2005).

A 2007 study by the Royal University of Agriculture of Phnom Penh entitled "Food, Incomes and Urban Waste Water Treatment in Phnom Penh, Cambodia" estimated that 20% of the total daily vegetable consumption of Phnom Penh comes from these lakes and wetlands within the city. Therefore these wastewater-fed aquatic vegetables are, despite their potential health risks, very important in supplying the city's vegetable markets and thus meeting the demands of the growing population of Phnom Penh.

However, as these lakes are infilled, the city's wastewater is discharged more rapidly into the Mekong without treatment and the need for a more formalized system grows. An infrastructure retrofit of this scale would be extremely costly and is unlikely to happen, threatening the health of the Mekong, Phnom Penh, and its downstream neighbors.

Figure 18:
Left: An open sewage canal runs the length of Street 105 and passes beneath Boeung Trabek Market.
Right: The Street 105 Canal terminates on Street 288 and Monivong Boulevard.

Figure 19:
The Street 105 sewage canal approaches overflow during a heavy rain mixing sewage, gray water, and trash with storm water.

Figure 20:
Vegetables are cultivated on the wetlands in the south of Phnom Penh.

Figure 21:
Effluent flows from a canal into a stream south of the city.

Figure 22:
A toilet over Boeung Tra Bek the southern termination of the Street 105 sewage canal.

5.6 Floods of Phnom Penh

Flood events in Phnom Penh are twofold – almost daily rainy season flood events and episodic larger scale flood plain events. During the rainy season (May-October) monsoon rains fill low-lying streets, some to nearly 1.5 meters deep. The Japan International Cooperation Agency (JICA) has conducted over $325 million of infrastructure upgrades in Phnom Penh including drinking water supply facilities, flood protection, drainage improvements and the rehabilitation of the Phnom Penh port (JICA Website, 2012). This work is ongoing and retrofitting the city is a slow and costly proposition. Although JICA's work has reduced flooding in some areas of the city, it cannot be relied upon to eliminate all of Phnom Penh's drainage problems or to prevent future flooding in areas developed without flood protection.

The near daily rain floods during the rainy season reframe the experience of inhabiting the city, altering its landscape and blurring the distinction between water and land. Roads become waterways and sidewalks disappear beneath the muddy waters. Curbs and tree roots are hidden from view, hindering walking and driving. Businesses unfurl overhangs, open umbrellas, and hang tarps, expanding available dry space. The streets become a patchwork of bright ponchos and headlights. Traffic slows to a near stop as cars, motos, and bicycles navigate the water and intermittently stall out or dip into deep unseen potholes (Figure 23).

The population anticipates the rains and has adapted to the accompanying flooding and its perceived cleansing effects. Nonetheless, the floods disrupt the flow of daily business and activity. Additionally, flooded streets carry potential disease as the storm water mixes with human waste and street drains are blocked by municipal trash, slowing drainage and posing a possible public health threat.

Figure 23:
Afternoon rain flooding near Russian Market. Photo by author.

As for larger scale flood events, Phnom Penh was founded in the alluvial plain of the Mekong River, which varies upwards of 12 meters in depth between the dry and wet seasons. The most devastating flood risk comes from the Mekong River cresting over its natural berm into the city. The volume of water produced by a Mekong flood could take weeks or even months to recede, evaporate or penetrate into the ground.

However, the greater threat comes from the areas north and west of Phnom Penh, which absorb a huge volume of monsoon rains. This water presses southward to the Tonlé Sap and Mekong, through the land, the city and a network of tributaries passing around and through Phnom Penh. A combination of both flooding events could be catastrophic for Phnom Penh: the Mekong River flooding from the east and flooding from oversaturated lands to the west and north. Although unlikely, the potential convergence of the two events is within the realm of possibility.

The factors contributing to the potential for increased flooding in Phnom Penh are: deforestation, the unknown impacts of climate change, overbuilding in catchment areas, the damming and diversion of natural waterways, and the infill of canals and lakes, combined with no formally accepted or followed master plan. The four central kahns, or districts are protected by a series of semi-concentric dykes built westward from the rivers that protect the most densely developed areas from inland flooding, virtually transforming downtown Phnom Penh into an island and leaving the outer kahns under-protected.

Vann Molyvann (2003) writes in New Khmer Cities: “The maintenance of dikes of Phnom Penh, as well as the preservation of the National Routes established on the banks and dikes, are crucial to the containment and control of floodwater. Canals created after the Protectorate have been calibrated to absorb the floodwaters and to allow excess ground water to drain towards the river. This hydraulic system has been virtually without maintenance over the last three decades. Indeed, it is astonishing that the system still functions today given these decades of neglect. The capacity to oversee and manage this hydraulic system must be re-established, supported and expanded.”

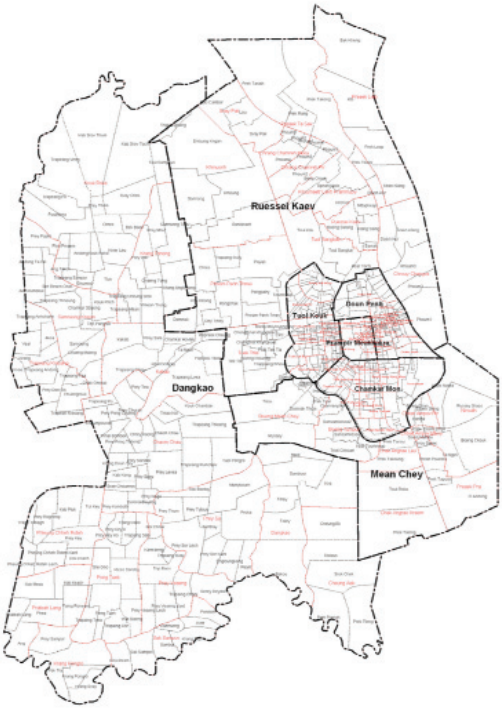

Figure 24:
Left: Administrative Districts of Phnom Penh
Source: Livre Blanc Right: Google Earth Map assembled by author

6. CONCLUSIONS + PROPOSALS

To return to the notion of 'site' and 'situation': 'Site' refers to the city's actual physical footing, 'situation' to its regional context and how it connects with the world. The 'site' of Phnom Penh, at the confluence of three rivers, creates a city sustained by and subject to the cyclical floods of these rivers.

Its 'situation' connects Phnom Penh to the Lower Mekong Basin through this shared resource, crossing political and economic boundaries. This 'situation' also remains deeply influenced by traces of French colonial planning, decades of war and the legacy of the Khmer Rouge. It also embodies the resilience of a city that has emerged from decades of unrest to grow and develop into a contemporary city, moving at high speed to make up for decades lost to war and conflict.

The benefits of development, including relative stability, economic opportunity, improved quality of life, access to education and healthcare, thus far outweigh its costs. However, the price of urbanizing a deltaic landscape cannot be ignored. A major, sustained flood in Phnom Penh could undo much of the progress achieved during the last twenty years. The scope and complexity of urbanization touches upon those issues, both internal and external, ranging from land tenure to health and climate change to human rights. Consequently, Cambodia once again must call upon its history of adaptation and resilience to create a Phnom Penh focused on the continual effort to find new solutions and strategies to these evolving challenges.

Many of the advancements necessary in Phnom Penh- an agreed upon master plan, redeveloped flood and sanitation infrastructure, a building code - rely upon thoughtful governance, careful law making and independent lobbying. Therefore, what agency does design have to operate in this environment?

There are several strategies available and pursued by this project. First and most important of these strategies is the creation, collection, documentation and distribution of urban resources for Phnom Penh. Such as the living archive available at www.cityofwater.wordpress.com and the Urban Lab Phnom Penh www.urbanlabphnompenh.wordpress.com.

The Urban Lab Phnom Penh provides a space for the exchange of ideas between university students, architects, artists and urban thinkers about the present and future of Phnom Penh. The Urban Lab is a group of people, a website and during the Our City Festival it will be a place, located at the Bophana Audiovisual Resource Center. During the Our City Festival the Urban Lab will bring together known urban resources for Phnom Penh: photos, maps, drawings, models, videos, interactive media, and student projects. The Urban Lab will open prior to the Our City Festival. This will allow for ongoing experimentation and free student workshops leading up to and during the Festival.

Our City Festival is a platform for dynamic art and architecture events, that explore urbanism in Phnom Penh and fosters opportunities for dialogue and public engagement. The Our City Festival 2012 theme is Urban Currents and takes as its point of departure the movements within the urban environment: the flows between the people, resources, environment, and landscape of the city within the context of its urbanization and its impact on greater Cambodia.

The second strategy is teaching within the local design profession with a focus on fostering the development of conceptual ideas among the young Cambodian designers who will practice in Phnom Penh. An example of this work can be seen at www.futureofphnompenh.wordpress.com.

The Future of Phnom Penh is a collection of conceptual and analytical drawings and writings about contemporary urban conditions in Phnom Penh, Cambodia. The work that follows was produced by architecture and urban planning students during a semester long seminar taught in Phnom Penh during Spring 2012 and entitled A Contemporary History of Urban Planning + The Future of Phnom Penh.

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