

# Metropolitan Manila

## A Vulnerability Issue

by  
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A Practicum submitted to the Faculty of Graduate Studies of  
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Department of Landscape Architecture  
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Winnipeg

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## **ACKNOWLEDGEMENTS**

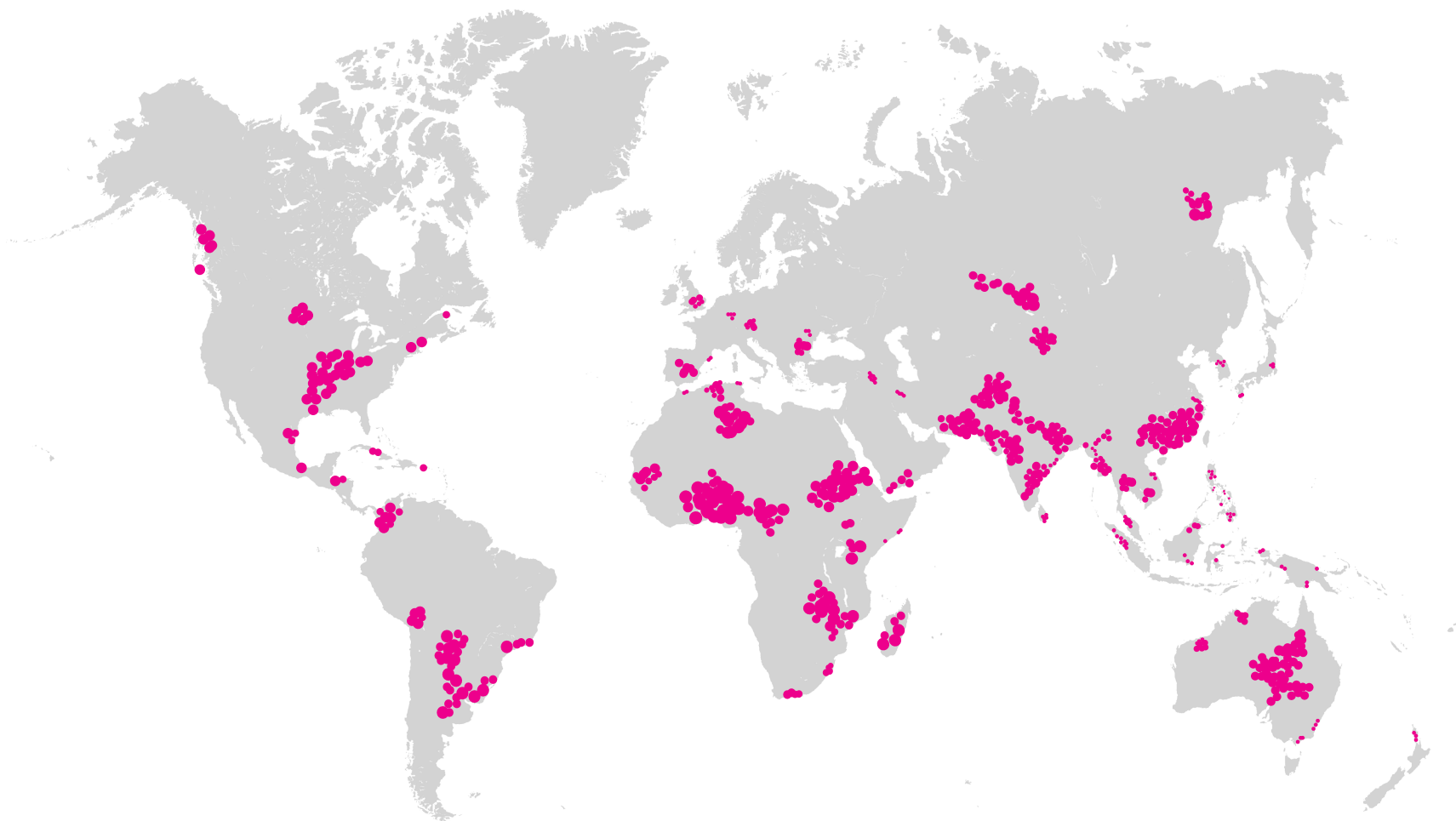
Thank you to my committee advisor Dr. Richard Perron and internal examiner Jean Trottier for their consistent sharing of knowledge, encouragements and insightful conversations that has helped my journey in developing this practicum.

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To my beloved parents, I thank you for your patience, love and support. For always being there to listen and to care during difficult times.

To my sister who has always told me that I 'could do it', thank you for your never-ending encouragement.



FLOOD LOCATION MAP, YEAR 2007  
MAJOR FLOODS REPORTED

ADAPTED FROM: DARTMOUTH FLOOD OBSERVATORY

## **ABSTRACT**

This practicum is an exploration of the meaning of resiliency within the discourse of the Landscape Architecture discipline. Its significance to ecological thinking and its conjunction to engineering solutions are examined for developing of an integrated approach towards flood mitigation strategies.

Although not the only hazard experienced in the Philippines, floods are the most pervasive. The severity of this natural event and the corresponding disaster is augmented by factors produced within the socio-economic realm. To measure the increasing frequency of disasters from floods, the inherent vulnerability of the study area, Metropolitan Manila and historical reports of said events are considered.

To further comprehend the role of Landscape Architecture within an integrated framework the three types of resiliency organized by Dovers and Handmer are examined and applied at various scale (regional, local, and micro) pertaining to the study area. This part of the practicum explores methods of resiliency in conventional response as well as ecological resiliency to flood events.



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**FIG 01** *MANILA SKYLINE DURING  
MONSOON SEASON  
PHOTO CREDIT: ROBERTO VERZO*

This practicum evolved from a personal interest about the vulnerable characteristic of my childhood home, metropolitan Manila. The harsh consequence of disasters from the increase of climatic and environmental events has become a major issue within our urbanized world. Previous mitigation practices have proven to be inadequate from the continuous onslaught of natural hazards. Efforts to adapt new concepts for reducing the impact of such occurrences are constant, as it is an important agenda in the contemporary period. The endeavour of this research is to further conceptualize the theory of resiliency within the discipline of Landscape Architecture and its role within an integrated approach in alleviating the effects of disasters.

The key words vulnerability and resiliency are explored and characterized. Because of their broadness and semantic differences, within this discourse the definitions are simplified to fit within the realm of the Landscape Architecture discipline. Vulnerability, according to Susan L. Cutter, are the inherent qualities of a system that is open to the possibility of harm.<sup>1</sup> The term vulnerability can be expressed as to who or what is exposed to potential risk and the scale of damage that people and place can undergo.<sup>2</sup> Resiliency is the ability of a system "to respond and recover from disasters."<sup>3</sup> Resilient systems usually have natural conditions that allow adaptive processes to occur during or after an event.<sup>4</sup>

In this paper vulnerability is a tool used to measure the extent of harm that people or place can be subjected to. In this perspective it incorporates the idea that both the social and biophysical sphere have a hand in the degree in which a place or person is exposed to risk. Scholars of disaster research agree in the concept that natural phenomena are great contributors to disaster events and risks in any environment. But the intensity of the consequences are made through the actions of society.<sup>5</sup> Urbanization practices have been a fundamental factor to majority of the environmental problems we face today. Sim Van der Ryn and Stuart Cowan, authors of *Ecological Design*, aptly stated that:

"In many ways, the environmental crisis is a design crisis. It is a consequence of how things are made, buildings are constructed, and landscapes are used. Design manifests culture, and culture rests firmly on the foundation of what we believe to be true about the world. Our forms of agriculture, architecture, engineering, and industry are derived from design epistemologies incompatible with nature's own. It is clear that we have not given design a rich enough context. We have used design cleverly in the service of narrowly defined human interests but have neglected its relationship with our fellow creatures. Such myopic design cannot fail to degrade the living world, and, by extension, our own health."<sup>6</sup>

The world today is predominantly urban, cities have become the places where social systems interact with the built environment and natural processes.<sup>7</sup> The complexities of the problems we face are due to a number of factors, but ultimately come from the discord between nature and society. Our built environment does not conform to the natural world. It is, as Van der Ryn and Cowan described, a world created for human purpose, an environment that is “a direct manifestation of what is most valued in our culture.”<sup>8</sup> If we are vulnerable due to the way we have created our environments, it is through the same process that we begin to engage in with these issues.

In this case metropolitan Manila, the place of study, has certain environmental conditions that creates the prospect of disasters to occur. Flooding in metropolitan Manila is a natural event that occurs consistently due to torrential rainfall brought by formation of rain clouds through relatively humid weather or by tropical cyclones that cross through the country. The geographical area where metropolitan Manila situates is a semi-alluvial floodplain that is open to two large bodies of water, Manila Bay to the west and Laguna de Bay on the southeast.<sup>9</sup> The metropolitan area is physically a vast urbanized drainage basin that is frequently inundated due to the rapid rise of water in rivers and storm waters. Despite the vulnerability of the metropolitan area, however, rapid urbanization has continued to grow unabated. More residential homes, industrial and

commercial sites are increasingly exposed to flood-related destruction.<sup>10</sup> The growth of the population is a result of an increase in urban migration that started during the Second World War, in which rural folk moved to metropolitan Manila in search for greater livelihood opportunities.<sup>11</sup> This urban migration then contributed to the influx of informal housing that is “often situated in the banks of rivers and canals.”<sup>12</sup> The constant downpour of rain can immediately cause flooding because “the resultant makeshift housing often blocks available waterways – narrowing their capacity to handle discharge.”<sup>13</sup> The sheer rise in population and urbanization has rendered the capacity of the existing drainage systems that were “constructed during the Spanish and American colonial periods inadequate.”<sup>14</sup>

Climate and topography makes the metropolitan area susceptible to flooding.<sup>15</sup> Yet, it is human-related activities associated with urbanization that has aggravate environmental conditions, that makes metropolitan Manila more vulnerable to disaster. The toll of population affected has been rising dramatically since the beginning of the new millennium. In 2009, one flood event caused by the relentless downpour of rain brought by the tropical storm (typhoon) ‘Ketsana’ “flooded 80 percent of the capital and claimed more than 460 lives.”<sup>16</sup>

In this discourse, resiliency becomes important because of its potential application towards flood mitigation strategies. In this practicum, Dovers and Handmers typology of resilience is used as the framework to compare conventional and other methods of responses to structure an idea on what approaches are appropriate for Metropolitan Manila to become resilient. By applying all of the three types of resiliency at the various scales of the study area we begin to understand that the standard practice of fortifying cities is hardly sufficient with the continuous changes in climatic and environmental events.

This inquiry is not solely for designers to solve, but it does create an opportunity for our discipline to re-evaluate how the components we build in the urban environment work within the natural world. In the instance of flooding events, how do we achieve a resilient environment? To allow an adequate way to secure the health of cities requires a more holistic approach to planning and design.

#### Endnotes:

1. Susan L. Cutter, Lindsey Barnes, Melissa Berry, Christopher Burton, Elijah Evans, Eric Tate, Jennifer Webb, "A place-based model for understanding community resilience to natural disasters," *Global Environmental Change* 18 (2008): 599, accessed September 14, 2015, <http://lbr.covalentwords.com/assets/docs/33.pdf>
- 2- 4. Cutter, et. al, "A place-based model for understanding community resilience to natural disasters," 599.
5. Anthony Oliver-Smith, "Theorizing Vulnerability in a Globalized World: A Political Ecological Perspective," in *Mapping Vulnerability: Disasters, Development and People*, ed. Greg Bankoff, Georg Frerks and Dorothea Hillhorst (London: EarthScan Publications Limited, 2004), 19.
6. Sim Van Der Ryn and Stuart Cowan, *Ecological Design* (Washington D.C.: Island Press, 1996), 9.
7. Cutter, et. al, "A place-based model for understanding community resilience to natural disasters," 599.
8. Van Der Ryn and Cowan, *Ecological Design*, 8.
- 9 – 10. Greg Bankoff, "Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila," *Disasters* 27, no.3 (2003): 98, accessed December 10, 2014, doi: 10.1111/1467-7717.00230.
11. Bankoff, "Constructing Vulnerability", 102.
- 12 - 13. Ibid, 103.
14. Ibid, 98.
15. Ibid, 101.
16. Jason Gutierrez, "Thousand Flee Flooding in Manila," *Sydney Morning Herald*, (2013), accessed November 25, 2013, <http://www.smh.com.au/world/thousands-flee-flooding-in-manila-20130820-2s9la.html>.

**FIG 02** [NEXT PAGE]  
FLOOD DAMAGE IN MANILA  
PHOTO CREDIT: AUSAID







***History and Context***



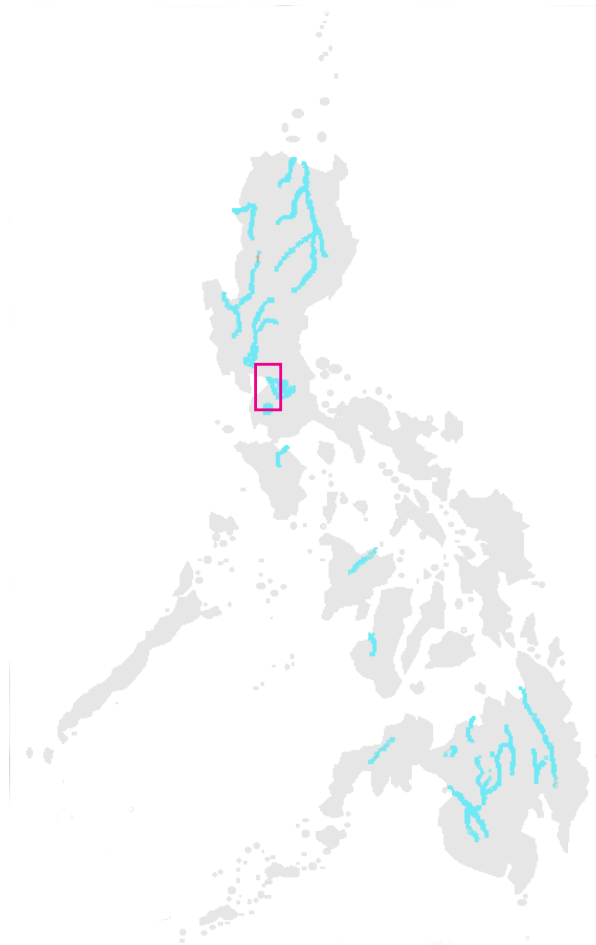
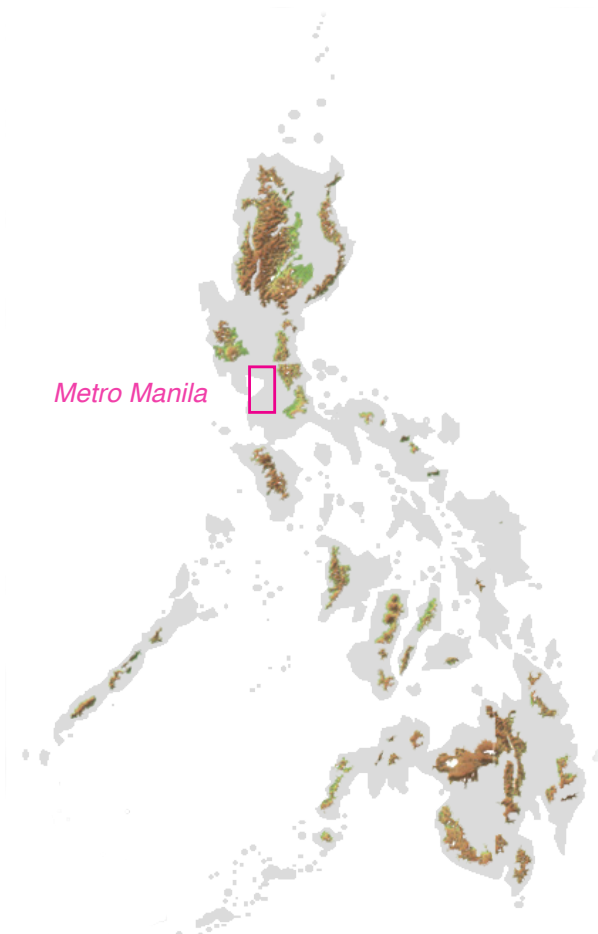




*Environment*

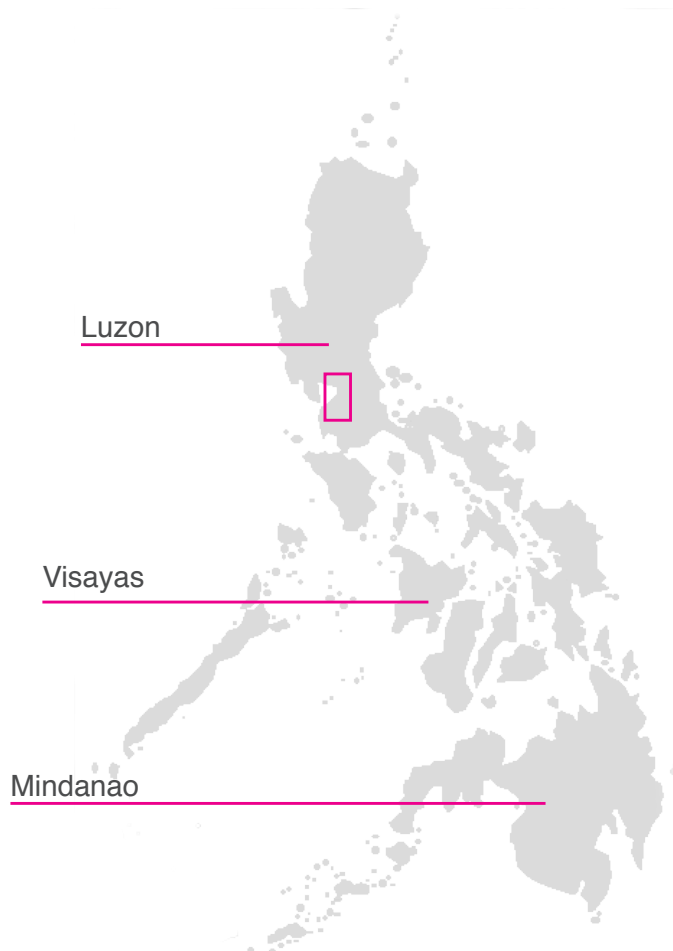






**FIG 03** [PREVIOUS SPREAD]  
MAHOGANY FOREST,  
CENTRAL VISAYAS, PHILIPPINES  
PHOTO CREDIT: ACE\_ALEJANDRE





**FIG 04** GEOMORPHOLOGY AND PHYSIOGRAPHY  
OF THE PHILIPPINES  
MOUNTAIN REGIONS, RIVER SYSTEM  
AND THREE MAIN ISLANDS

## Geomorphology and Physiography

The Philippines is an archipelago located in Southeast Asia within the western Pacific region. Consisting of 7,107 islands and islets, the Philippine islands stretches from north to south. Its three geographic divisions, Luzon, the Visayas, and Mindanao have a total land area of 300,000 square kilometres “and are crisscrossed with mountain ranges and drained by small river systems.”<sup>1</sup> The archipelago has 36,290 kilometres of coastline and is surrounded by great expanses of water, the Pacific Ocean to the east and the South China Sea to the west. In some aspects the Philippines have similarities with southeast mainland, which includes “some elements of physical geomorphic history, climatic regimes, vegetative assemblages, and the characteristics of soil.”<sup>2</sup> But due to its geographical position, the archipelago has a “physiographic composition and a topographic form”<sup>3</sup> that is solely unique to the Philippines.

The natural features of the Philippine Archipelago are varied and unique. Although to an extent most of these features are the same to one another, their uniqueness stems from the regional variations of weathering and tectonic histories. Mountainous regions dominate most of the larger islands and

alternates with plains, lowlands and valleys. Coastlines are irregular, some set with spurs and some with re-entrant embayment. Volcanism has contributed to the irregularity of the archipelago's landmass by depositing igneous materials throughout its geological timeline.<sup>4</sup> Even in a uniformed context, there is still diversity within the local environment of the archipelago. Some of the areas are inhabitable for humans due to the rough environment either they are "too rough, too rainy, too windy, too, wet" or not easily accessible.<sup>5</sup> Other areas have circumstances that are highly attractive for human occupancy, easily able to yield for human purpose and comforts. Areas by Manila Bay, Laguna de Bay, and the surrounding lowlands have these characteristics.

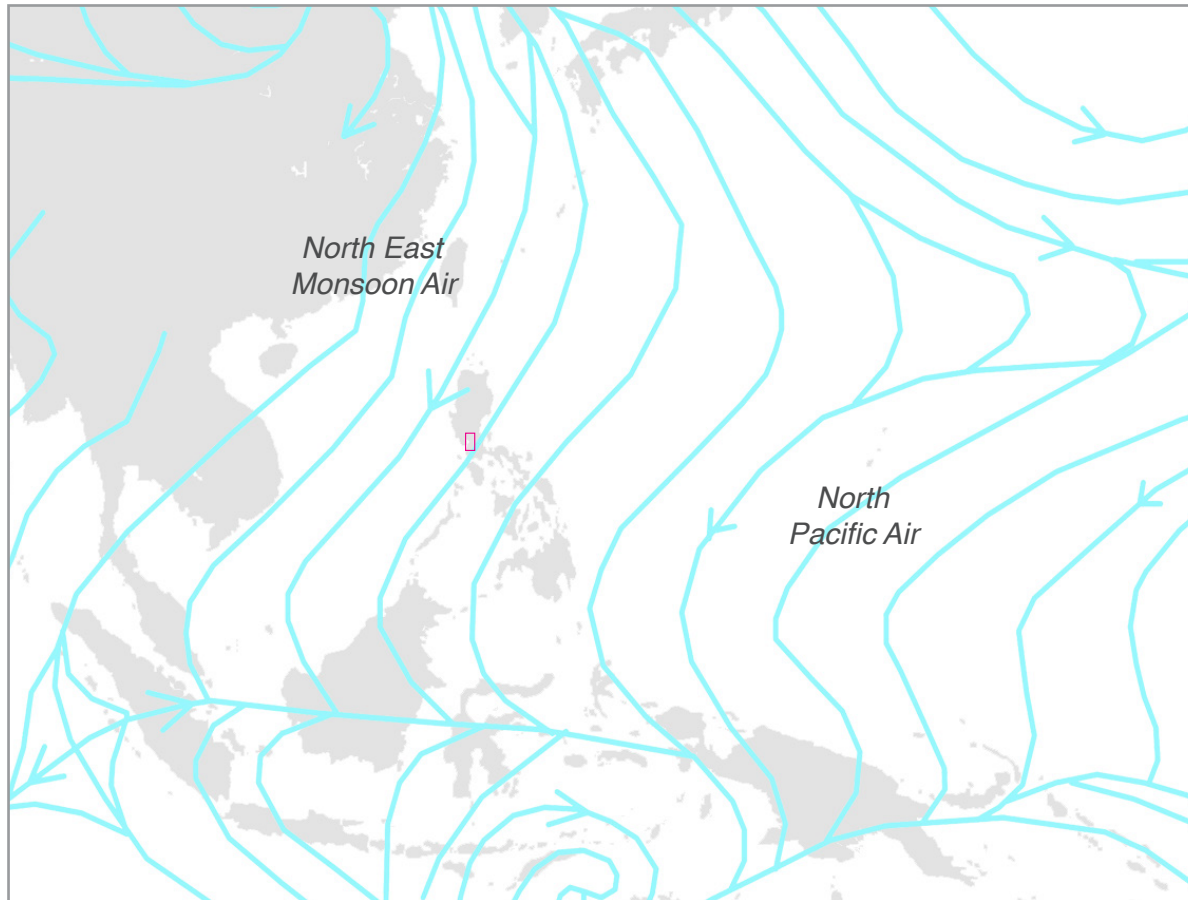
## **Climatology**

The equatorial area is regarded as 'constant', and generally does not show significant change in both weather and climatic patterns. But even if there are no variations in seasonal changes within these areas, there is "considerable degree of climatic contrast"<sup>6</sup> that exists among the tropical realm. Due to its placement, in low latitude and offshore of the continent, the archipelago experience "near-tropical, humid climatic regime."

High temperatures, abundant rainfall and relatively humid weather, result in both extremes of wet and dry seasons, that characterize the climate of the Philippines. From the months of May to October rain is predominantly present while drier winds from the northeast make the months of November to April reasonably dry. There are substantial variations in frequency and amount of precipitation throughout the country. "Rainfall and aridity vary a great deal, depending upon exposure, elevation, and situation, from a few sub regions that receive less than 40 inches (1000 mm) annually to those that experience more than 200 inches (5000 mm) per year."<sup>7</sup> The overall temperature, however, remains constant, reaching 38 degrees Celsius on the hottest days in the plains and a pleasant cool weather of 4 degree Celsius during the coldest months within the mountainous regions.<sup>8</sup>

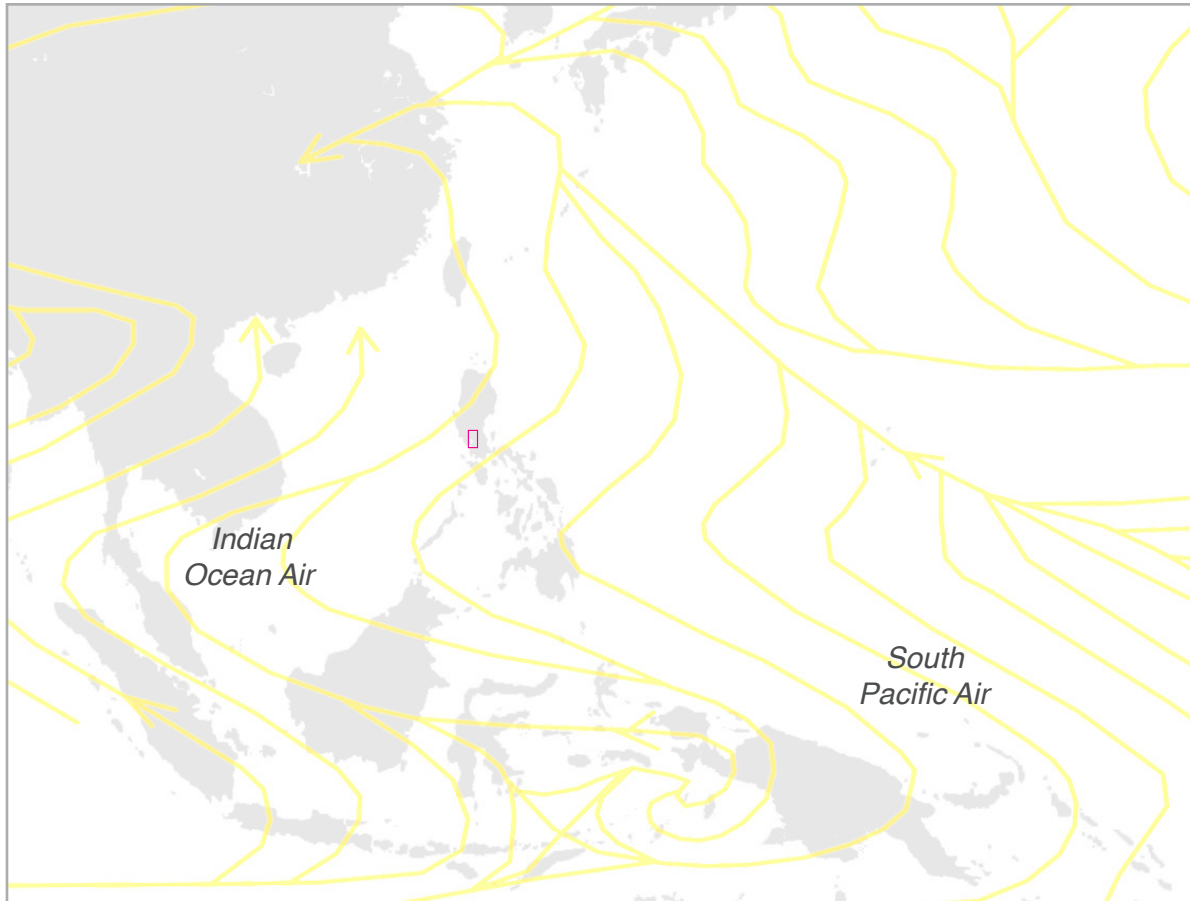
"The early Spanish settlers described the Philippine climate as 'seis meses de lodo, seis meses de polvo, seis meses de todo' (six months of mud, six months of dust, six months of everything)"

- Walter Tower <sup>9</sup>



**FIG 05** AIR MASS SOURCE REGIONS AND  
PREVAILING SURFACE WINDS.  
COLDEST: JANUARY

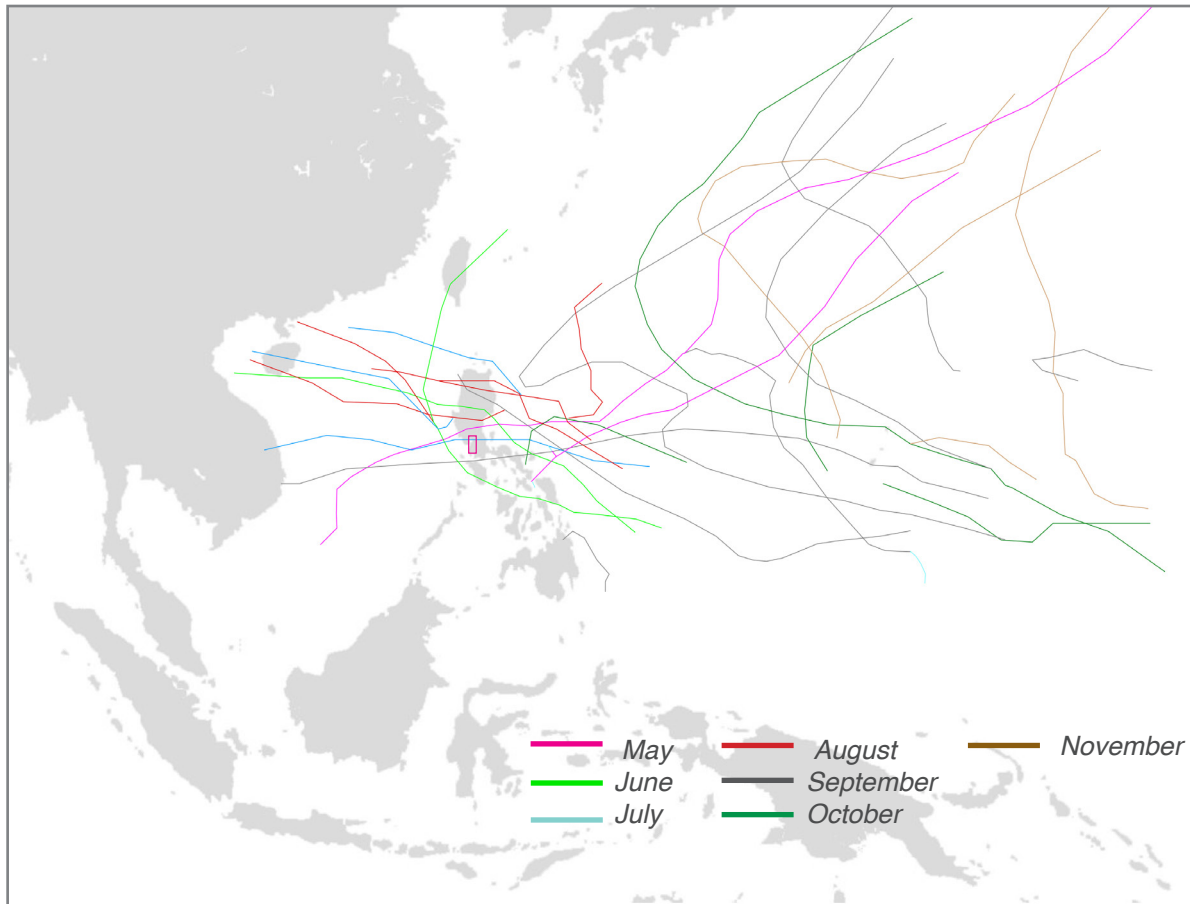
ADAPTED FROM: F. WERNSTEDT  
THE PHILIPPINE ISLAND WORLD, 47



**FIG 06** AIR MASS SOURCE REGIONS AND  
PREVAILING SURFACE WINDS.  
WARMEST: JULY

ADAPTED FROM: F. WERNSTEDT  
THE PHILIPPINE ISLAND WORLD, 47





**FIG 07** TROPICAL CYCLONE (TYPHOON)  
TRACKS, 2010

ADAPTED FROM: UNISYS WEATHER

The Philippine Islands experiences dry and hot summers, but it is frequently visited by tropical storms or typhoons throughout the rest of the year. The months of June to November are what they consider as typhoon season as the country visited by at least 20 typhoons annually during that time. Not all of these tropical storms make landfall or cross the archipelago but they do bring a considerable amount of rain, thus providing proper nourishment to crop production, yet it is also the main cause for loss and property damages in the country.<sup>10</sup>

#### Vegetation:

“The archipelago presents a relatively youthful landscape; there are no ancient massifs that have been worn down to the basic cores and weathered into extreme senility.”<sup>11</sup> It is rich in natural resources, fertile plains and valleys makes up the bed for agriculture, producing diverse “crops for local consumption and for export.”<sup>12</sup> The usable land in the country for agricultural is 45 million acres in its entirety.<sup>13</sup> While the rest of the land was described to be covered with lush forests cover which provided resource materials for early settlers. Before man’s advent in the Philippine environment, it was evident that the majority of the archipelago was covered in “dense and complex tropical rain forests.”<sup>14</sup>



**FIG 08**    *VEGETATION*  
*PHOTO CREDIT: JOJO NICDAO*

As a tropical country, the natural vegetation is highly diversified. Mangrove forest and vegetation that has tolerance to saline are classified as the beach vegetation. Further inland, the type of vegetation changes into what is considered as the commercial forests, made up mostly of tall dipterocarp trees. The next vegetation cover, which are sometimes intermixed with the dipterocarp forests, are made up of the hardiest wood and they occupy dry areas. In the slopes of mountains lies the dense mid-mountain forest that has abundance of undergrowth. As the landscape alters to higher elevation, where the air is constantly saturated, we find the moss forests and pine forests. In areas that have been cleared the original dipterocarp forests is replaced through gradual succession by second-growth broadleaf forests. Where forest clearing has been constant, grassland vegetations begin to inhabit and take over the space.<sup>15</sup>

It is clear that vegetation cover in the Philippines is important. Valued as an economic resource for both domestic and export use. Mainly, the significance of the Philippines' forest lies in its ability to reduce the country's exposure to hazards and due damages. Accordingly, the preservation and the proper management of the vegetation cover is the most important for the country, as it reduces the degree of exposure to natural hazards. It is proven that vegetation cover reduces the acceleration of soil erosion, as it also helps mitigate water flow during a storm event.

#### Endnotes:

1. Teodoro Agoncillo, *A Short History of the Philippines*, (New York: The New American Library, 1975), 7.
2. Frederick Wernstedt and J.E. Spencer. *The Philippine Island World: A Physical, Cultural, and Regional Geography*, (Berkeley: University of California Press, 1967), 2.
3. Wernstedt and Spencer. *The Philippine Island World*, 3.
4. Ibid, 109.
5. Ibid, 112.
6. Ibid, 39.
7. Ibid, 3.
8. Carolina Hernandez, "Philippines", *Encyclopedia Britannica*, accessed May 5, 2015, [www.britannica.com/EBchecked/topic/456399/Philippines](http://www.britannica.com/EBchecked/topic/456399/Philippines).
9. Walter Tower, "The Climate of the Philippines," *Bulletin of the American Geographical Society* 35, no. 3 (1903): 258, doi: 10.2307/197391
10. Bankoff, Greg. "Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila." *Disasters* 27, no 3 (2003): 96 – 97, accessed January 2, 2015 , doi: 10.1111/1467-7717.00230.
11. Wernstedt and Spencer. *The Philippine Island World*, 111.
12. Agoncillo, *A Short History of the Philippines*, 8.
13. Wernstedt and Spencer. *The Philippine Island World*, 63.
14. Ibid, 83.
15. Ibid, 85.

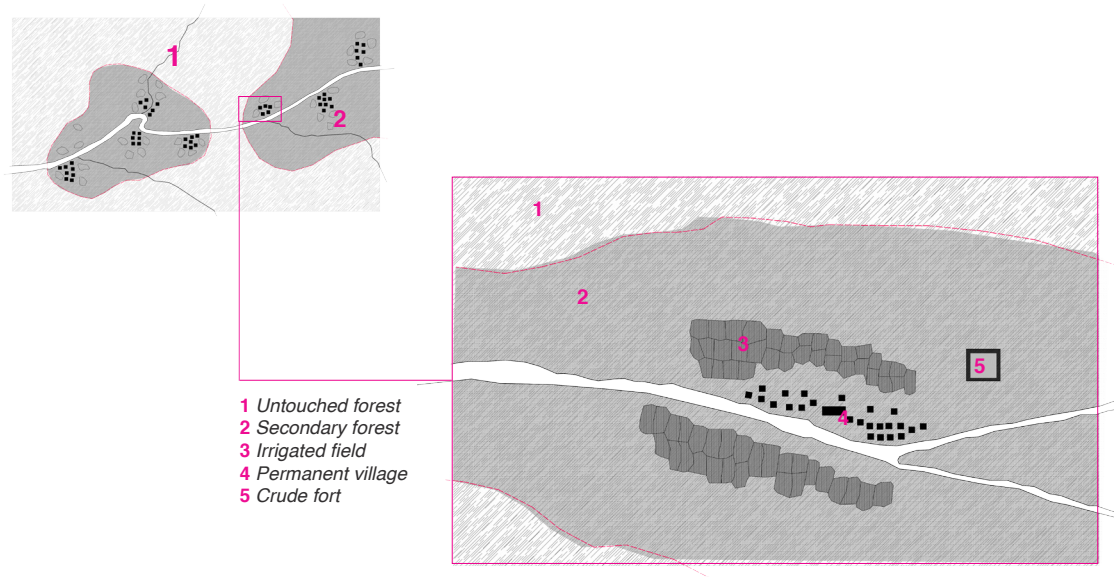




*Birth of Manila: Urban Development*







## Pre-colonial Settlement

Long before Europeans have reached the shores of the archipelago, the native Filipinos had already established enduring and healthy relations between neighbors. Trade routes and port towns flourished and thrived. These places became the centres of economy, thus greatly influencing the settlements within its sphere. There were no set towns with civic order or governing body; each tribe or village had their own territory and laws, each remained apart from the rest.

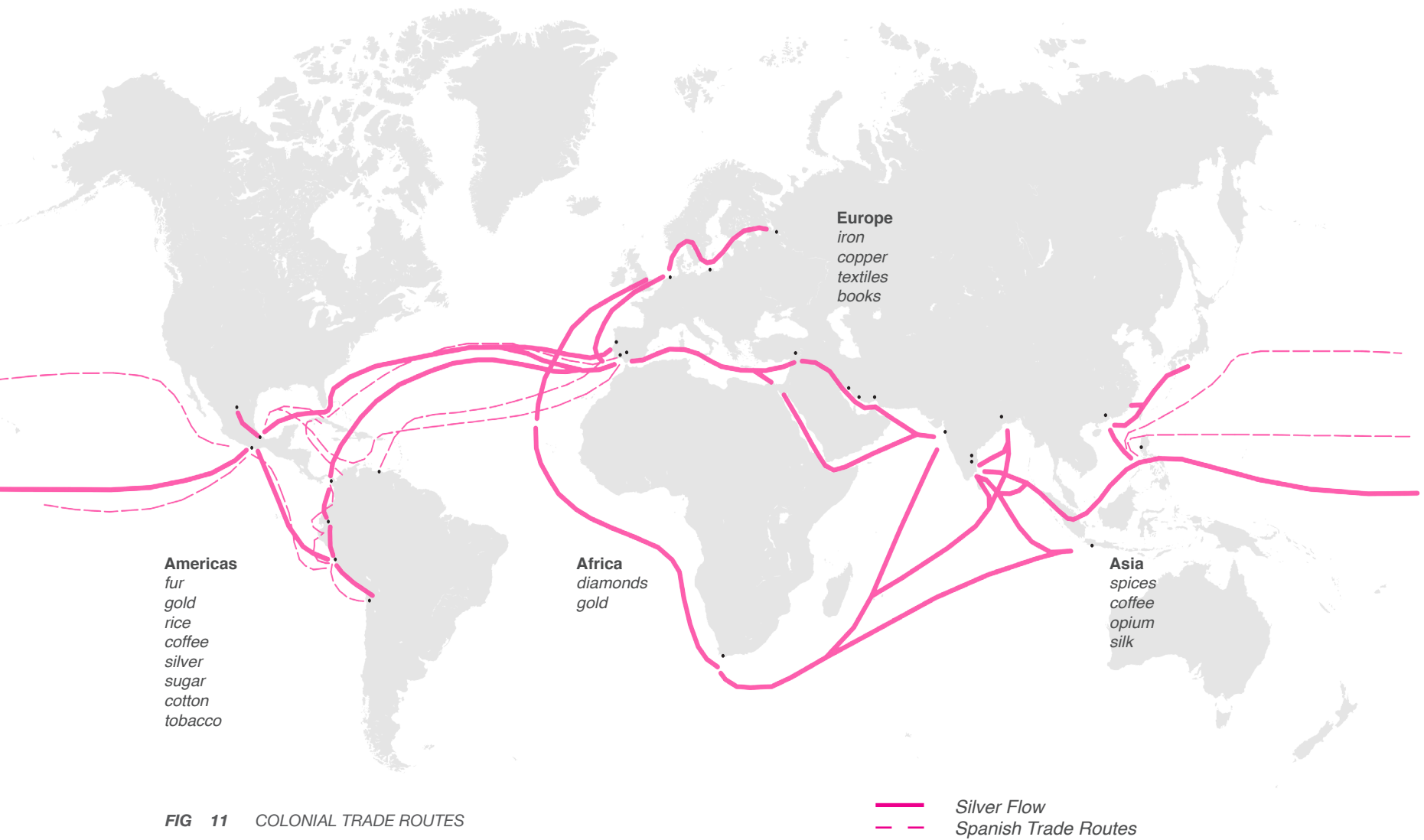
**FIG 09** [PREVIOUS SPREAD]  
MANILA ON A CLOUDY DAY  
PHOTO CREDIT: BROWNPAY

**FIG 10** PRE COLONIAL SETTLEMENT  
PATTERNS  
ADAPTED FROM: REED,  
"COLONIAL MANILA".

History of Pre-Hispanic Philippines is mostly obscure, evidence of the demographics of trade centres are scant, yet they accumulatively suggest that Manila was the largest concentration of population in the archipelago. In pre-Hispanic Manila, separation between villages (with their own ruler) occupying the Pasig River length still exist, but due to its wealth as a port, these settlements enjoyed a camaraderie that are unlike any of the pre-Hispanic communities.<sup>1</sup>

Spanish writers described that the morphology of these villages were not unlike those of the rural communities found throughout Southeast Asia. The typical settlement parallels rivers or streams and some where located within close proximity of the sea. They are linear in form and are situated in the midst of agrarian land. With several dozen to a hundred families, most of these hamlets are painted on the

landscapes as somewhat semi-permanent with clusters of houses surrounded by farmland.<sup>2</sup> Villages and houses were constructed from materials, such as bamboo and others that can be obtained readily from the nearby forest. Antonio de Morga described that the houses and dwellings were “universally set upon stakes and arigues [columns] high above the ground.”<sup>3</sup> It is said that the lower part of these dwellings were unoccupied due to the fact that most of these dwellings reside on the banks of rivers, thus allowing water to flow freely beneath without harming the upper house. In some areas settlements were nomadic, when food source are scarce they relocate periodically, but it was common within agrarian rich areas, Manila for instance, to be permanent.<sup>4</sup>



## Colonial Settlement

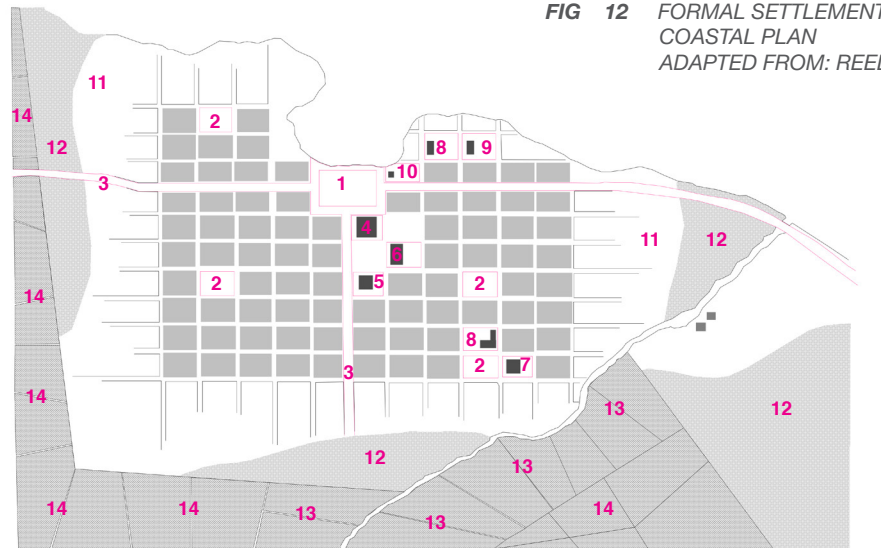
- Spanish occupation (1521 - 1898):

“The city is located on a narrow piece of land, between the sea on one side and a river of considerable size, which flows through part of the city, on the other; while on another side is a swamp or morass. On the side fronting the sea is a handsome beach. Where the river enters the sea, the land forms a point, upon which is built a very small and dilapidated wooden fort. Neither on the seacoast nor in any other part was there any defense. On this account, in view of our danger, I resolved to set about fortifying the city. I have constructed a stone tower on the said beach and nearby I am constructing a very strong and handsome fort.”

- Governor – General Santiago de Vera<sup>5</sup>

Due its renowned connections of trade with China and its reputable trade with other villages within the archipelago, in 1569 the Spanish conquistadores decided to establish a permanent and enduring colonial capital in Manila.<sup>6</sup> The location was seen as favorable, being easily defensible and rich in resources. It has great access for transportation with its proximity to the Pasig River, which bisects Manila and connects to great bodies of water, Laguna de Bay to the east and Manila de Bay to the west. Situated within the Central Plains of Luzon, Manila has an abundant means to food source, both in land and sea. Manila was the “urban keystone”<sup>7</sup> that the Spaniards needed in order to establish their rule, for it already functioned as a main capital and a major entry port in the islands. By the turn of the seventeenth century, colonial Manila was a complete Hispanic capital.

- 1 Plaza Major
- 2 Plaza
- 3 Street with arcade
- 4 Cathedral
- 5 Hospital - non contagious
- 6 Monastery
- 7 Hospital - contagious
- 8 Custom House
- 9 Arsenal
- 10 Tribunal
- 11 Commons
- 12 Pasture land
- 13 Irrigated land
- 14 Cultivated land



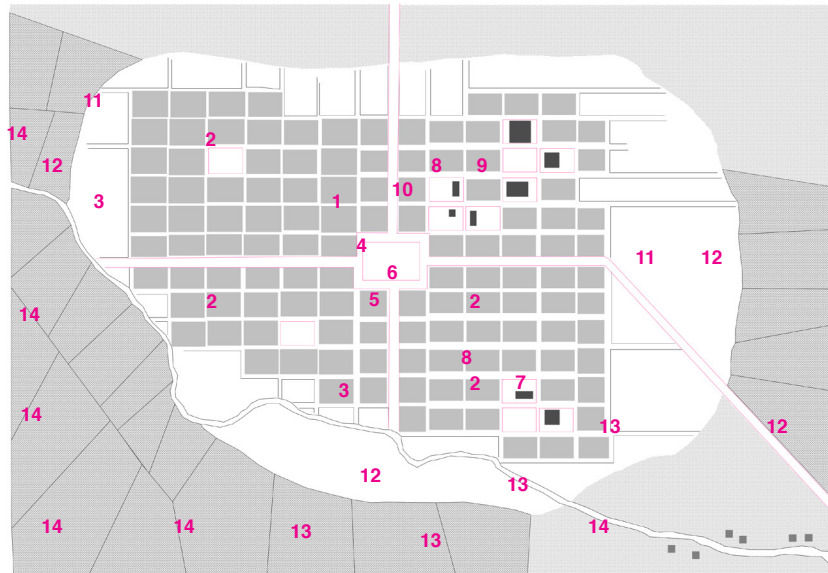
**FIG 12** FORMAL SETTLEMENT  
COASTAL PLAN  
ADAPTED FROM: REED

The urban development of colonial Manila followed a similar system of colonial cities established in Hispanic America; Mexico City became the model for most of the Hispanic urban centres in the Philippines.<sup>8</sup> The morphology of colonial Manila diverged from the irregular street pattern that was most common in European cities, but rather followed a systematic grid pattern. When the initial plan for Manila was laid out, it was important to have a defensible location and still guarantee access to the agricultural riches of the area. The mouth of the river Pasig, facing Manila de Bay, was chosen as the strategic site for the main Spanish quarters, Intramuros, the 'walled city' of Manila. Outside of these walls were the various residential, institutional and commercial areas for

the rest of Manila's population. Although the urban morphology conforms to a very systematic and grid-like pattern, the colonists still adhered to the pre-colonial patterns of following the length of the river Pasig.

The foreign merchants and sailors who came to Manila during the flourishing galleon exchange became year-round dwellers and had "a considerable freedom of movement and residence within the environs."<sup>9</sup> When the numbers of these 'year-round' dwellers increased, separate quarters were established for them. These quarters were somewhat specific to their country of origin, the Chinese stayed with their own, as did the Japanese merchants.





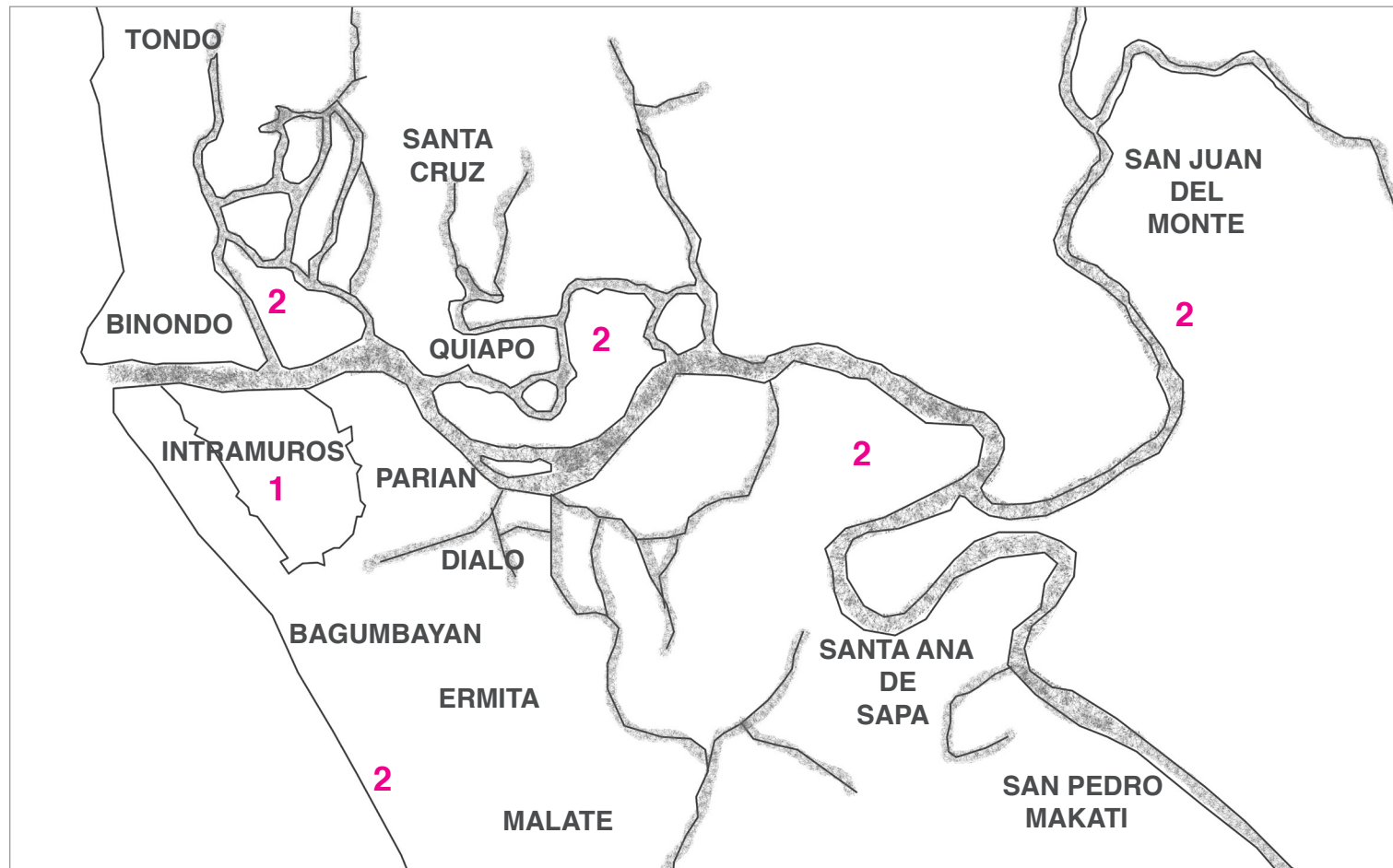
**FIG 13** FORMAL SETTLEMENT  
INLAND PLAN  
ADAPTED FROM: REED

- 1 Plaza Major
- 2 Plaza
- 3 Street with arcade
- 4 Cathedral
- 5 Hospital - non contagious
- 6 Monastery
- 7 Hospital - contagious
- 8 Custom House
- 9 Arsenal
- 10 Tribunal
- 11 Commons
- 12 Pasture land
- 13 Irrigated land
- 14 Cultivated land

Manila became a mosaic of Asian and Spanish cultures, different tongues and ways of dress were prominent, yet they all inhabited within proximity of the river in order to get access to the various and numerous galleon trade that came and went.

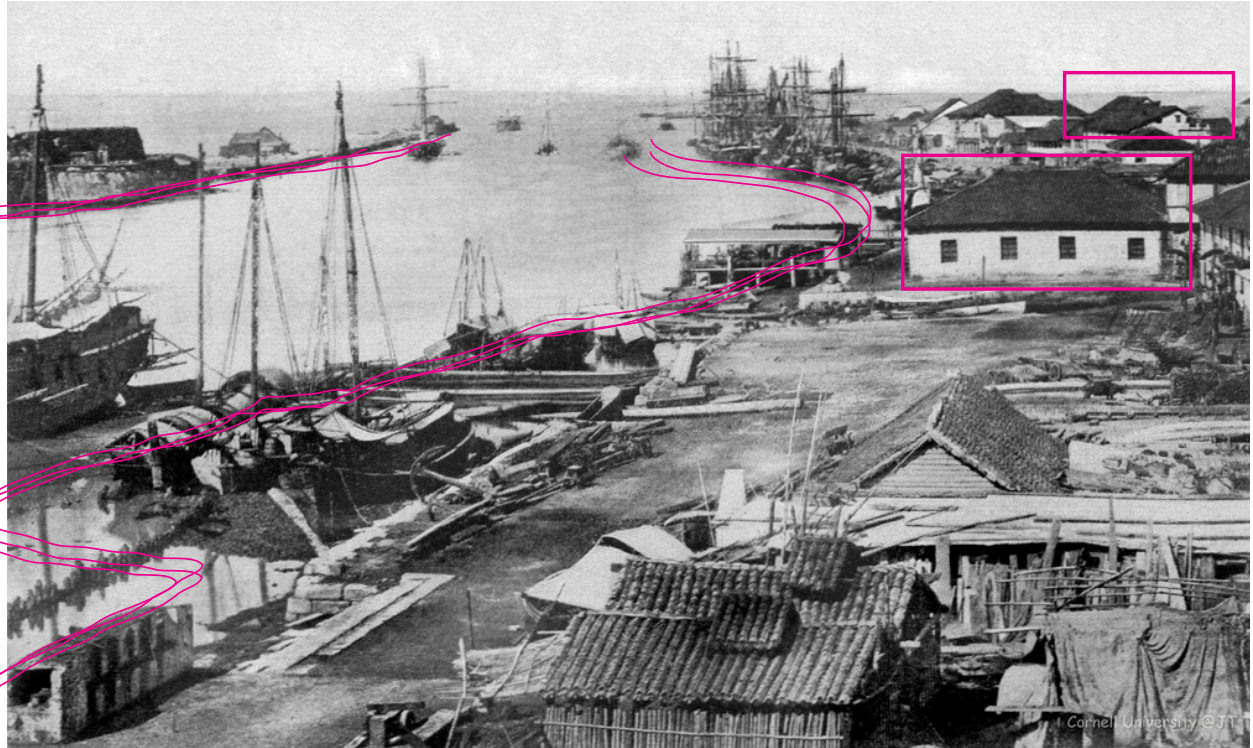
Most of the residential suburbs of Manila were established on or near the sites of pre-colonial villages. Majority of these suburbs were inhabited by the native Filipino, but due to the flourishing trade Manila was made home to various ethnic groups and these small settlements became urbanized communities.<sup>10</sup>

As years passed country estates started to occupy some of the riverside, while informal settlements are also present. These informal houses were used as storage and warehouses for trade, agriculture, and various residence whose occupation were tied to land and sea. Manila being the seat of the Spanish government was the main driving force to change the agrarian landscape into a robust and vibrant colonial capital. For three hundred years Manila continued to become urban, streets were laid with cobblestones, transportation networks were determined, and residential suburbs expanded.

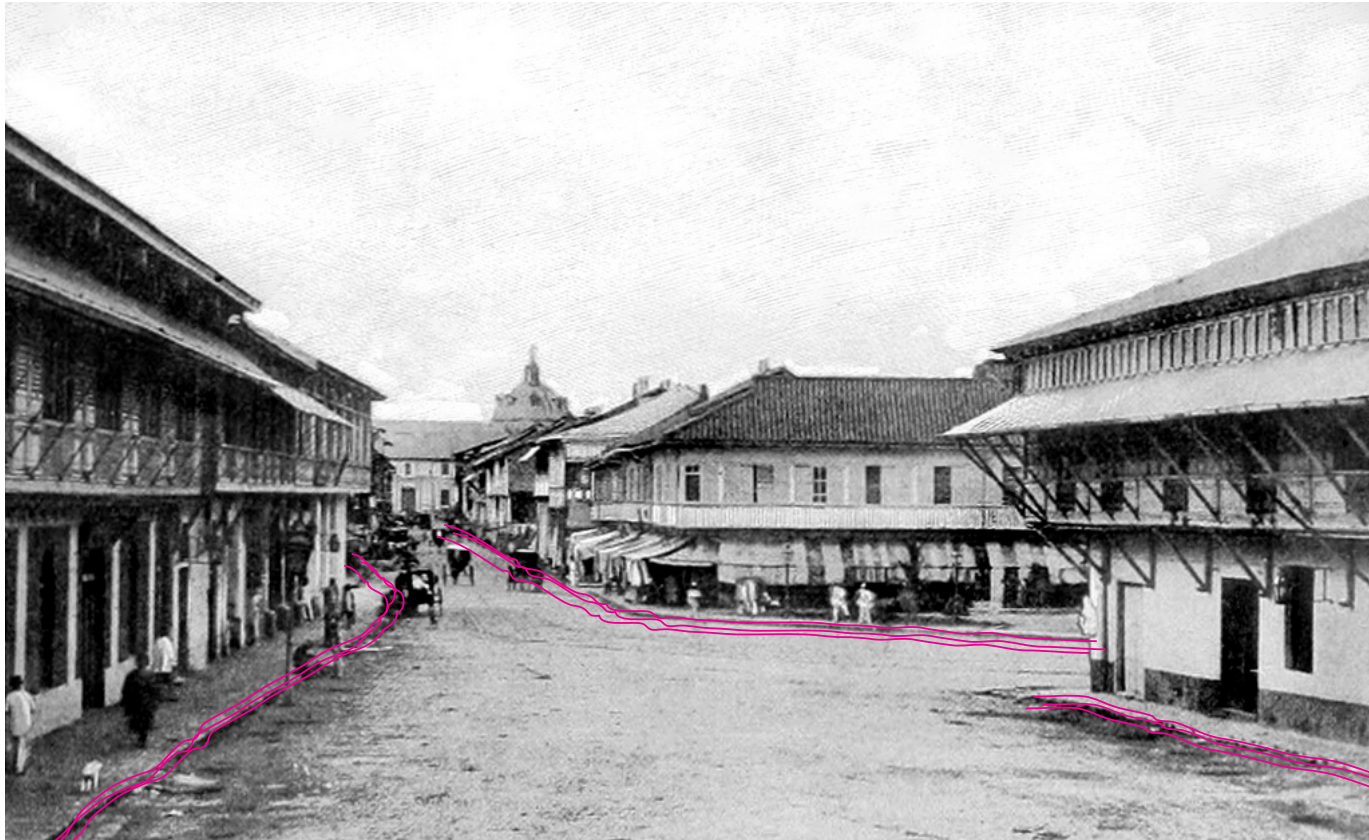


**FIG 14** COLONIAL SETTLEMENT  
MANILA C. 1630  
ADAPTED FROM: REED

**1** High Density - Formal Settlement  
**2** Low Density - Temporary Settlement



**FIG 15** INFORMAL SETTLEMENT  
SCATTERED ESTATES BY THE  
PASIG RIVER, 1800  
PHOTO CREDIT: JOHN TEWELL



**FIG 16** FORMAL SETTLEMENT  
ROSARIO STREET WITH BINONDO  
CHURCH IN THE DISTANCE, 1899  
PHOTO CREDIT: JOHN TEWELL

- American occupation (1898-1946):

By the turn of the century, a short time after the end of Spanish rule, the Philippines found itself within another foreign rule. The turn over of power from Spain to the United States of America had significant impact on the creation of the modern day Manila. Daniel Burnham was one of the architects that heavily contributed to the planning and improvement of the newly acquired tropical city. Burnham was part of the City Beautiful movement, which emphasized the beautification and adding opulence to cities. Despite this, according to Thomas Hines, the general plan of Manila “was remarkable in its simplicity and its cognizance of Philippine conditions and traditions.”<sup>11</sup> Burnham’s recommendation for Manila was in accordance with his ideas from various cities he’d planned for, such as Washington and Cleveland.<sup>12</sup>

Burnham’s recommendation for Manila’s detail took note of the city’s tropical climate and highlights

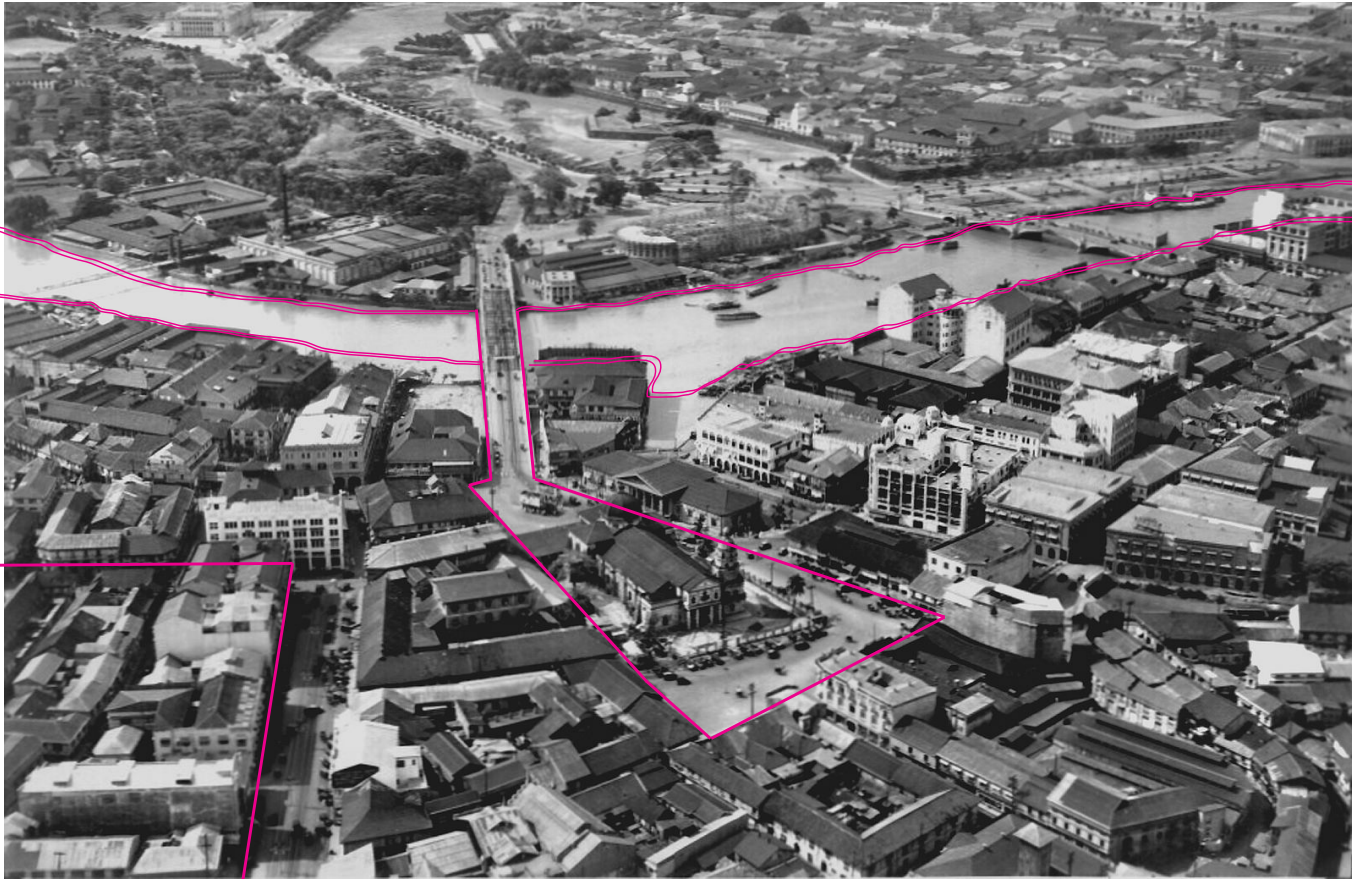
the strong evidence of Spanish-Philippine culture, furthering to create the Spaniards description of Manila as “the Pearl of the Orient”.<sup>13</sup> The plan suggested that government institutions would be arranged together into civic centres and open to face plazas and squares. The proposal of these centres would be less monumental than the cities across the western world.<sup>14</sup> Burnham saw the need to widen street space to accommodate transportation. The existing street system was lacking for convenient and easy passages throughout the city, thus Burnham recommended “superimposed diagonal arteries, radiating from the civic core to all the outlying sections.”<sup>15</sup> It was fitting in the planner’s perspective to have civic centres accessible from every vantage point. Accordingly, for future expansion, streets would conform to this type of pattern.

Most of the existing buildings are distinctly Spanish in style and the older section of the city, with its “well-shaded, narrow streets” were maintained for



historical and aesthetic purposes. There were many other recommendations for Manila's improvement, one of them being the use of the neglected canal systems. The esteros (canals) are channels that branch off from the Pasig river. Their main purpose unknown, some say that they were made as a way to allow a wider range for trade and transport, others speculate that their purpose was to help channel water flow during a storm event. In Burnham's report he suggested that even though they were stagnant and unsanitary they held promise to become valuable for transportation purposes and may become as an aesthetic element such as the canals in Venice.<sup>16</sup>

As time progressed the city started to embrace what the modern world had to offer. Although Burnham was not physically in the Philippines to be involved in the redevelopment of Manila, his 'Plan for Manila' was as Cameron Forbes stated in *Writing of Manila* in 1928, "sacred and being strictly adhered to."<sup>17</sup> The urban development did help create a capital city that is deferential "toward the symbol of the Nation's power,"<sup>18</sup> to "improve and reorder the national landscape."<sup>19</sup>



**FIG 17** THE BANKS OF THE PASIG RIVER  
1920  
PHOTO CREDIT: JOHN TEWELL



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|    |                              |           |
|----|------------------------------|-----------|
| 1  | Caloocan City.....           | 1,489,040 |
| 2  | Venzuela City.....           | 575,356   |
| 3  | Malabon City.....            | 353,337   |
| 4  | Navotas City.....            | 249,131   |
| 5  | Quezon City.....             | 2,761,720 |
| 6  | Marikina City.....           | 424,150   |
| 7  | San Juan City.....           | 121,430   |
| 8  | Manila City.....             | 1,652,171 |
| 9  | Pasig City.....              | 669,773   |
| 10 | Mandaluyong City.....        | 328,699   |
| 11 | Makati City.....             | 529,039   |
| 12 | Municipality of Pateros..... | 64,147    |
| 13 | Pasay City.....              | 392,869   |
| 14 | Taguig City.....             | 644,473   |
| 15 | Parañaque City.....          | 588,126   |
| 16 | Las Piñas City.....          | 552,573   |
| 17 | Muntinlupa City.....         | 459,941   |

National Capital Region (total pop.) 11,855,975

**FIG 18** METRO MANILA [SATELLITE MAP]  
NATIONAL CAPITAL REGION  
POPULATION, 2010  
PHOTO CREDIT: ARCGIS

1:250,000  3500m





## Contemporary period

Although Manila was heavily damaged during the Second World War, Burnham's improvement was still intact creating a basis for the urban development of post-war Manila. Today Metropolitan Manila or the National Capital Region encompasses all 16 cities and 1 municipality near the historic centre City of Manila. By the beginning of the 20th century, Manila's urbanized area covered almost 2000 hectares of land.<sup>20</sup> In the 1990s it has expanded to a 30-kilometre radius from the original City of Manila, and is still growing rapidly.<sup>21</sup> Since the end of World War II, Metropolitan Manila has seen a "massive movement of rural dwellers to urban centres"<sup>22</sup> that has led to the increase of poor urban settlements in the metropolitan area. Changes to accommodate "this unplanned and uncoordinated urban growth"<sup>23</sup> were made. Along the coast of Manila Bay, a number of land reclamation projects were implemented to provide more land for the masses to occupy. Agricultural lands were converted into residential subdivisions and commercial uses. Informal settlements expanded within the most vulnerable spaces such as the riverbanks. These actions reflected the need for additional space but in doing so drastically altered the city and made it more vulnerable to natural hazards.

**FIG 19** [PREVIOUS PAGE]  
INFORMAL HOUSING BY A CANAL  
(ESTERO DE LA REINA)  
PHOTO CREDIT: TRAVEL ORIENTED

### Endnotes:

1. Robert Reed, *Colonial Manila: The Context of Hispanic Urbanism and Process of Morphogenesis* (Berkeley: University of California Press, 1978) 5-8.

2. Reed, *Colonial Manila*, 59.

3 - 4. Ibid, 9.

5. Ibid, 47.

6. Ibid, 21.

7. Ibid, 26.

8. Ibid, 39.

9. Ibid, 52.

10. Ibid, 59.

11. Thomas Hine, "The Imperial Façade: Daniel H. Burnham and American Architectural Planning in the Philippines," *Pacific Historical Review*, 41, no.1 (1972): 43, accessed October 27, 2015, <http://www.jstor.org/stable/3638224>.

12. Hines, "The Imperial Façade," 43.

13 -14. Ibid.

15. Ibid, 44.

16. Ibid, 46.

17. Ibid, 51.

18. Ibid, 44.

19. Ibid, 52.

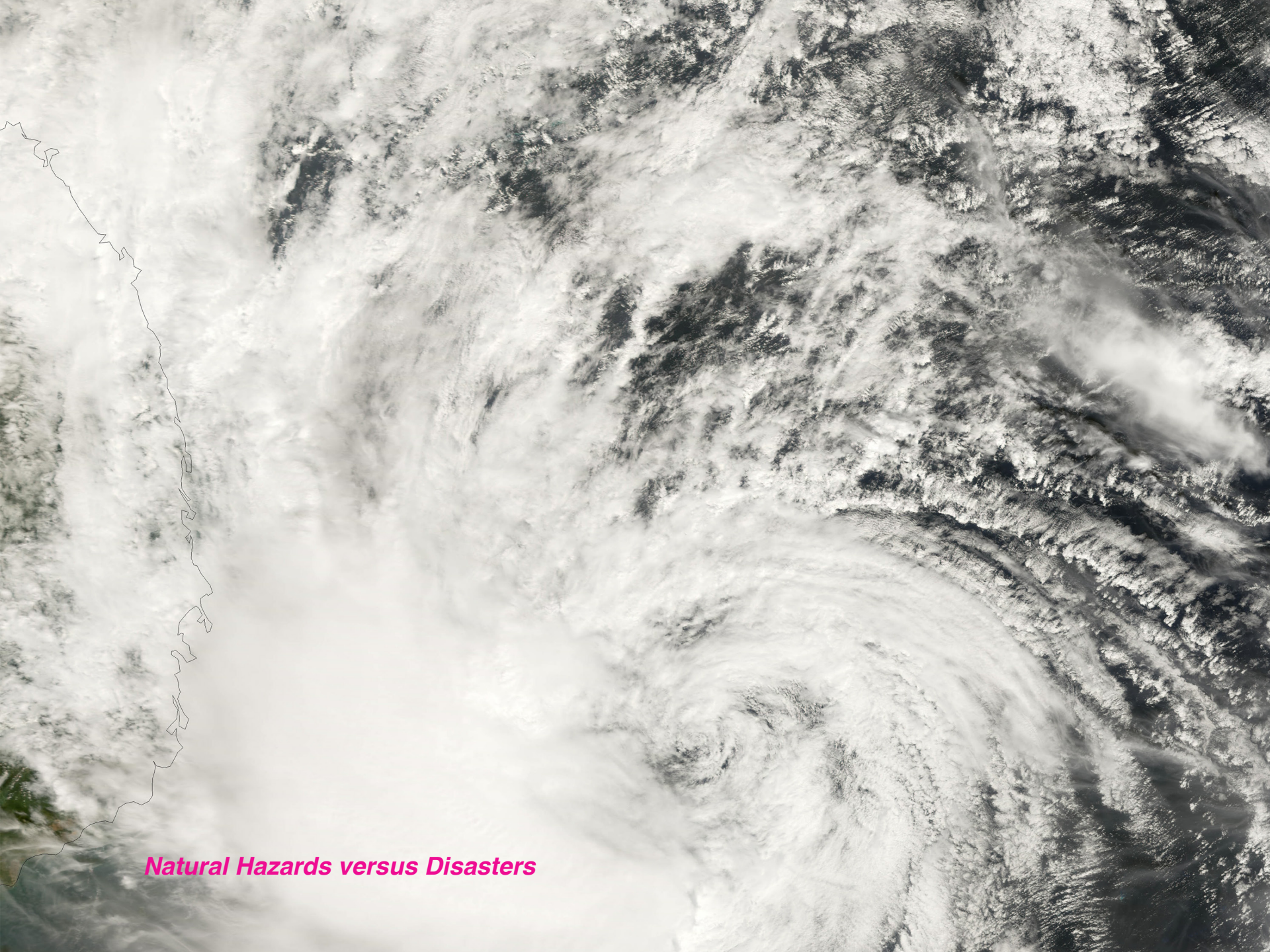
20. Doracie Zoleta-Nantes, "Flood Hazards in Metro Manila: Recognizing Commonalities, Differences and Course of Action," *Social Science Diliman*, 2006, accessed May 12, 2015, <http://www.journals.upd.edu.ph/index.php/socialsciencediliman/article/viewFile/36/7>.

21- 23. Zoleta-Nantes, "Flood Hazards in Metro Manila," 66.

***Vulnerability***

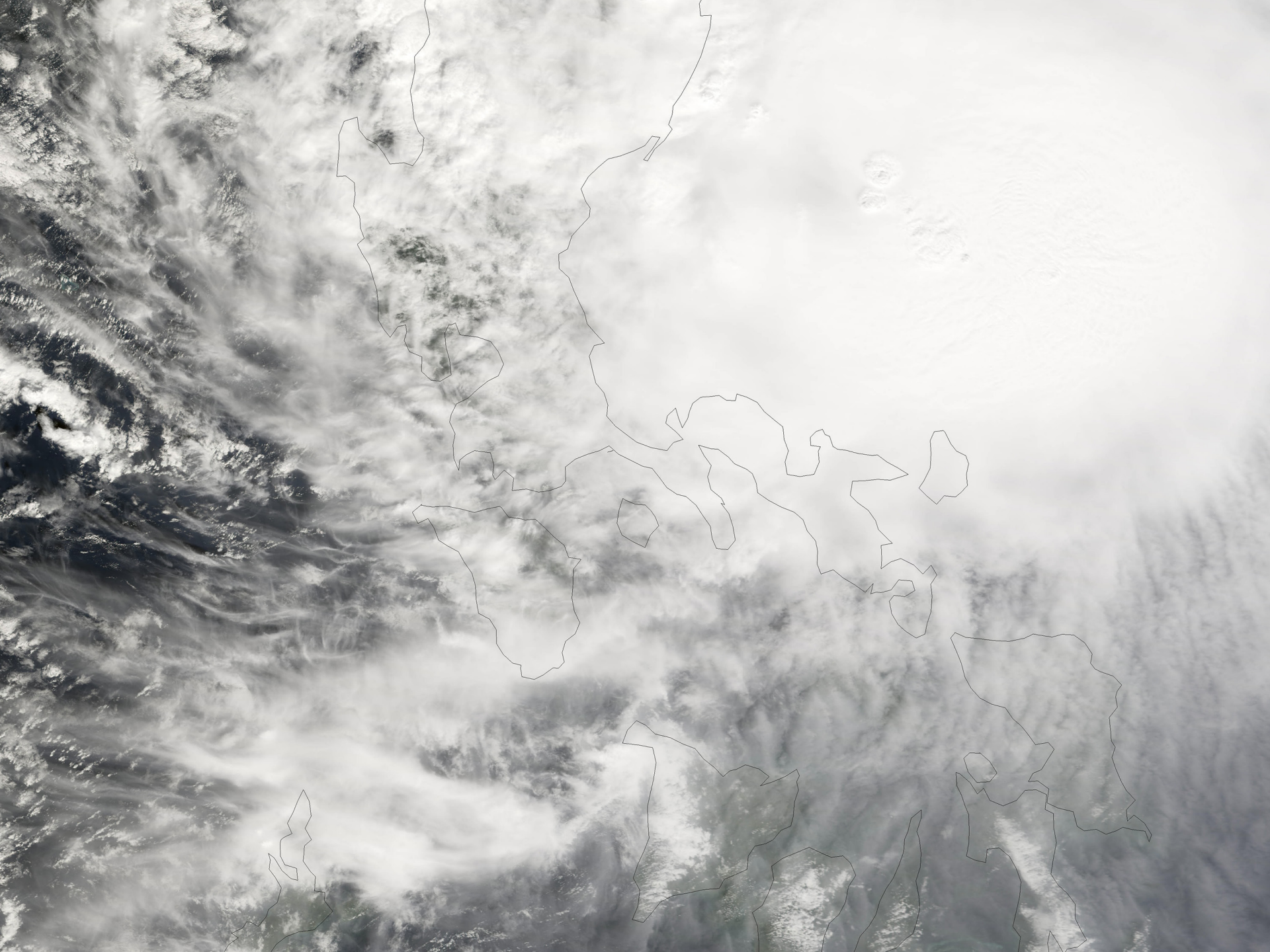






***Natural Hazards versus Disasters***







**FIG 20** [PREVIOUS SPREAD]  
 TYPHOON MITAG (RIGHT) ENTERING  
 THE PHILIPPINES WHILE TROPICAL  
 STORM HAGIBIS (LEFT) LEAVES ON  
 NOV. 25, 2007  
 PHOTO CREDIT: NASA IMAGE BY  
 JESSE ALLEN

## Natural Hazard versus Disasters

The geographical location of the Philippine's plays a significant role in the country's continuous exposure to hazards. According to the Belgium-based Centre for Research on the Epidemiology of Disasters (CRED) the Philippines is both "geophysically and meteorologically one of the world's natural hazard hot spots", it experiences the occurrence of natural hazards more than any other country in the world.<sup>1</sup> It lies on what has been called the 'Pacific Rim of Fire', wedged between the much larger Pacific and Eurasian tectonic plates, making the country susceptible to extreme seismic activity.<sup>2</sup> The extent of the hazards



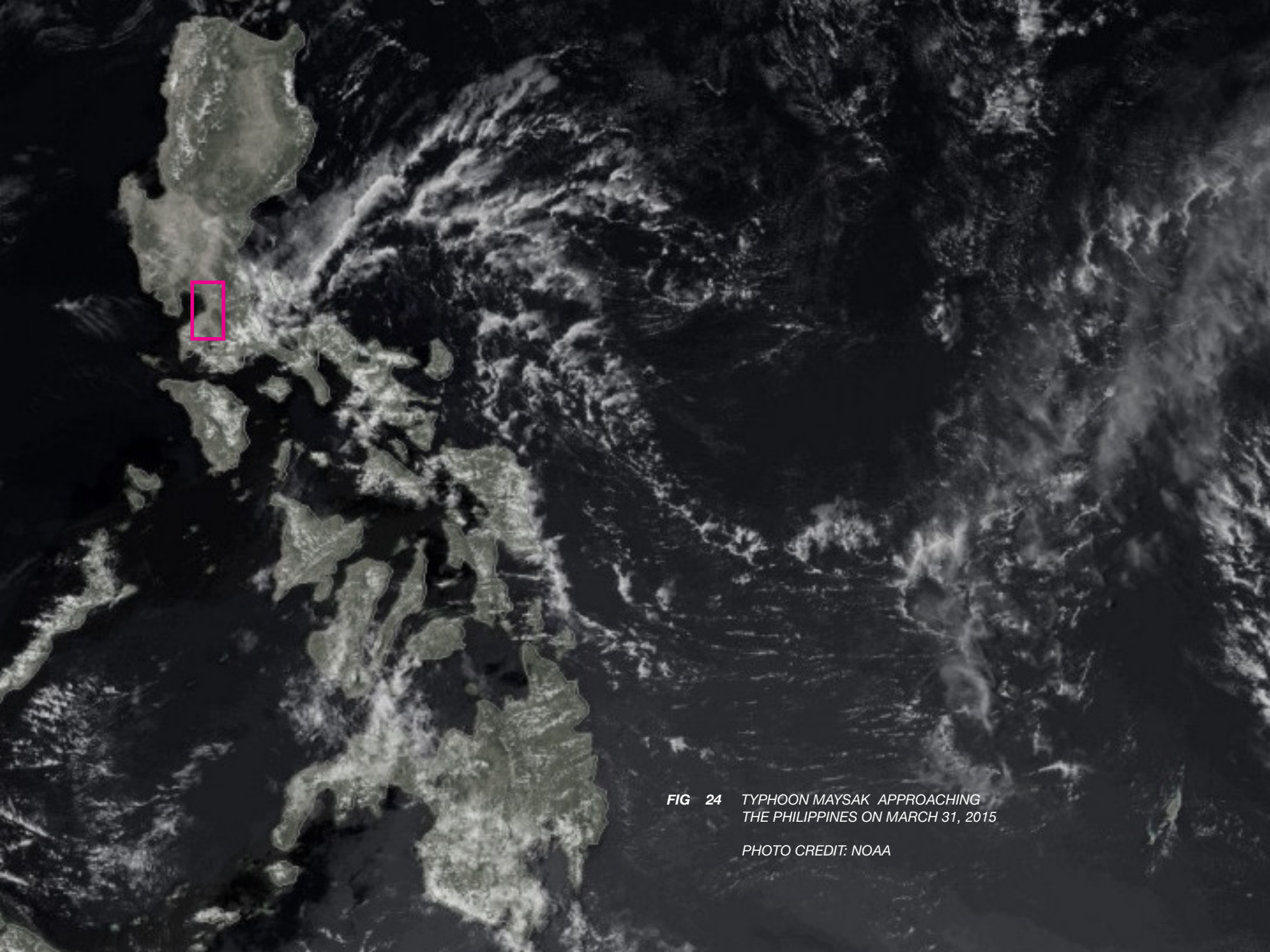
are not limited to those caused by seismic activity - the archipelago is also prone to heavy inundation caused by typhoons (tropical cyclones) due to the fact that it lies within the Pacific Typhoon system. This particular feature is a part of the reasons that make metropolitan Manila susceptible to heavy inundation, which renders daily activity to a standstill.

Flooding has been an intrinsic part of the Philippine setting. It has been, "historically, the source of much privation and suffering."<sup>3</sup> According to chronicled accounts there are two major types flooding in the archipelago. One is due to localized rainfall that results in water to peak quickly and dies away just

as fast after. While the other type of flooding takes a longer period of time to dissipate and affects an extensive amount of area. The latter type is usually the result of persistent rainfall that can last for an extended time. The Archive of Manila Observatory has a list of records pertaining to flood events that occurred since the 17th century and has made a connection that "56 per cent of all incidences are directly attributed to typhoons."<sup>4</sup>

**FIG 21, 22, 23** HISTORICAL IMAGE OF FLOODING  
IN MANILA  
PHOTO CREDIT: JOHN TEWELL

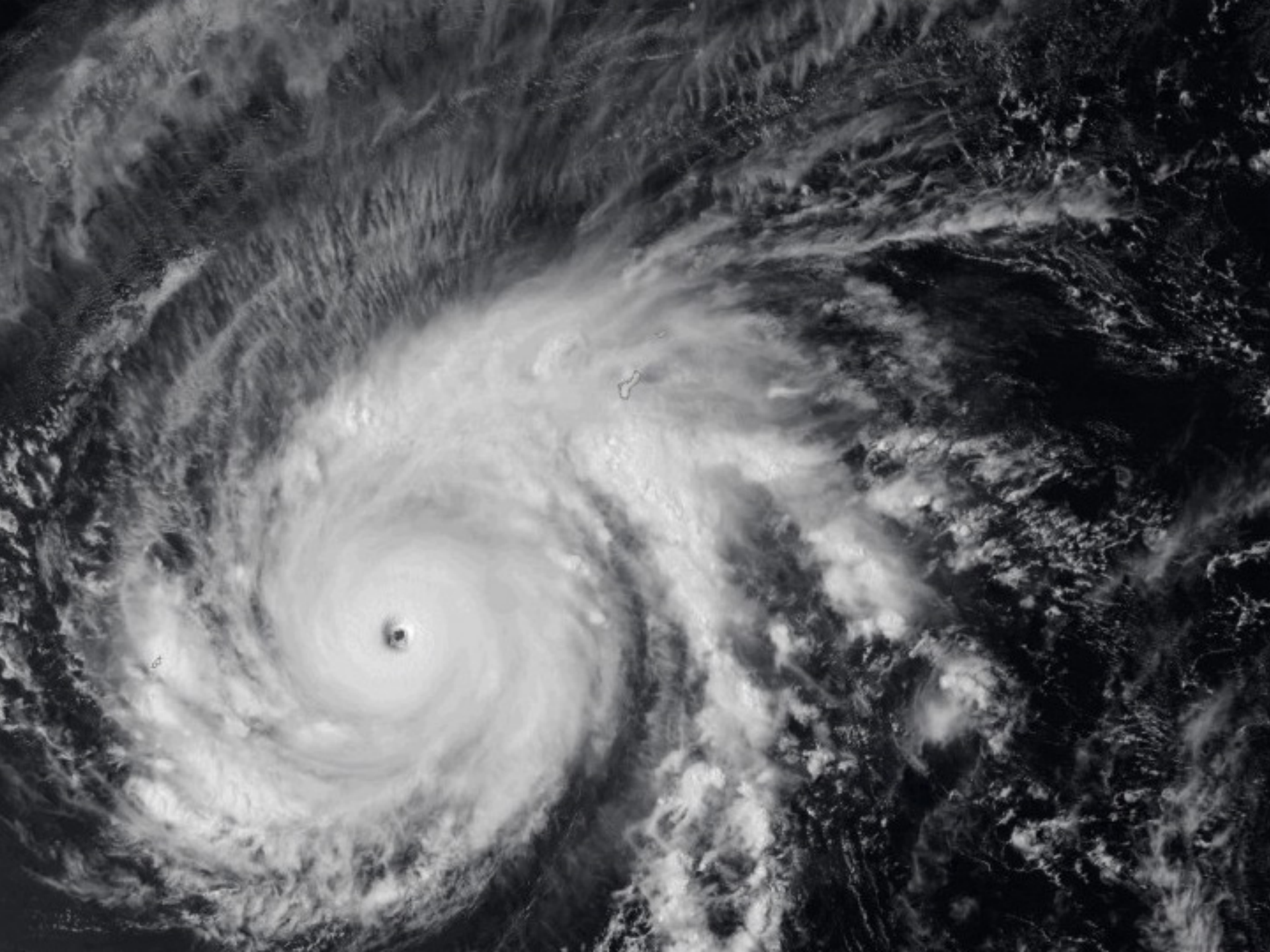




**FIG 24** TYPHOON MAYSAK APPROACHING  
THE PHILIPPINES ON MARCH 31, 2015

PHOTO CREDIT: NOAA



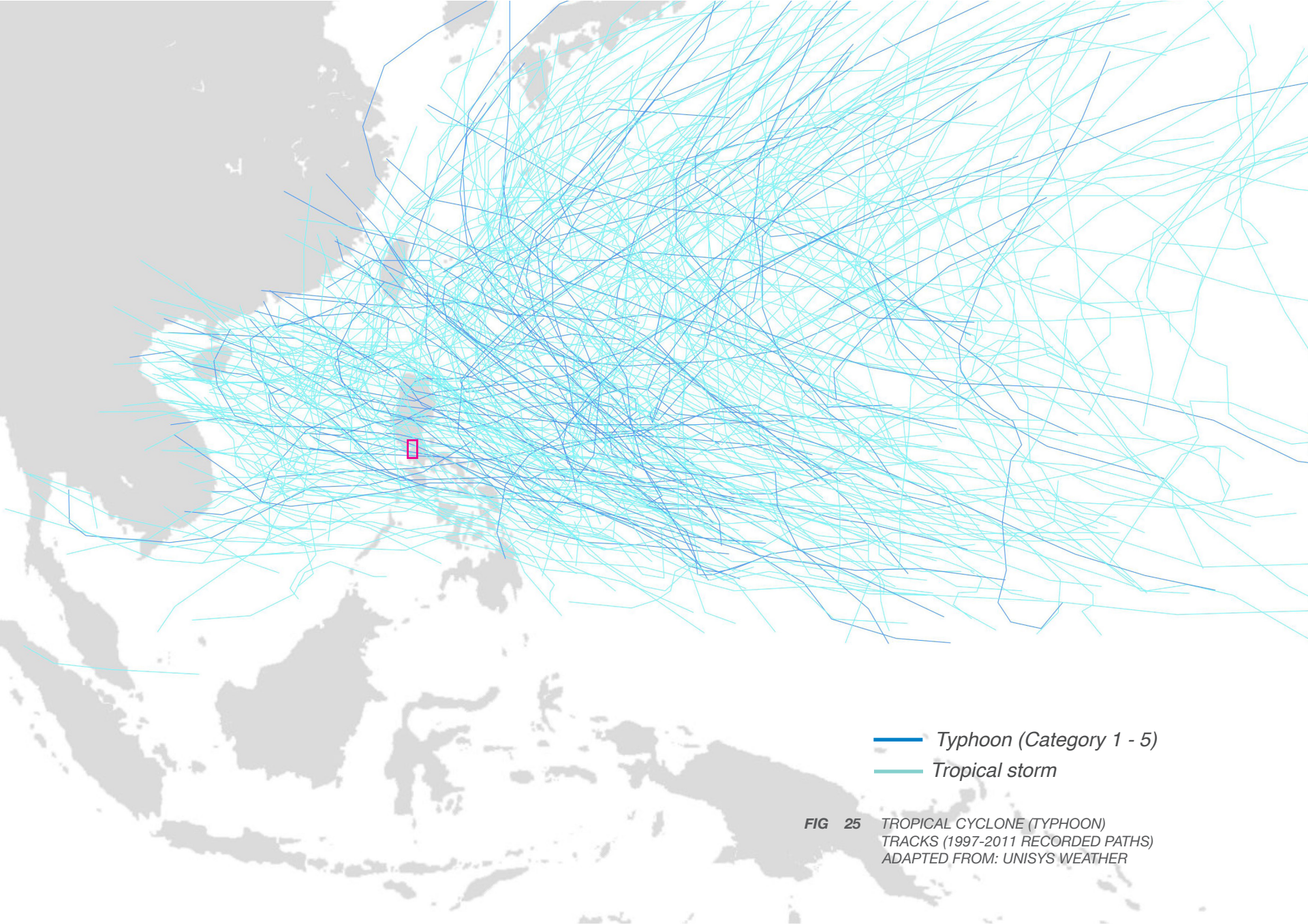


To understand the nature of flooding events, there should be a comprehensive grasp of the impact of tropical storms, or typhoons within the archipelago's climate. As stated earlier major flood events happen due to torrential rainfall that either happens quickly or ones last for a long duration of time. Most of these flood events are brought about by the passage of tropical cyclones. Typhoons bring about "38 per cent of annual average rainfall."<sup>5</sup> The annual average precipitation in the country is 2,928 millimetres, which in some cases 50 per cent is reached during a single typhoon event. <sup>6</sup>

Typhoons or topical cyclones are an amalgamation of low atmospheric pressure, heat, and slight winds. Under these circumstances a storm is produced. The hazardous characteristics that tropical cyclones and hurricane bring when they make landfall are its violent winds, heavy rain and storm surges.<sup>7</sup> There are five main identified routes that a typhoon takes through the archipelago: "one that crosses to the north of Manila; one that traverses south of the capital; one that passes east or north-east of the archipelago either disappearing or re-curving in the Pacific; one that forms in the China Sea to the west of the Philippines; and another that re-curves in the China Sea between the parallels 10 degrees and 20 degrees."<sup>8</sup>

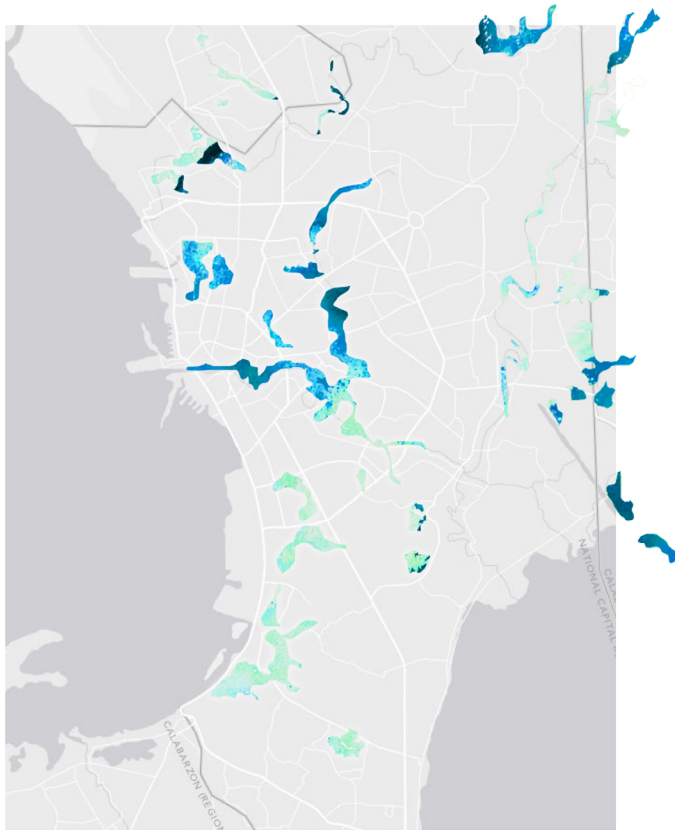
It is equally important to know the paths a tropical cyclone takes as it gives us an overview of which areas are prone to the consequences of their passage. Rarely does a tropical storm form and pass through between the months of January and March, but is more frequent between July and November. At least 20 tropical storms or typhoons pass through the Philippines Area of Responsibility annually.<sup>9</sup> Not all of them are what we term as 'remarkable' or destructive typhoons, in reality only 1 per cent of the annual average are of this nature. The rest are responsible for the torrential rainfall that makes the archipelago so fertile.<sup>10</sup> It is significant to be familiar with tropical cyclone patterns as it provides a correlation regarding about the regularity and the intensity of floods. Also, it gives us a certain pattern in the seasonality of their occurrence, which corresponds directly to the peak of flooding events. By studying the various accounts of typhoon paths it is revealed that the Luzon Island receives the higher number of typhoon, and thus also prone to a higher number of flood events. Metropolitan Manila is situated within this region and is predisposed to receive its hazardous characteristics, which includes the inundation of most of its areas.



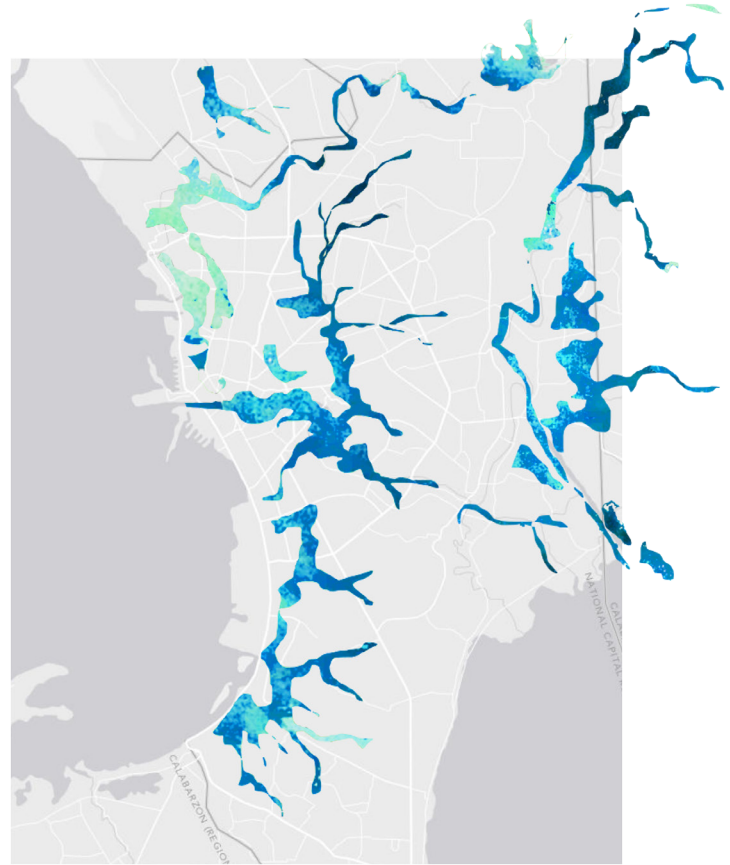


— Typhoon (Category 1 - 5)  
— Tropical storm

**FIG 25** TROPICAL CYCLONE (TYPHOON)  
TRACKS (1997-2011 RECORDED PATHS)  
ADAPTED FROM: UNISYS WEATHER



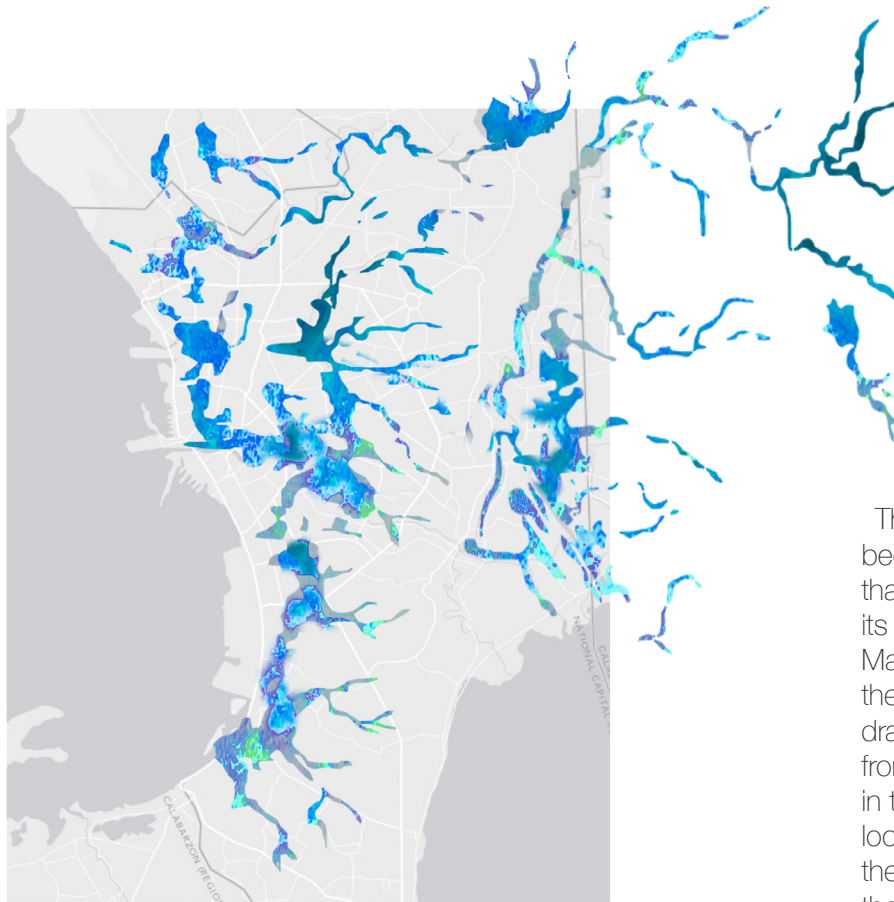
5 year flood plain



10 year flood plain



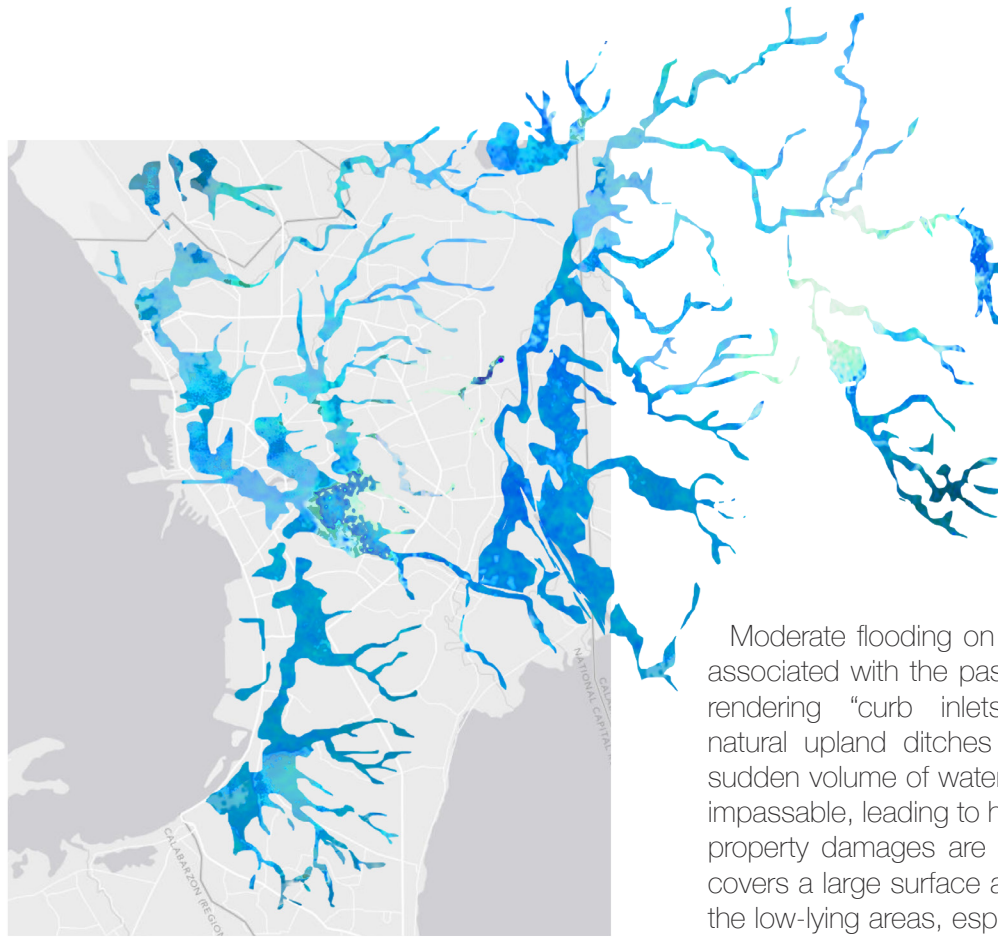




*25 year flood plain*

**FIG 26, 27, 28 FLOOD MAPS (LEFT-RIGHT)**  
ADAPTED FROM: NOAH DOST

The metropolitan area is predisposed to flooding because it is situated in a semi-alluvial floodplain that is formed by sediment flow from river basins in its northern and eastern borders. It is open to the Manila Bay on the west and the Laguna de Bay on the southeast. The conurbation is “a vast urbanized drainage basin that experiences frequent inundations from overflowing rivers and storm waters.”<sup>11</sup> Flooding in the metropolitan area is classified into three types: local, moderate and regional. The difference between the three categories is the reach of areas affected and the duration of the flood event. “Local street flooding is the result of intense, sudden thunderstorms over a few city blocks that cause inundations of 20-50 centimetres.”<sup>12</sup>



*50 year flood plain*

Moderate flooding on the other hand is typically associated with the passage of a tropical cyclone rendering “curb inlets, drainage, culverts or natural upland ditches insufficient to handle the sudden volume of water.”<sup>13</sup> Whole districts can be impassable, leading to heavy traffic congestion and property damages are considerable as the event covers a large surface area. Flood events occur in the low-lying areas, especially near water channels and the Pasig River.

**FIG 29** FLOOD MAP  
ADAPTED FROM: NOAH DOST

1:200,000  3500m





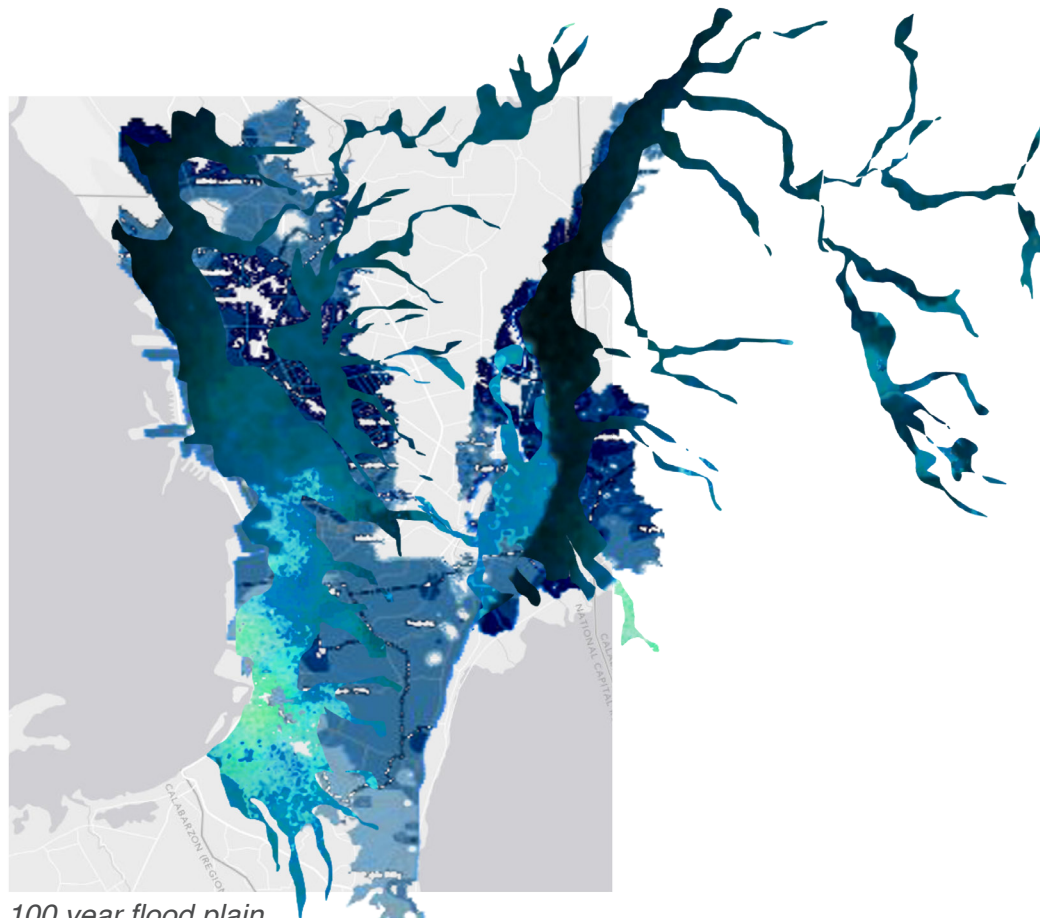
FIG 30. STREET FLOOD IN MANILA  
PHOTO CREDIT: ROBIN ZEBROWSKI





**FIG 31** TYPHOON KETSANA FLOODS THE  
NATIONAL CAPITAL REGION  
SEPTEMBER 24-26, 2015  
PHOTO CREDIT: KRIS CARILLO





100 year flood plain

**FIG 32** FLOOD MAP  
ADAPTED FROM: NOAH DOST

1:200,000  3500m

The most severe type of flooding in Metro Manila affects almost the entirety of the region and its surrounding river basins. This large-scale event ensues from heavy rainfall that last several days, which is characteristically linked with typhoons (tropical cyclones) and consequently magnify storm surges from the coast.<sup>14</sup> With Regional flooding events “all gainful activities are severely curtailed until the waters subside.”<sup>15</sup>

#### Endnotes:

1. Greg Bankoff, *Cultures of Disaster: Society and Natural Hazard in the Philippines* (London: Routledge Curzon, 2003) 31.
2. Bankoff, *Cultures of Disaster*, 31.
3. Greg Bankoff, “Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila.” *Disasters* 27, no 3 (2003): 96-97. doi: 10.1111/1467-7717.00230.
4. Bankoff, “Constructing Vulnerability”, 96-97.
5. Ibid.
6. “Average Precipitation per Year,” *The World Bank*, accessed April 30, 2015, <http://data.worldbank.org/indicator/AG.LND.PRCP.MM>.
7. Donald Watson, and Michele Adams. *Design for flooding: Architecture, Landscape, and Urban Design for Resilience to Flooding and Climate Change* (New Jersey: John Wiley and Sons, 2011) 57.
- 8 - 10. Bankoff, “Constructing Vulnerability”, 96-97.
- 11 -14. Ibid. 98-100.
15. Ibid, 99.



Urbanization





“Natural hazards, then, are an integral feature of the Philippine environment.”<sup>1</sup> The metropolitan area continues to grow and expand which exposes many residential homes, industries and commercial sites to flood related destruction. Flooding may be attributed to natural causes such as the area being a flood plain and susceptible to storm surges from its coastline. However what truly subject metropolitan Manila to “natural hazards and increasing the incidence of disasters”<sup>2</sup> are human activities that have altered and affected the physical environment.

Despite the overall vulnerability of the area rapid urbanization continues to grow unabated. This continuous growth collectively with the differences in land usage and misuse of environmental resources increases the extent of flooding in the metropolitan area.

**FIG 33** *[PREVIOUS SPREAD]*  
*METROPOLITAN MANILA*  
*PHOTO CREDIT: PATRICK ROQUE*

**FIG 34** *INFORMAL HOUSES ALONG AN*  
*ESTEROS (CANAL) IN MANILA*  
*PHOTO CREDIT: BBC WORLD SERVICE*

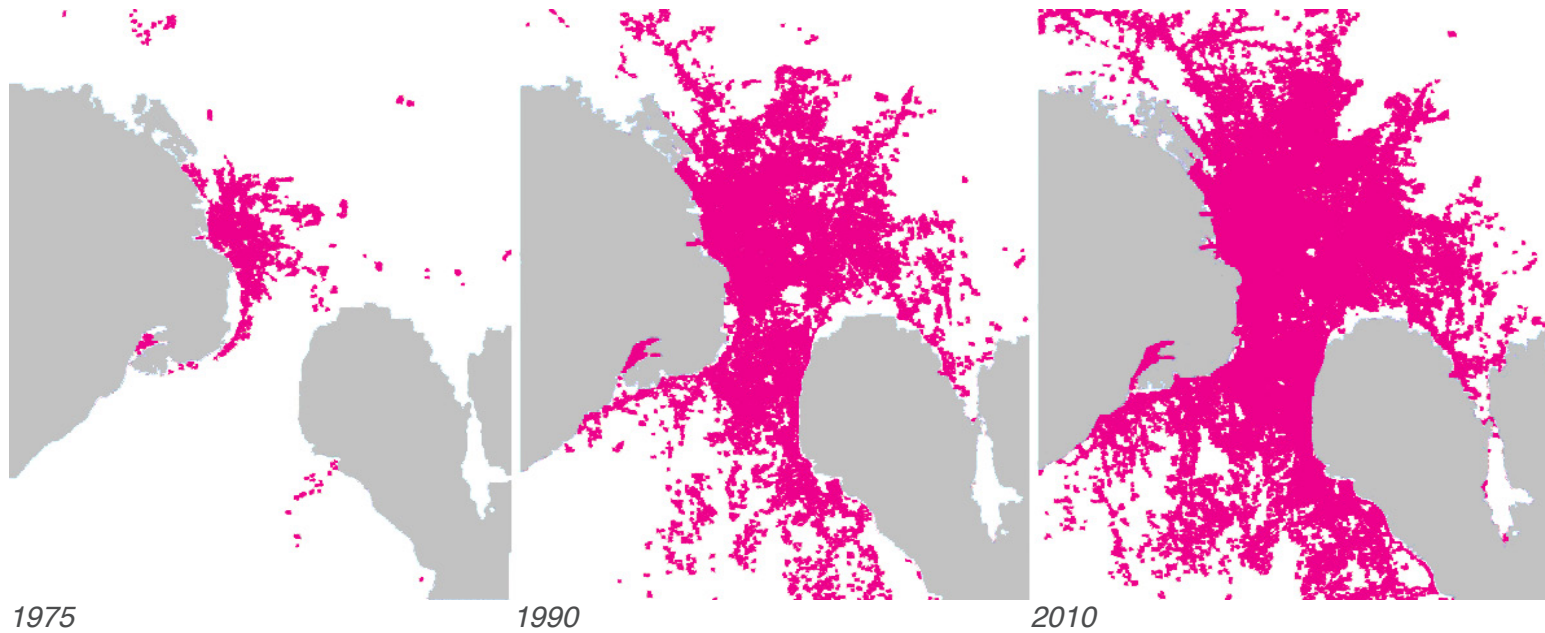




As the metropolitan area grew over time, activities pertaining to modernization have led to formation of a vulnerable capital city. The encroachment of new structure to the hills east of the metropolitan area and the reduction of “width and depth of tidal channels,” such as the Pasig River, has subjected 70 per cent of the metropolitan area to floods. The widespread use of non-permeable material such as concrete and bitumen has greatly increased the volume of run-off which then intensifies the event. These are just some of the numerous human-induced activity related to urbanization.

The principal factor that has brought about the vulnerability issue in metropolitan Manila is the ever-escalating size and density of its population. This growth in population begun during the end of the Second World War, where rural folk were inclined to venture to the city to gain higher livelihood opportunities. Most of these migrants were poor and could not afford the high cost of building and construction materials for housing. Land values throughout the area have also increased overtime, and were mostly reserved for commercial and business purposes. As a result, many of the rural folk

looking for opportunities had to find accommodation elsewhere and most of them found themselves within the informal housing areas. The city’s drainage system capacity was greatly affected by this unintended urban growth.<sup>3</sup> Overcrowded informal settlements are often situated near available waterways and along major transportation links. In the past, before the immediate rise of the population, the capacity of rivers, canals, and modified natural channels (esteros) were usually able to handle the volume of flood water discharge. The infringement of these informal structures has hindered that capacity.<sup>4</sup> As the metropolitan area grew in size and density, the only outlet for water run-off from the area and the overflow from Laguna de Bay has become the Pasig River. During flood events the main responsibility of the Department of Public Works And Highways is to mitigate discharge, along with the drains and canals spread throughout the metropolitan area. Their course takes the volume of water towards Manila Bay.<sup>5</sup> Unfortunately because of the lack of permeable surfaces and the large volume of water that is directed to these channels, inundation happens before the flood waters have been discharged to the bay area.



**FIG 35** POPULATION GROWTH IN 35 YEARS  
METROPOLITAN MANILA  
ADAPTED FROM: EARTHZINE.ORG









Land-use around the metropolitan area has also changed. Residential and commercial areas, to hold the ever-growing metropolis, removed large parts of the natural watershed forestlands on surrounding hills. Reclamation of land along the coast reflected the need of additional space. These changes made extensive ramifications on flood patterns. Reclaimed areas were slightly higher in elevation than the mainland, which then "lessened the flow gradient of water in adjoining sewer and drainage systems."<sup>6</sup> In correlation with the denuded forestlands, rivers from upstream are instantly inundated during a storm event, which then easily flooded low-lying areas in coastal parts of Manila. As the year's progressed, without sufficient management in land use practices and the continuous influx of urban dwellers, flooded areas have extended beyond low-lying areas.

#### Endnotes:

1. Greg Bankoff, *Cultures of Disaster: Society and Natural Hazard in the Philippines* (London: Routledge Curzon, 2003) 39-40.
2. Bankoff, *Culture of Disaster*, 39 – 40.
3. Doracie Zoleta-Nantes, "Flood Hazards in Metro Manila: Recognizing Commonalities, Differences and Course of Action," *Social Science Diliman*, 2006, 66, accessed May 12, 2015, <http://www.journals.upd.edu.ph/index.php/socialsciencediliman/article/viewFile/36/7>.
4. Greg Bankoff, "Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila," *Disasters* 27, no.3 (2003): 103, accessed December 10, 2014. doi: 10.1111/1467-7717.00230.
5. Ibid.
6. Zoleta-Nantes, "Flood Hazards in Metro Manila," 66.

**FIG 36** ALONGSIDE THE PASIG RIVER  
METROPOLITAN MANILA  
PHOTO CREDIT: GOYA BAUWENS









## Environmental Degradation

“Forests also serve as efficient watersheds to collect and regulate the supply of water and moderate its pollution. Deforestation on the scale experienced by the Philippines over the last 50 years has caused massive soil erosion and led to the siltation and sedimentation of inland and coastal waters.”<sup>1</sup>

This continuous rise in population is not only affecting the urban fabric but “puts considerable pressure on resources that, in turn, has substantial consequences on the environment and intensifies both the severity and duration of floods.”<sup>2</sup> For instance, the swift deforestation that overtook the country since the 1930s has caused large areas within the archipelago to be exposed to existing hazards “as well as raised its predisposition to new ones.”<sup>3</sup>

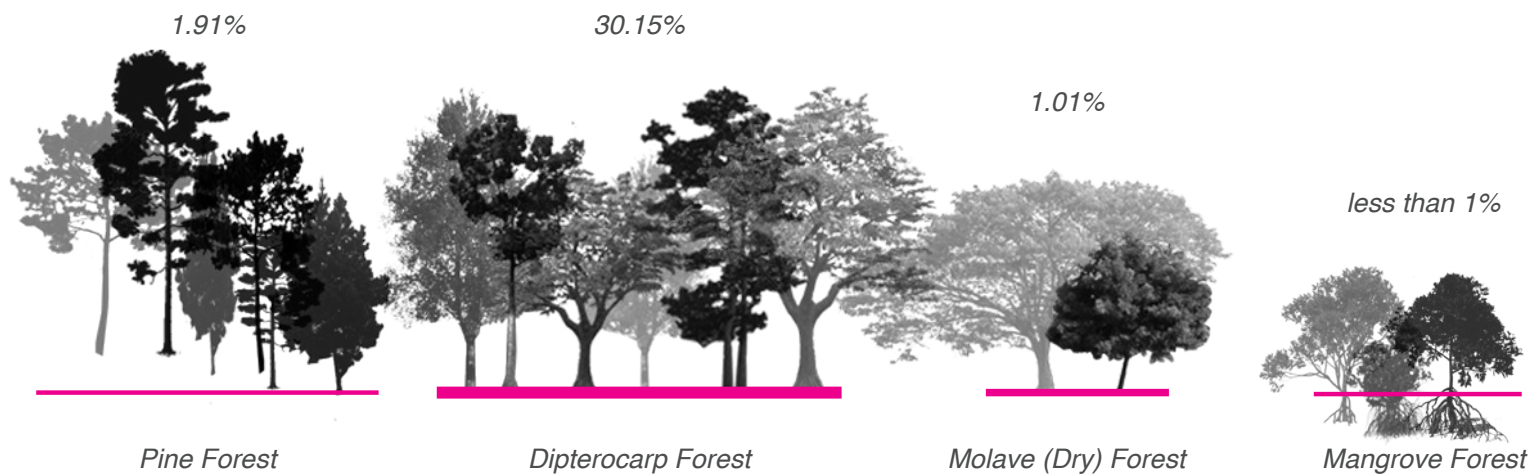
**FIG 37** [PREVIOUS SPREAD] MT. BATULAO,  
BATANGAS, PHILIPPINES  
PHOTO CREDIT: JOJO NICDAO





**FIG 38**    *DEFORESTATION*  
*MINDANAO, PHILIPPINES*  
*PHOTO CREDIT: FRANCESCO VERONESI*

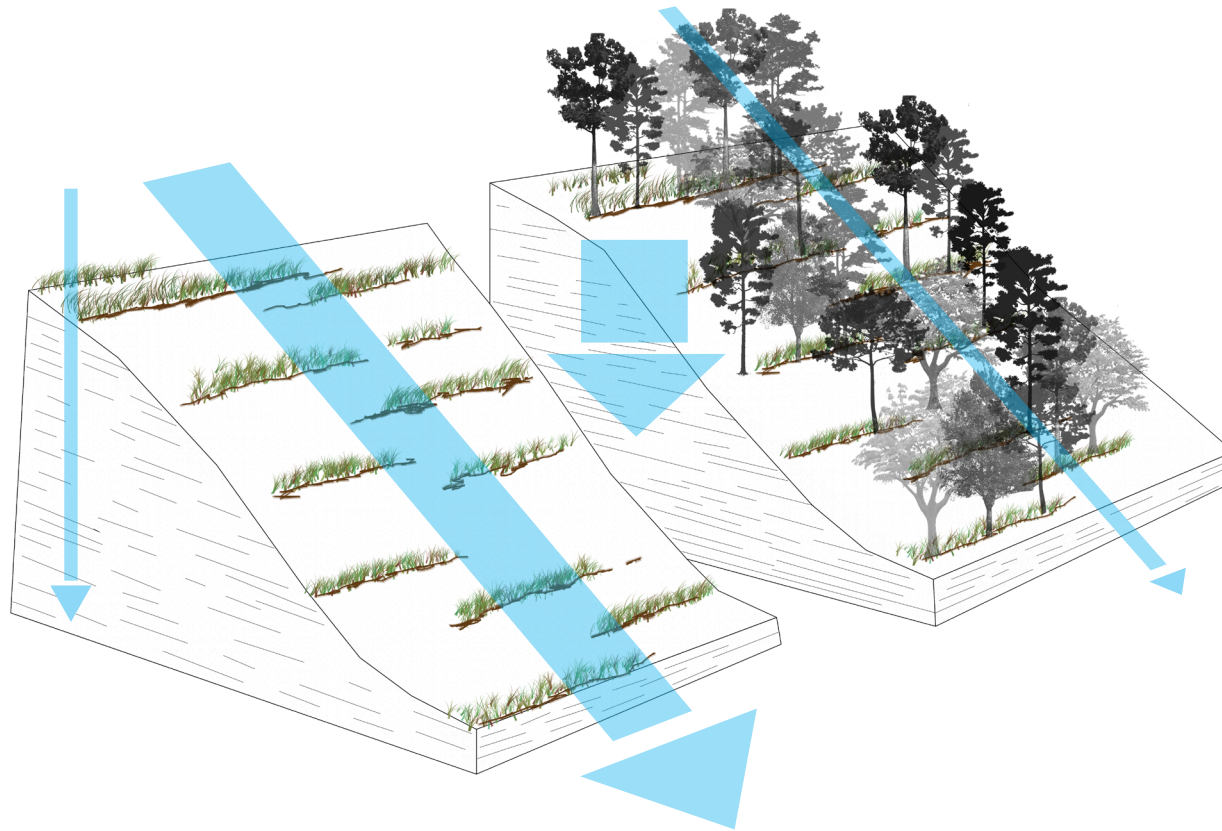




**FIG 39** FOREST TYPES IN THE PHILIPPINES  
ADAPTED FROM: F. WERNSTEDT,  
THE PHILIPPINE ISLAND WORLD

The islands were once described as a place with “nearly unparalleled diversity”<sup>4</sup> in vegetation. Through few written records it was said that the Philippine islands were enveloped by thick forest, “ringed with mangroves, coral reefs and rich fishing grounds.”<sup>5</sup> Forests in the Philippines were prized for their abundance and fertility. With their beauty, wealth, and “more recently, their diverse and largely untapped genetic resources,”<sup>6</sup> they were seen as a promise of commercial and economic prosperity. Overtime, cultivated fields and human settlements started to create great gaps in this ‘primeval forest’ and are now considered by biologist as lost ecosystems.<sup>7</sup> Practices in agriculture have succeeded to permanently change the landscape. At the end of World War II, the Philippines logging industry accelerated, “and by the 1950s and 1960s became the world’s largest exporter of tropical logs.”<sup>8</sup> The dipterocarp, a family of tropical hardwoods, were ultimately the timbers that were exported – mature dipterocarps that towered over vast lands that were cleared. Warnings of future consequences were ignored for profit, decades of advice to manage the islands forest as renewable resources, left unheard, and only when tress left uncut were in its lowest did deforestation slow down.<sup>9</sup>

“ In cities, the storms flood low-lying neighborhoods...they wrench roofs form walls. In the rural provinces, they batter the open land. The forest’s multiple layers can endure this onslaught. They buffer the high winds, deflect the hammering of rain, and shield the soil. They also modulate the water cycle. The rain drips through the many layers of leaves and runs down branches and trunks, soaking into the litter covering the forest floor. In what scientist call the sponge effect, the thick litter, soil, and plant roots absorb much of the rainfall, and over time, excess moisture seeps into underground streams and eventually into the rivers.”<sup>10</sup>



**FIG 40** CHANGES OF OVERLAND FLOW WITH  
LOSS OF VEGETATION  
ADAPTED FROM: WILLIAM M. MARSH  
LANDSCAPE PLANNING:  
ENVIRONMENTAL APPLICATIONS



Clear-cutting the forest indiscriminately contributed to the weakening of biodiversity and to serious soil erosion in the archipelago. Vegetation cover is one of the fundamental ways to control the extent and severity of soil erosion.<sup>11</sup> It is also a key factor in lessening rapid water run-off. The mountains and hills surrounding the National Capital Regions have undergone drastic changes to accommodate the expanding metropolitan area. Areas that were classified as part of the 28,000 hectares Marikina Watershed were transformed into residential subdivisions, villages and agrarian land.<sup>12</sup> Clearing part of a watershed resulted in erosion of 20 to 50 percent of the topsoil.<sup>13</sup> Taking away the natural protection that vegetation cover provides can lead to heavy rains cascading down bare slopes, bringing layers of soil, inundating rivers with muddy runoff, which would then accumulate and hinder the capacity of rivers, reservoirs and dams to carry water.<sup>14</sup> The Philippines would continue to experience great tragedy due to the “continued neglect, abuse, overuse, and exploitation of its natural vegetation.”<sup>15</sup> The ongoing loss of forest cover affects local climatic conditions, which then accentuates the severity of floods.<sup>16</sup>

#### Endnotes:

1. Greg Bankoff, *Cultures of Disaster: Society and Natural Hazard in the Philippines* (London: Routledge Curzon, 2003) 31.
2. Greg Bankoff, “Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila,” *Disasters* 27, no.3 (2003): 98-100, accessed December 10, 2014. doi: 10.1111/1467-7717.00230.
3. Bankoff, *Culture of Disaster*, 31.
4. Barbara Goldoftas, *The Green Tiger: The Cost of Ecological Decline in the Philippines* (Oxford: University Press, 2006), 4.
5. Goldoftas, *The Green Tiger*, 4.
6. *Ibid*, 27.
7. *Ibid*, 25.
- 8 – 9. *Ibid*, 27-28.
10. *Ibid*, 28.
11. Frederick Wernstedt and J.E. Spencer. *The Philippine Island World: A Physical, Cultural, and Regional Geography* (Berkeley: University of California Press, 1967), 78.
12. Doracie Zoleta-Nantes, “Flood Hazards in Metro Manila: Recognizing Commonalities, Differences and Course of Action,” *Social Science Diliman*, 2006, 66, accessed May 12, 2015, <http://www.journals.upd.edu.ph/index.php/socialsciencediliman/article/viewFile/36/7>.
13. Zoleta-Nantes, “Flood Hazards in Metro Manila,” 66.
14. Goldoftas, *The Green Tiger*, 28.
15. Wernstedt and Spencer. *The Philippine Island World*, 85.
16. Bankoff, *Culture of Disaster*, 34.

***Resiliency***



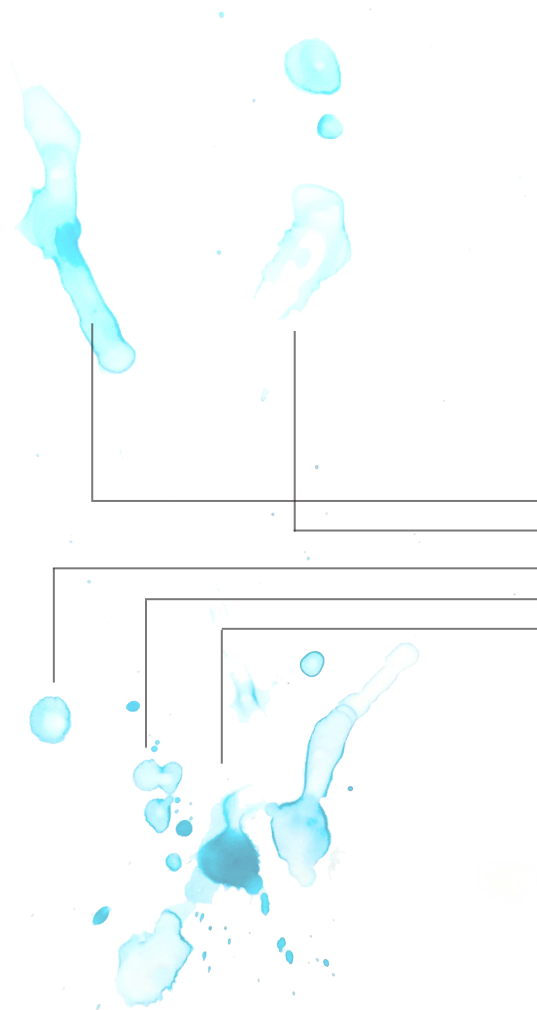




*To be Resilient*







*inundates a small percentage of the area  
affects pedestrian and street level*

*water discharges within a few minutes up to an hour of the event  
light traffic congestion  
"business as usual" for majority of the city*

**FIG 41** [PREVIOUS SPREAD]  
INFORMAL SETTLEMENT ALONG THE  
PASIG RIVER  
PHOTO CREDIT: MIGUEL CASTANEDA

**FIG 42** [DIAGRAM 1]  
TOLERANCE LEVEL MAP DURING  
LOCAL FLOODING, METRO MANILA





### *Within Tolerance Level*

“Holling (1973) coined the term resilience for ecosystems as a measure of the ability of these systems to absorb changes and still persist. As such, it determines the persistence of relationships within an ecosystem. This is contrasted with stability, which is defined by Holling (1973) as the ability of a system to return to a state of equilibrium after a temporary disturbance. Thus, a very stable system would not fluctuate greatly but return to normal quickly, while a highly resilient system may be quite unstable, in that it may undergo significant fluctuation (Handmer and Dovers, 1996).”<sup>1</sup>

Human societies’ first and foremost goal is survival, to ensure the continuity of the well-being and health of each individual. Stability is sought but is hardly achievable, especially in environments that are prone to the unpredictability of its systems.<sup>2</sup> Change is inevitable in a system, thus the concept of resilience has become an intense topic of discussion amongst ecologists, because there is a need to understand how a system can cope well with change. Resilience’s definitions are broad, conceptual and have numerable perspectives and interpretations. Even so, the concept of resilience is now used in a great number of disciplines that work closely with the

**FIG 43**    *TOLERANCE LEVEL  
LOCAL FLOODING  
PHOTO CREDIT: DANIEL GO*



### *Beyond Tolerance Capacity*

interactions between society and nature, including disaster and hazard mitigation.<sup>3</sup>

The traditional description for resiliency explains that after a disturbance, a system would return to its original state. But further studies mention that resiliency is in fact the ability of a system to “accept the inevitability of change,” learns from the disturbance and creates a system that is capable of persisting another onslaught. Dovers and Handmer term this as proactive resilience.<sup>4</sup> Rather than reactive resilience, which is the term Dovers and Handmer use to

describe the strengthening of ‘present systems’ to be resistant to change.<sup>5</sup>

The current approach to mitigating the consequences of hazards is a heavy emphasis on reactive resilience: “protecting or shielding from change.”<sup>6</sup> This method may not be wholly appropriate with the ever-increasing natural and environmental hazards. During a period of uncertainty the capability to adapt is imperative. In Peter Timmerman’s *Vulnerability, Resilience and the Collapse of Society*, he writes that society has always followed a strategy that is

**FIG 44** TOLERANCE LEVEL  
REGIONAL FLOODING  
PHOTO CREDIT: ALDRICH LIM



**FIG 45** [DIAGRAM 2]  
TOLERANCE LEVEL MAP DURING  
REGIONAL FLOODING, METRO MANILA



*Targets “Root” Cause*

***Human Induced Activities*** .....



***Vulnerability*** .....

***Natural/ Environmental Hazards*** .....



***Aftermath/ Consequences***







**Targets Symptoms**



**FIG 46** RESILIENCY FRAMEWORK  
METROPOLITAN MANILA

The diagram shown here (1) reflects what is determined a resilient framework, which is known to those in the Hazard Mitigation field as “Change at the Margins”. In contrast to diagram (1) which targets symptoms, diagram (2) attempts to correct the root cause of the problem. This is called as the “Openness and Adaptability Resilience”. Within this practicum a combined approach based on local circumstances would be most ideal.

PHOTO CREDIT: GOYA BAUWENS

## Hazards Research Framework for Resilience

### - Pre-event Measures

- prevent hazard related damage/ loss  
[PREPAREDNESS]

### - Adaptive Measures [for “ Uncertainty]

- strengthen inherent resilient components of systems

### - Transformative Capacity

- the necessary steps to “correct” the cause of issues

### - Post event Strategies

- cope with/ minimize disaster impacts  
[MITIGATION]

INTEGRATED RESILIENCE  
FRAMEWORK

FIG 47 [DIAGRAM]  
INTEGRATED RESILIENCE FRAMEWORK



defensive and quite reliable with shielding the brutality of the event rather than tolerate it.<sup>7</sup> The concept of tolerating the harshness of hazards does not appeal to the majority of those who are vulnerable. These two expressions of resilience are both at the extreme of the spectrum; to use one over the other would result in equally positive and negative outcomes. John W. Handmer and Stephen R. Dovers produced a typology of resilience to create a framework for the range of 'present institutional' responses to disturbances. They classified responses into three categories: 'resistance and maintenance', 'change at the margins', and 'openness and adaptability'. Within this practicum, Dovers and Handmers typology of resilience is used as a way to place the discipline of Landscape Architecture in the development of hazard and risk management.

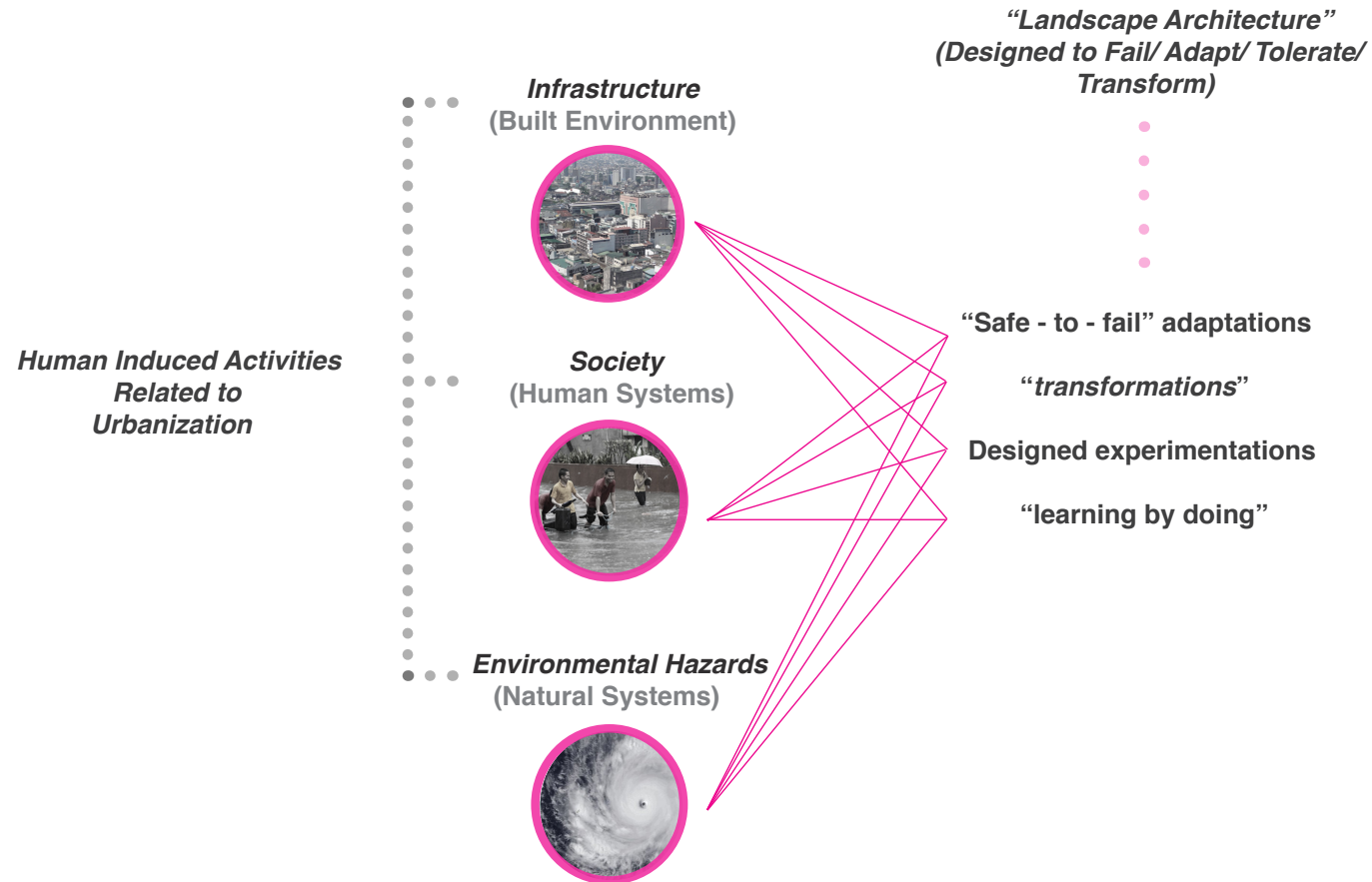
*Resistance and Maintenance* is distinguished by a society's reluctance to change. According to Dovers and Handmer's description human system with this type of resilience "would do its utmost to avoid change and would typically deny that a problem exist."<sup>8</sup> This inaction allows the current status quo to remain unchanged, with the expense of enormous resources in order to maintain stability. Issues and present threats are then transferred in both time and space. Succeeding generations would find themselves in a position were they are accountable to solve these conflicts and find that the environment is

further degraded than at present.<sup>9</sup> Following this type of response to disturbances may have some limited success (at some level in society) but only for a short period. Collapse of the system is probable and would be complete without any expectation of return.

*Change at the margins* is, as its name describes, changes only the minimum of resilience. Dovers and Handmers characterized this type as a system or society acknowledging that there is a problem, that there are drastic implications to the well-being of individuals but does not try to challenge the true cause of these problems. This type of response focuses on lessening symptoms (consequences) rather than addressing both causes and symptoms. Change at the margins is the typical approach that is currently practiced considering environmental change as it specifically affects hazard and risk, and responses of this type have great advantages. First, it is a reliable type, as most of the responses fall within the reactive resilience category, where society is shielded from any incoming disturbance or threat. Another advantage is that change is made but does not completely disrupt how society functions. On the other hand, there is a false sense of security that the threat is neutralized and a major change in the make-up of society and its relation to the environment is not necessary. Vulnerability is reduced but only at a short term, as methods within this type are mostly static.<sup>10</sup>

## Vulnerability

## Resiliency



**FIG 48** [DIAGRAM]  
LANDSCAPE ARCHITECTURE  
OPEN AND ADAPTABLE RESILIENT  
FRAMEWORK FOR METROPOLITAN MANILA

*Openness and Adaptability* is the type of resilience that deals with the primary cause of the problems. By having flexibility, or the preparedness to adopt completely new structures and functions, the system would then be capable to adapt to the disturbance rather than having to resist them.<sup>11</sup> The procedure for this type initially identifies the causes and then possible options are explored before any changes are implemented. The difference between this approach and change at the margins lies in the fact that instead of minimizing the consequences, it attempts to correct the root of the problem.<sup>12</sup> Although the concept of this type of resilience is straightforward and promises advantageous results, it is hard to implement it in reality. Basically, this method of approach asks to abandon current practices that directly relates to the problem. The difficulty in this is that in some cases whole cultural practices are entirely the reason these problems persists, hence there is a reluctance to embrace such a drastic approach. Another reason with this type of resilience is that it carries unknown dangers. Due to the fact that it requires change in the system it is possible that these changes would be maladaptive to both the environment and human welfare. In other words, the implications might have detrimental cause to society.<sup>13</sup>

The first type of resiliency that Dovers and Handmer classified as Resistance and Maintenance, the denial

of a need for change, is not a common response in the now more informed world. The second type, change at the margins, the managing of symptoms, is much more palatable to a society that desires stability without responding to disturbances by means of openness and adaptability (third type), the alteration of their way of life. Presently, there is a shift in how resiliency is perceived. Social Resilience (Human systems) and Ecological Resilience (Natural systems) have been regarded as two separate entities. Timmerman defined social resilience as the "ability of human communities to withstand external shocks or perturbations to their infrastructure".<sup>14</sup>

It has been a recent development that human and ecological systems are viewed together. Resiliency is related to the interactions of systems rather than the stability of components within their separate systems. That in order to achieve an open and adaptable system it is important to note that there must be an introduction of 'new variables' (or valuable components missing in the system) across all systems (ecological, economical, social) in order to re-configure a 'new system' that has the capacity to overcome the issues at hand. This step in adaptive capacity is called '*transformability*'.<sup>15</sup> In the case of metropolitan Manila where society and the environment is so intertwined, there is a demand for an integrative framework towards hazard mitigation strategies that strives to be open and adaptable.<sup>16</sup>



### **Landscape Architecture's Role (how does it fit within an Openness and Adaptability Resilience Framework?)**

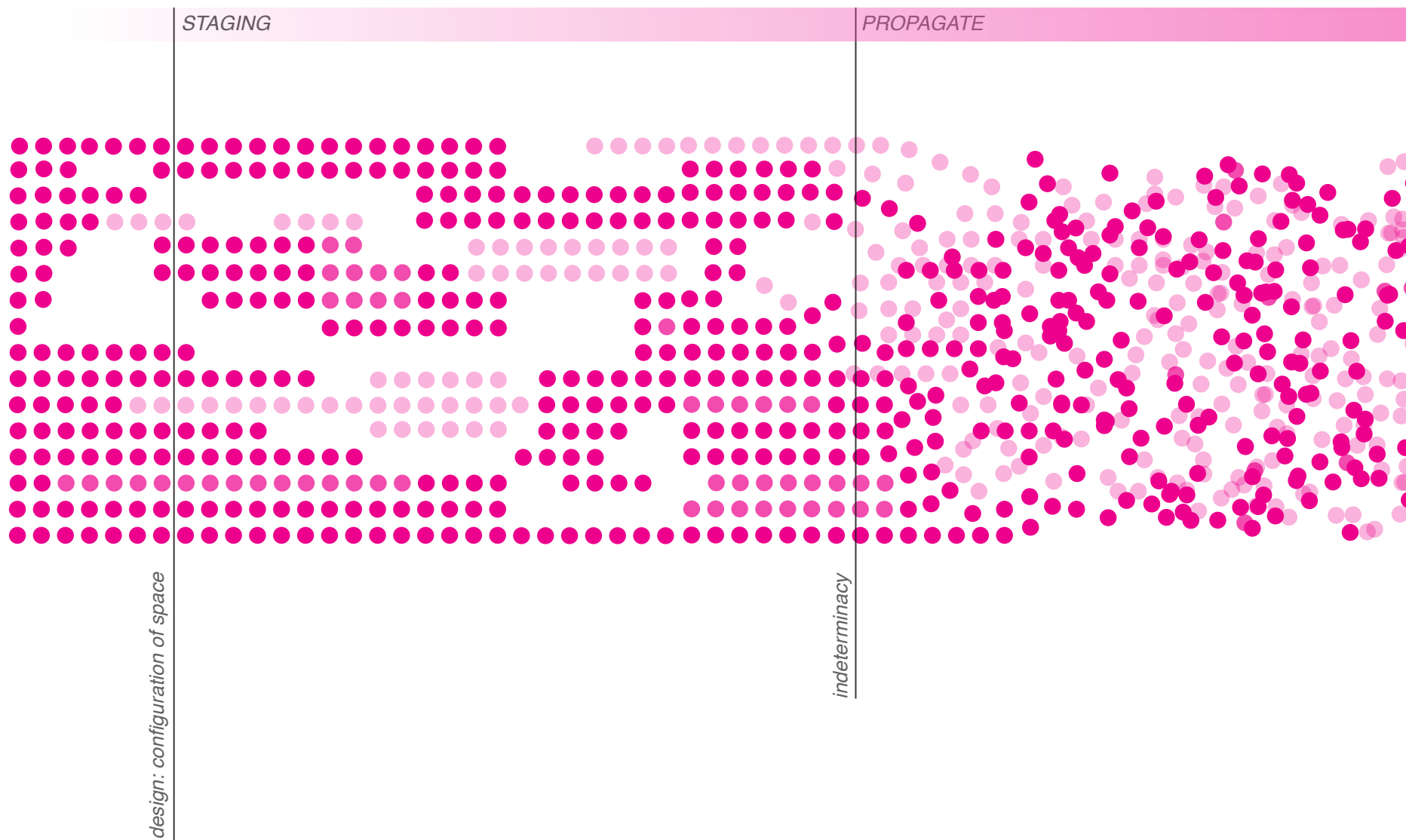
"The approach to the natural (non-human) environment has been to seek dominance, or control, mostly through technical means such as engineering approaches. But the environmental problems are now acknowledged to threaten the global environment and are less amenable to technological solutions. In fact, it is our addiction to technology that is largely responsible for much of the current crisis – the principle of techno-addiction (Boyden, 1987). There appears to be no alternative to major social, political, and economic change: We must change the way we interact with the natural systems that support us." <sup>17</sup>

J.B. Jackson describes landscapes as "man-made system of spaces superimposed on the face of the land."<sup>18</sup> Landscape Architecture, traditionally, is a discipline that concerns itself with the design of spaces which values symbolic representation and aesthetic works through the manipulation of land. However, with the discipline's close tie with ecology there is a profound shift in direction within both practice and academia. James Corner sees this shift as a possibility of a more "meaningful and imaginative cultural practices than the merely ameliorative, compensatory, aesthetic, or commodity-oriented" work that Landscape Architecture seem to produce,<sup>19</sup> where the relationship between Ecology and Landscape Architecture must be considered beyond their aesthetic appeal. Moreover, to be distinguished as instruments, agencies of implementing change in the world.<sup>20</sup>

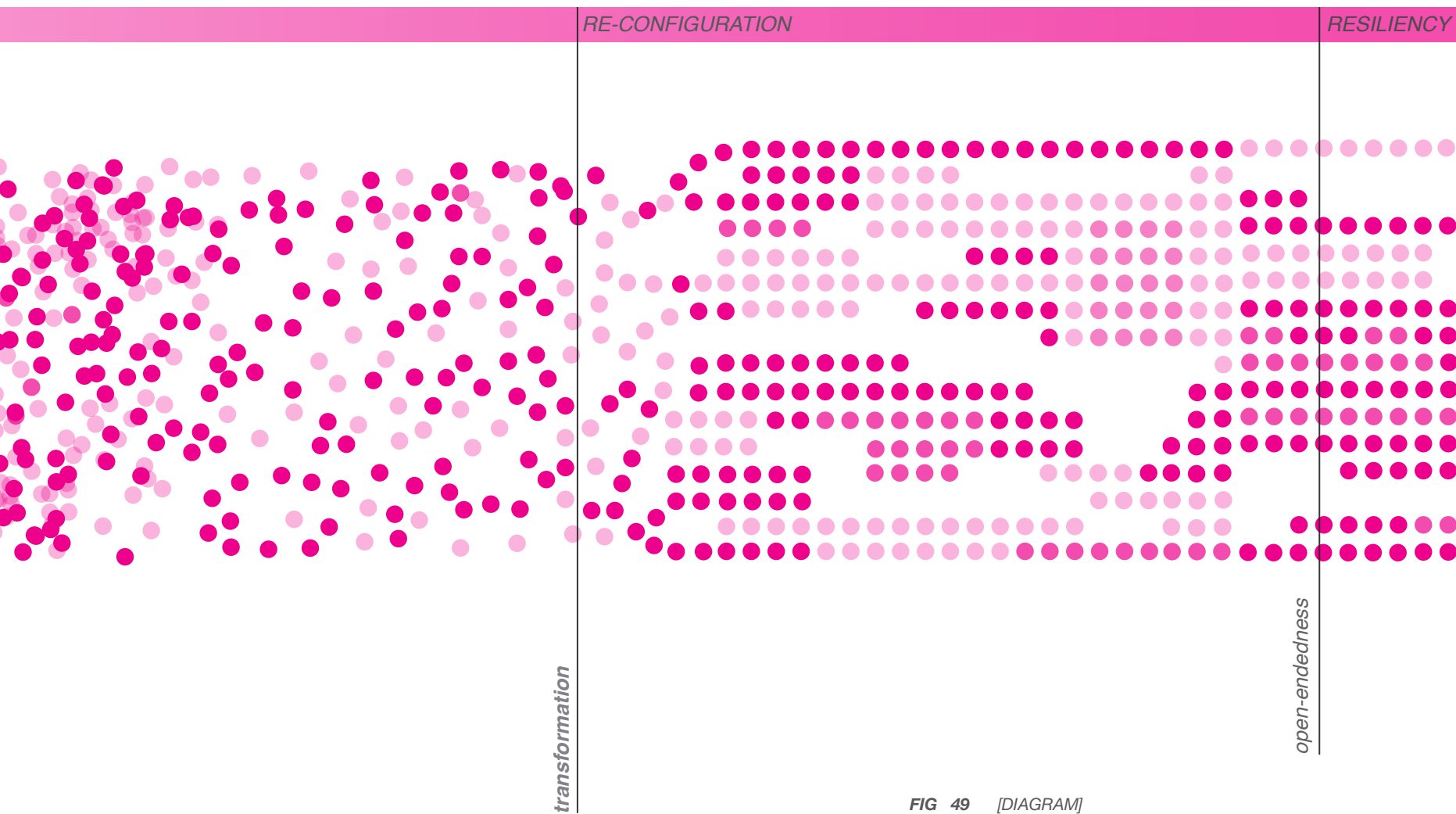
In his article Do Landscapes Learn? Ecology's New Paradigm and Design in Landscape Architecture, Robert E. Cook describes three ways of how

Ecology can be valued in disciplines with ecological applications such as Landscape Architecture. The first is the application of ecology as knowledge. The understanding of the environment and the biological processes would inform the designer certain conditions and consequences that would be involved within the project.<sup>21</sup> The second way he describes is that ecology provides inspiration for the visual appearance of the design intervention. The last possibility is that ecology could become a foundation of a “deeper engagement with the land and its inhabitants.”<sup>22</sup> Ecology can be the means to provide a dialogue between the dynamic world, filled with fluctuations and uncertainty, and the designed landscapes. Instead of landscapes being just spatial objects imposed on the land, recognized mostly for their mechanical and prescriptive use,<sup>23</sup> they can be of greater potential as “successfully designed system of processes.”<sup>24</sup> Landscapes that are open, adaptive, and functions as actants that engages the continuous transformative nature of the world.<sup>25</sup>

*“The idea of strategy, more generally, invokes the art of engagement, typically in battles, but also in any activity that requires careful positioning and intelligent, informed, coordinated actions to ensure success. However, to think solely in terms of ends is perhaps not accurate, for a good strategy remains dynamic and open and thereby assures its own longevity. It is more conversational and engaging than it is confrontational or assertive. A good strategy is a highly organized plan (spatial, programmatic, or logistical) that is at the same time flexible and structurally capable of significant adaptation in response to changing circumstances. Too rigid a strategy will succumb to a surprise or to a logic other than that for which it was designed, and too loose a strategy will succumb to anything more complex, organized, or better coordinated.”*<sup>26</sup>







**FIG 49** [DIAGRAM]  
“STAGING PROCESSES”  
LANDSCAPE ARCHITECTURE  
IN AN OPEN AND ADAPTABLE  
RESILIENT FRAMEWORK

Resilient systems are inherently malleable in order for adaptation to occur. Systems that fall into this category are described as open. The components within such systems continually persevere and morph their structure in order to not succumb during a disturbance. This ability to learn ensures that components within the system (inhabitants) recover or survive. The application of ecological knowledge in designing for human systems is significant in shaping a city's make-up and landscape architecture should become a practice geared towards the improvement of urban issues.<sup>27</sup> and in designing for resiliency for cities.

Landscape Architecture is "inevitably formal", meaning that it is ruled with the use of forms, specific configurations, and organization. The complexity in this is, how should a discipline with its foundation firmly rooted in the spatial (giving form and shape) begin to understand space as essentially being in continuous flux? James Corner aptly addressed this question in *Not Unlike Life Itself: Landscape Strategy* Now where he described that while it is true that Landscape Architecture is physically an object in the land, of substance and form, it is, as everything else,

subjected to time, process and to external forces that influence its being in the world. Hence, as Corner further points out, strategy becomes fundamental to the design practice. Rather than viewing a project as a completed product, it must be seen as a process where specific conditions are set into place in order for the specificity of the site, its environment, culture, economies and politics, to 'perform' and 'propagate' on this created 'stage' (landscape).<sup>28</sup> The ambiguous prospects of such landscapes, by "staging uncertainty, for indeterminacy and open-endedness,"<sup>29</sup> characterize the affordances that will make them resilient.

Landscapes' formality is not irrelevant; in fact each designed configurations, each detail, "form, geometry and material are precisely the physical media"<sup>30</sup> through which the strategy in place will act out. Organization and the preciseness of the design is what will eventually construct a dynamic space – able to learn, morph, transform and to have the capacity to adapt.<sup>31</sup> By understanding the potential of any given space or environment, design strategy becomes important in shaping the evolution of life to unfold.

## Endnotes:

1. Richard J. T. Klein, Robert J. Nicholls, and Frank Thomalla, "The Resilience of Megacities to Weather-Related Hazards," in *Building Safer Cities: The Future of Disaster Risk*, ed. Arnold, Margaret, Anne Carlin and Alcira Kreimer (Washington D.C.: World Bank, 2003), 111.
2. John Handmer and Stephen Dovers, "A Typology of Resilience: Rethinking Institutions for Sustainable Development," *Organization and Environment* 9, no.4 (1996): 482, accessed January 7, 2016. doi: 10.1177/108602669600900403.
3. Klein, Nicholls, and Thomalla, "The Resilience of Megacities to Weather-Related Hazards", 112.
- 4 - 6. Handmer and Dovers, "A Typology of Resilience", 494.
7. Peter Timmerman, "Vulnerability, Resilience and the Collapse of Society: A Review of Models and Possible Climatic Applications," *Environmental Monograph* 1 (1981): 32, accessed January 7, 2016. <http://www.ilankelman.org/miscellany/Timmerman1981.pdf>
8. Handmer and Dovers, "A Typology of Resilience", 495.
9. Ibid, 497.
10. Ibid, 498 - 501.
11. Ibid, 502.
12. Ibid, 499.
13. Ibid, 504.
14. Klein, Nicholls, and Thomalla, "The Resilience of Megacities to Weather-Related Hazards", 112.
15. Jianguo Wu and Tong Wu, "Ecological Resilience as a Foundation for Urban Design and Sustainability," in *Resilience in Ecology and Urban Design: Linking Theory and Practice for Sustainable Cities*, ed. M.L. Cadenasso, Brian McGart, and S.T.A. Pickett (New York:, Springer, 2013), 224.
16. Handmer and Dovers, "A Typology of Resilience", 483.
17. Ibid.
18. John Jackson, *Discovering the Vernacular Landscapes* (New Haven: Yale University, 1984), ii.
19. James Corner, "Ecology and Landscapes as Agents of Creativity," *The Landscape Imagination: Collected Essays of James Corner 1990 -2010*, ed. James Corner and Alison Bick Hirsch (New York: Princeton Architectural Press, 2014), 258.
20. James Corner, "Ecology and Landscapes as Agents of Creativity", 258.
21. Robert Cook, "Do Landscapes Learn?: Ecology's New Paradigm and Design in Landscape Architecture," 2, accessed January 15, 2016. [http://www.responsivelandscapes.com/readings/ecology/COOK\\_DoLandscapesLearn.pdf](http://www.responsivelandscapes.com/readings/ecology/COOK_DoLandscapesLearn.pdf)
22. Robert Cook, "Do Landscapes Learn?", 2.
23. James Corner, "Ecology and Landscapes as Agents of Creativity", 258.
24. Robert Cook, "Do Landscapes Learn?", 27.
25. James Corner, "Ecology and Landscapes as Agents of Creativity", 279.
26. James Corner, "Not Unlike Life Itself: Landscape Strategy Now," *The Landscape Imagination: Collected Essays of James Corner 1990 -2010*, ed. James Corner and Alison Bick Hirsch (New York: Princeton Architectural Press, 2014), 285.
27. Elizabeth Mossop, "Landscapes of Infrastructure," *The Landscape Urbanism Reader*, ed. Charles Waldheim (New York: Princeton Architectural Press, 2006), 166.
28. James Corner, "Not Unlike Life Itself: Landscape Strategy Now," 286 - 287.
29. Ibid, 288.
- 30 - 31. Ibid.





**Typical Approaches for Resiliency at Different Scales**

*overwhelming population growth*



*blocks water ways*

*hinders infrastructure to properly  
discharge water*



It has been debated that as a country develops over time it has to go through the inevitable stage of compromise between economic growth and ecological protection. As seen with the example of the Philippines where the economy heavily relies on the country's natural resources, one has taken importance over the other. The argument is that ecological protection would come later when a country's economy is stable and able to afford such endeavour.<sup>1</sup> Even though this stage of economic development is deemed "unavoidable and temporary" it is not so within tropical ecological systems. The ecological systems in the Philippines, which suffered sustained degradation cannot easily be recovered. We have seen the consequences of this trade-off between economic growth and ecological importance, rather than being a temporary phase the changes within these systems became irreversible and disastrous.<sup>2</sup>

**FIG 50** [PREVIOUS PAGE]  
DIAGRAM  
CAUSE OF FLOODING IN  
METROPOLITAN MANILA



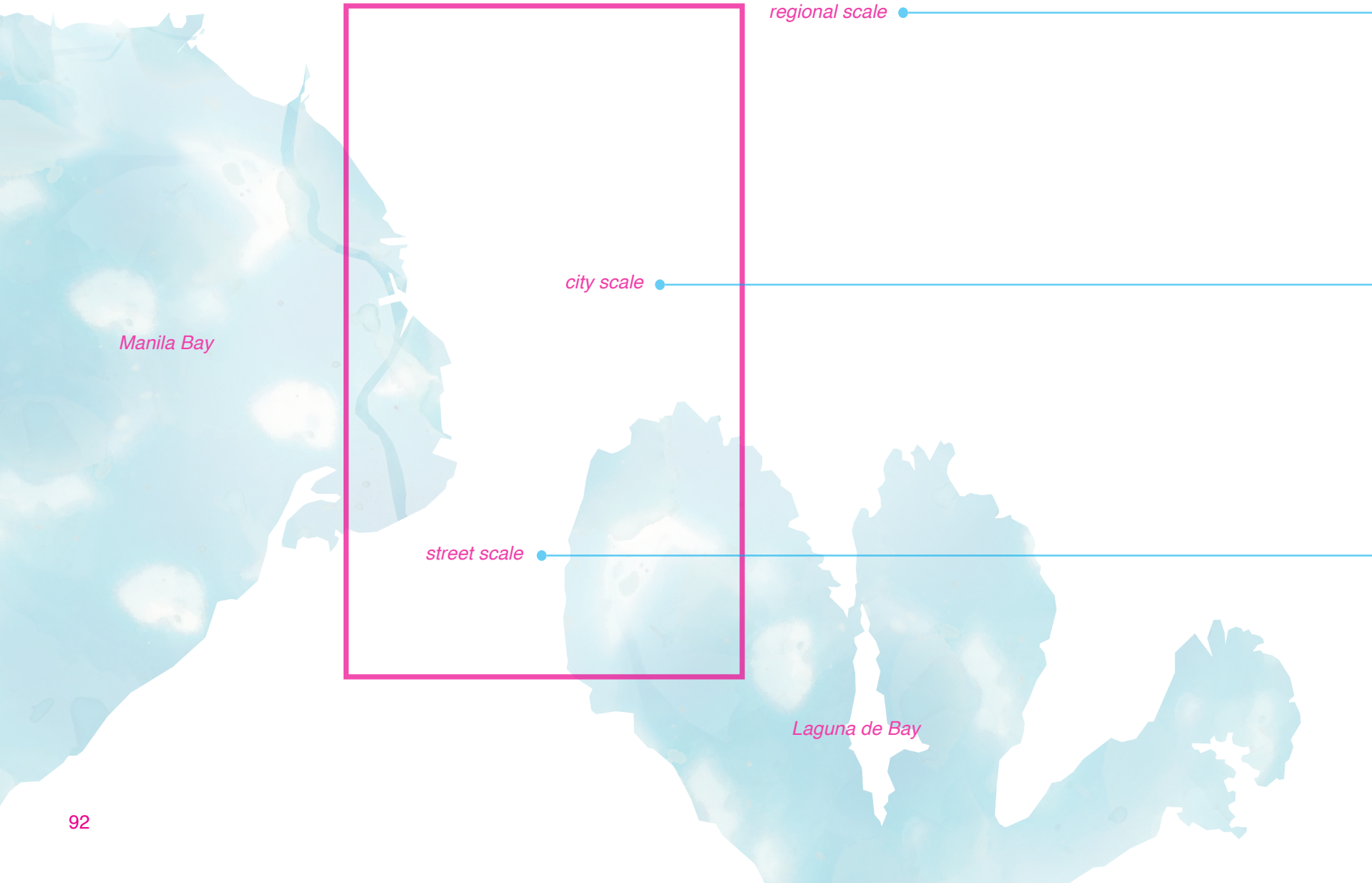
The proper management of natural resources must coincide with the growth of the urban environment and not be misplaced as the later part of development. It must recognize that “acting otherwise brings cost”<sup>3</sup> - changes brought into the system increases further consequences.<sup>4</sup> In this complex network of systems (ecological, social and economical systems) there is no denying the difficult processes that would need to take place in order to be resilient to the harsh consequences of past and ongoing actions. There is not one solution for this, rather it will be a set of strategies, ranging from short to long term interventions, at different scales, whether they be regional, city or street (local) level, to allow flexibility and to anticipate the most catastrophic of consequences.

The restoration or remake of an ecosystem, commonly termed as rehabilitation, may certainly be a possibility in some areas but may not apply to others because of the extent of the damage.<sup>5</sup> Is it then through rethinking the ways we use the land and

through changing cultural practices that the alleviation of the flooding phenomenon in metropolitan Manila be achievable? By using Dovers and Handmers typology of resilience as a framework to compare the various strategies and methods that could take place within these various scales enables us to comprehend the possible approaches appropriate to make Metropolitan Manila more resilient to flooding events.

It is not the intention of this practicum to fully resolve the issue of flooding within the metropolitan area for it is recognize that flooding is the norm, that it will always flood. Rather, can the complex nature of this area become resilient, to tolerate to a certain extent the harsher realities of future flood events.

In what follows resiliency is considered through the three types applied at different scales - toward a way of thinking about the complexities and approaches of flooding.



*Manila Bay*

*regional scale*

*city scale*

*street scale*

*Laguna de Bay*

*Upper Marikina Watershed.*



*Pasig River / “Esteros” (canals).*



*Streets.*



**FIG 51** [DIAGRAM]  
REGIONAL, CITY AND LOCAL SCALE

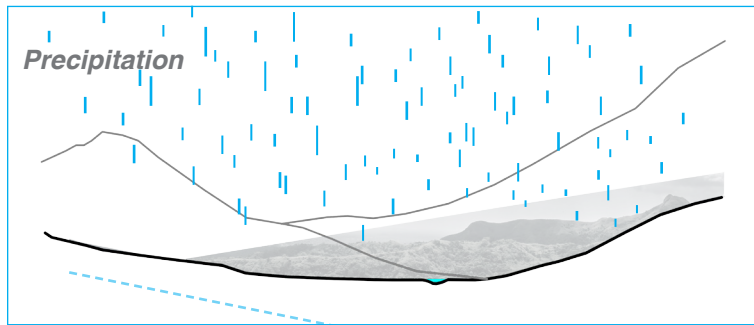
1:250,000  3500m





### ***Regional Scale: Upper Marikina Watershed***

Watersheds are important in controlling the amount of water run-off that gets discharged into streams and rivers before draining towards larger bodies of water. The Upper Marikina Watershed is located north-east and a few hours away from the metropolitan area and is a large contributing factor to the devastating floods that have recently affected the area. Once covered with extensive forestlands, its 28,000 hectares are now converted into agrarian lands and denuded mountains. The watershed can no longer regulate water run-off as it once did. During periods of heavy rainfall, surface water run-off has increased, rapidly carrying water and eroded soil towards the river tributaries. The increase of eroded topsoil has silted most of the streams and rivers decreasing their water loading capacity even more.<sup>6</sup> The Upper Marikina Watershed basin drains towards the Pasig River. Carrying large volumes of water effortlessly overwhelming the lowlands (metropolitan Manila).



*Run-off*

 *Current Conditions*

 *Water Flow (direction)*

*River  
sediment*

*Dipterocarp forest  
Tropical Hardwoods  
(White Lauan, Narra, etc.)*

*Nutrient  
uptake*

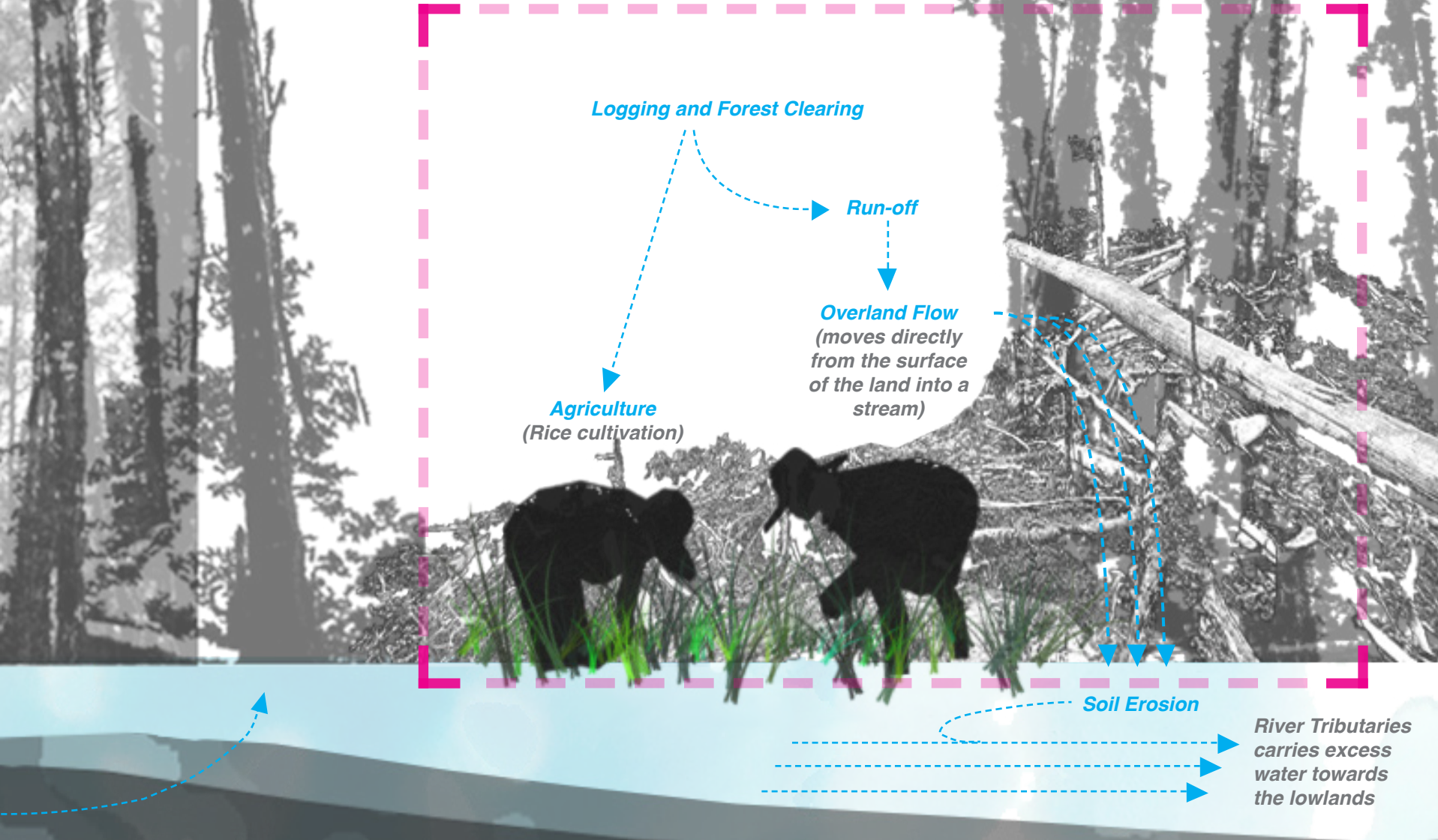
*Interflow  
(water infiltrates  
soil)*

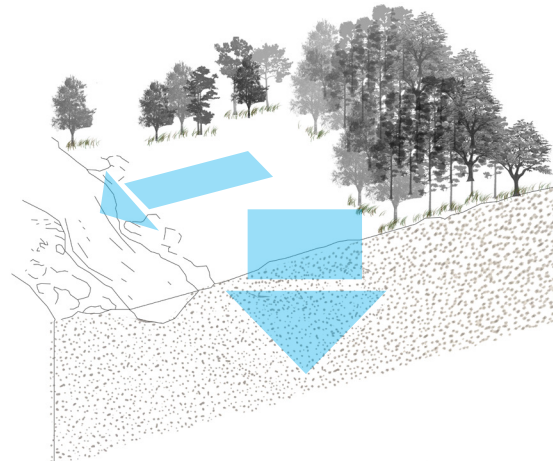
*Nutrients*

*Groundwater*



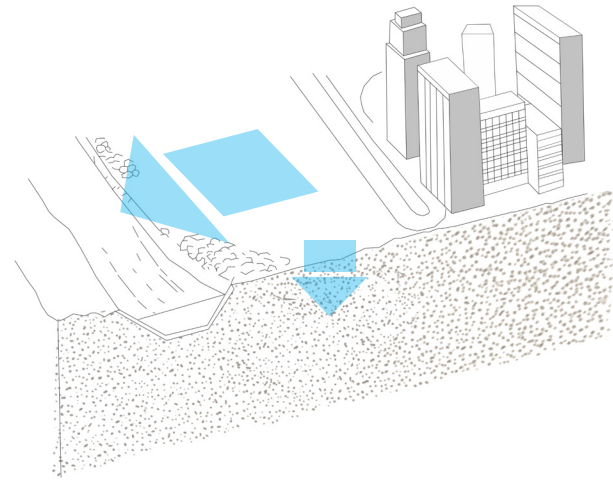
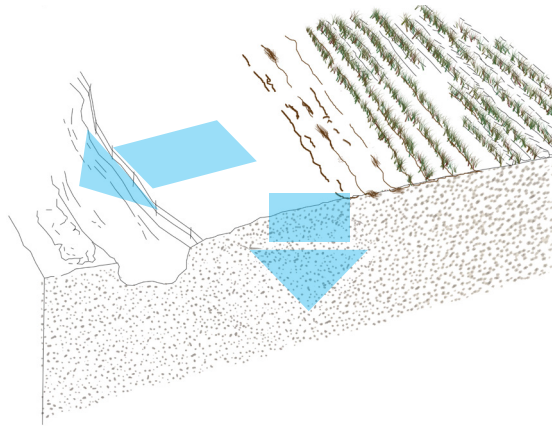
## Upper Marikina (Watershed System Process)





As was previously discussed in the earlier chapters, the forestland serves as a natural defense against erosion and it decreases the amount of water flow that gets discharge into streams. To fully grasp the magnitude of how cultivated lands change the carrying capacity of the watershed it is important to know how water flows within the drainage basin. The first source of streamflow is baseflow, where groundwater intersects with the water table through the river bed. It is a major source of water discharge and supplies streams at a continuous pace.<sup>7</sup> Interflow, on the other hand is the movement of water through the infiltration of the soil. The water moves within soil channels and gradually flows towards the river bed. In heavily forested areas, interflow is the next most important water discharge source.<sup>8</sup> In urbanized and cultivated areas the major contributor

**FIG 53**     *DIAGRAMS (1-3)*  
*CHANGES OF WATER FLOW*  
*ADAPTED FROM: WILLIAM M. MARSH*  
*LANDSCAPE PLANNING:*  
*ENVIRONMENTAL APPLICATIONS*



for discharge is what we call overland flow, where water moves directly from the surface of the land, unhindered by vegetation, into streams and rivers.<sup>9</sup> Currently, the watershed basin water flow, especially during heavy rainfall periods, moves mostly as overland flow.

Agricultural practices have a great impact on the “relative balance of contributions from these sources”<sup>10</sup> of water flow (run-off) processes in the watershed area. The sustained clear-cutting and burning of forest, to make way for cultivated lands, has resulted in the reduction of water infiltration through the soil and increased overland flow. Tropical soils are rich in nutrients, however the removal of the forest reduces the soil of most of its nutrients, making it mostly sterile.<sup>11</sup> Hence there is the need

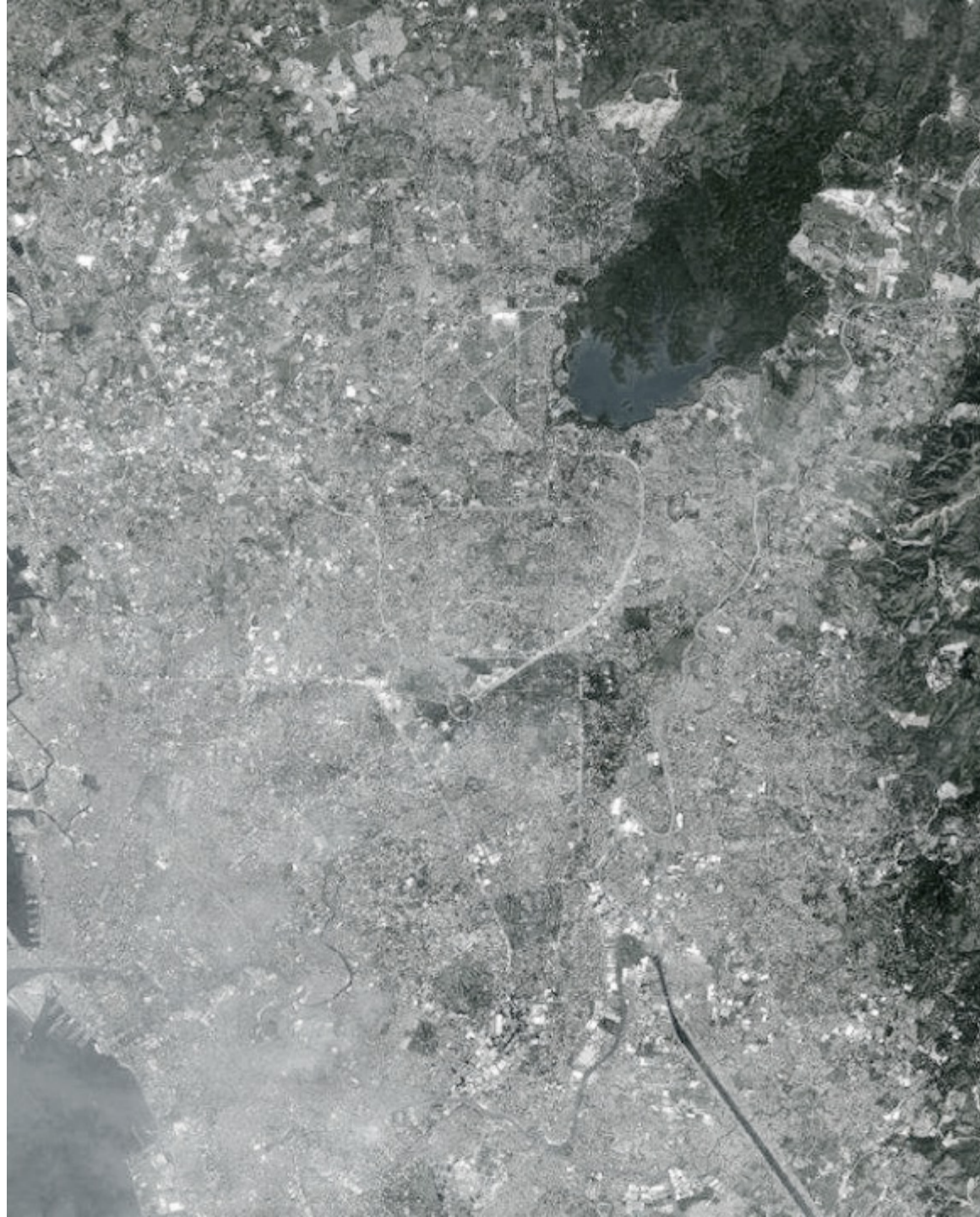
to find other “suitable” area for cultivation, because “logged-over land often cannot support crops for more than one or two seasons.”<sup>12</sup> The main crop cultivated in this region is rice and takes up most of the cleared spaces. Other crops such as corn, root crops, coffee, tobacco, cotton, etc are grown specifically where suitable (i.e. the soil is suitable) for them to be grown. This continuous cycle of clearing, burning, cultivating then abandoning the land when the soil is no longer deemed suitable is missing the necessary step of rehabilitating the land required to start a new forested area. This way of practicing land use has proven to be detrimental to the overall resiliency of the area, but is done to accommodate the need for economic stability.



**FIG 54** UPPER MARIKINA WATERSHED  
[SATELLITE MAP]

PHOTO CREDIT: ARCGIS

1:150,000  3500m







1

2

3



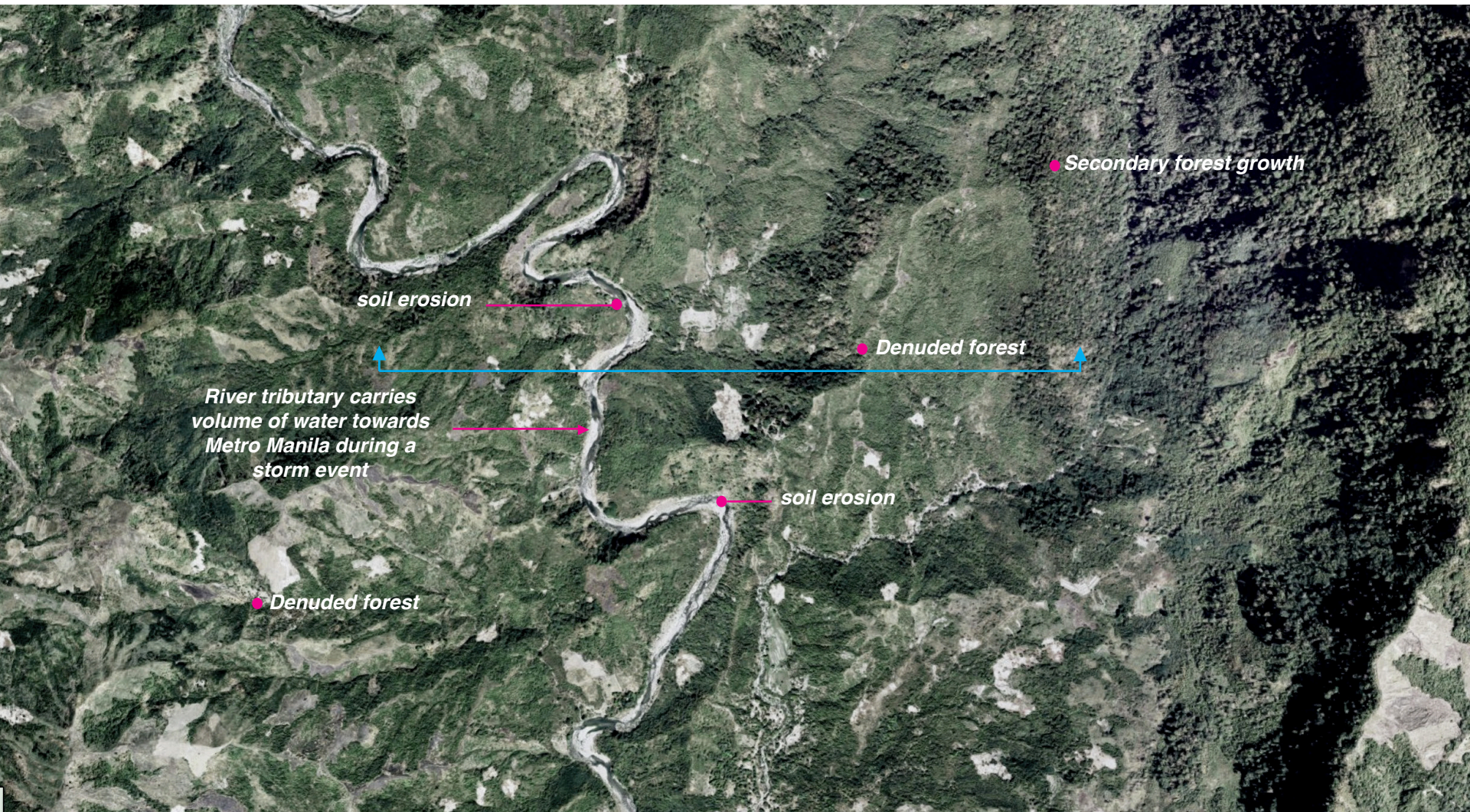


FIG 55 SATELLITE MAP: GOOGLE EARTH, 2016.







FIG 56

SATELLITE MAP: GOOGLE EARTH, 2016.





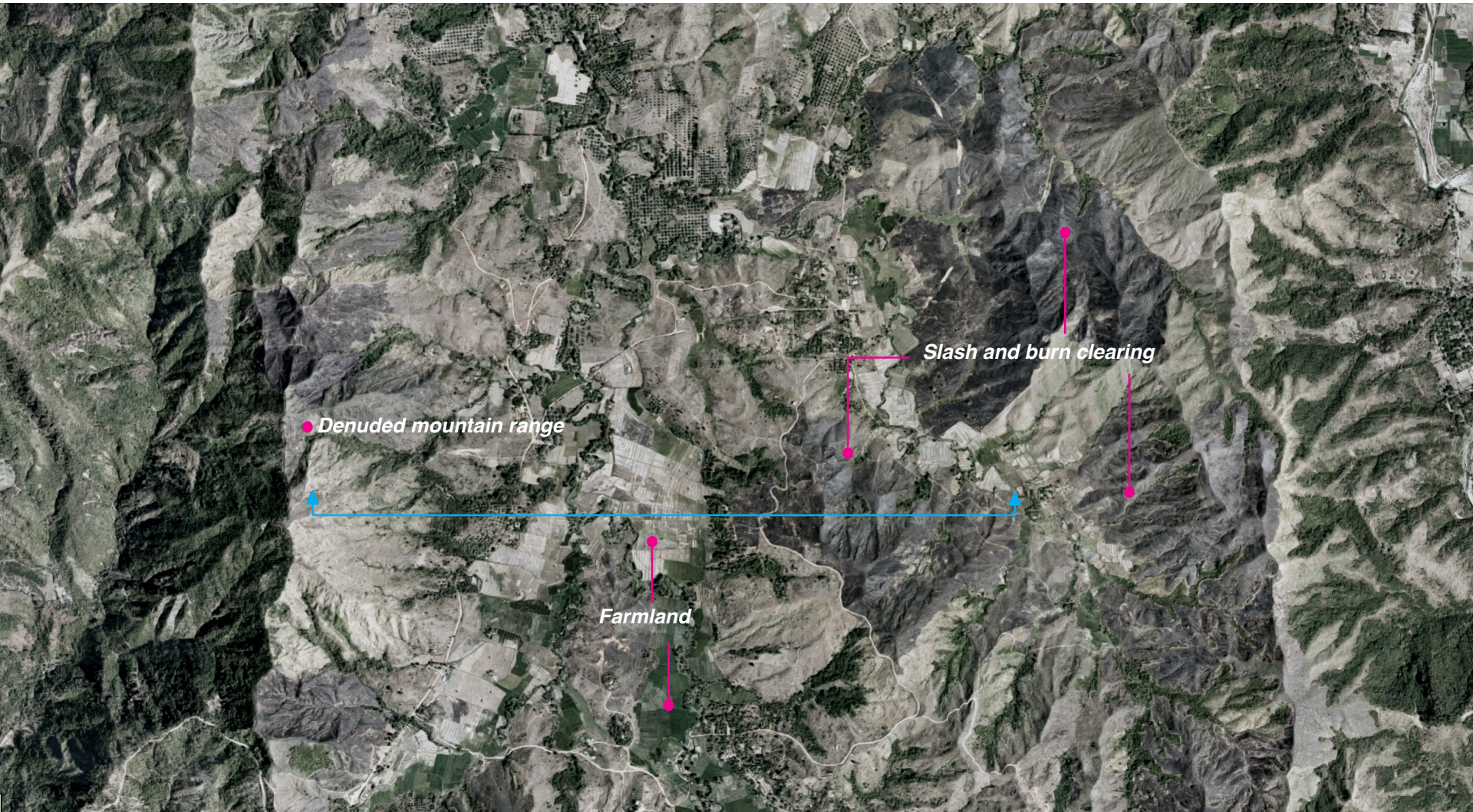


FIG 57 SATELLITE MAP: GOOGLE EARTH, 2016.





***Issues:***

*Denuded Mountains*

*Erosion of Soil*

*Inundation of River Tributaries*

*Mismanagement of Forest clearing*

With the extent of the degradation within the Upper Marikina Watershed it would require time before it can be completely resilient to hazards pertaining floods. To realize such a feat entails not only technological or engineered solutions but a significant change in practices concerning widespread cultivation. To support a holistic approach to attain resiliency the three types of resiliency; Resistance and Maintenance, Change at the Margins, and Openness and Adaptability, are used to frame strategies and methods appropriate to this area and scale.

## Resiliency Framework: Regional Scale (Upper Marikina Watershed)

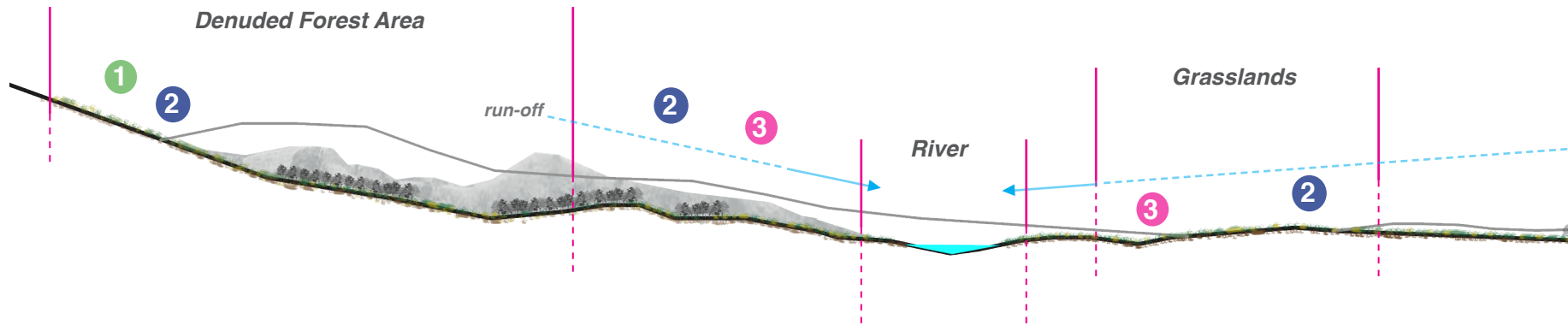
|                                                                                                                                                                                | Methods                                                                                                                                                                                                                                                                                | Advantages                                                                                                                                                                                                                                                                                                                               | Disadvantages                                                                                                                                                                                                                                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Resistance and Maintenance</b><br><br><i>maintains the current resisting measures at the expense of enormous resources.<br/>(denial that a problem exist)</i>               | <ul style="list-style-type: none"> <li>- Reinforce Landslide Prevention Retaining Walls.</li> <li>- Monitoring Facilities</li> <li>- Floodproofing properties</li> </ul>                                                                                                               | <ul style="list-style-type: none"> <li>- Prevent further harm on properties. Somewhat controls the accumulation of sediments on streams.</li> <li>- Provide accurate information on rainfall intensity and inundation warning.</li> <li>- Protect individual properties within the watershed.</li> </ul>                                 | <ul style="list-style-type: none"> <li>- This method only provides a short term reprieve and be overburdened overtime.</li> <li>-Does not truly alleviate the problem.</li> <li>- Problems would still exist. Short-term protection.</li> </ul>                                          |
| <b>Change at the Margins</b><br><br><i>minor changes - essential to mitigate symptoms. a false sense of security that the threat is neutralized.<br/>(incremental changes)</i> | <ul style="list-style-type: none"> <li>- Dredging Larger Tributaries</li> <li>- Dam Specific Tributaries</li> <li>- Erosion Control in Denuded Areas.</li> </ul>                                                                                                                       | <ul style="list-style-type: none"> <li>- Increase a river's carrying capacity.</li> <li>- Control volume of water entering the lowlands (metropolitan area).</li> <li>- Regulate soil loss and slows down surface run-off.</li> </ul>                                                                                                    | <ul style="list-style-type: none"> <li>- The process of dredging may cause irreparable change in the river ecosystem.</li> <li>- Costly and can alter the natural environment.</li> <li>- Longevity is not assured.</li> </ul>                                                           |
| <b>Openness and Adaptability</b><br><br><i>this resiliency type ask to abandon current practices. long-term flexibility.<br/>(targets underlying problems)</i>                 | <ul style="list-style-type: none"> <li>- Proper Irrigation in Rice Cultivation</li> <li>- Reforestation or Rehabilitation of Deforested areas.</li> <li>- Enforcement of Watershed Protection Laws. (Protection Against Logging and Further Expansion of Agriculture Lands)</li> </ul> | <ul style="list-style-type: none"> <li>- Allows to properly retain water on site for rice cultivation. Could regulate water run-off.</li> <li>- By adding this step in agricultural practices within the watershed allows the environment to adapt for a longer term.</li> <li>- To prevent any more damage to the watershed.</li> </ul> | <ul style="list-style-type: none"> <li>- Contesting agricultural practices. Must be a requisite for rice farmers.</li> <li>- Hard to implement. Change must come from the social system.</li> <li>- Hard to implement when the economy is dependent on the natural resources.</li> </ul> |



Methods that fall under 'Resistance and Maintenance', are of a nature that do not particularly try to improve the current situation but rather it resist any type of change, at a high cost to remain stable. Protection against the onslaught is important but disregards resolving the issues that have a hand in the flooding events. Reinforcing current methods are deemed to be enough to maintain stability in the system. Landslide Protection methods, for example, do not prevent the erosion of soil, rather they try to prevent any harm to transportation routes, residential areas, cultivated lands and somewhat try to halt further accumulation of sediments on receiving streams. Anticipatory methods are also characterized as Resistance and Maintenance, such as monitoring the intensity of rainfall and volume of run-off to provide warning to those who would be affected.

Change at the Margins type of resiliency are those that lessen the impact of consequences. Acknowledging that there are problems within the system still not fully address them. At the watershed level, methods within this type are ones that changes

little to accommodate the disturbance, but provides enough stability to be reliable. In terms of methods that can be applied, focus profoundly on possible ways to regulate the inundation of the lowlands (metropolitan area) and the further damage to the watershed. Erosion control techniques are the first step to regulate inundation. Surface run-off on denuded forestlands are the main source of high levels of water and sediments that are received in streams, to regulate this erosion control techniques are used to stabilized soil and increase infiltration of water. Dredging, the removal of sediments to enlarge the carrying capacity of rivers and streams within the watershed would ensures that inundation does not easily happen upstream. To fully regulate water discharge towards the lowlands, dams can be placed to store excess water during periods of high water volume. This method can be done at a small scale or to expensive and large reservoirs to store water, but the principle of storing water then releasing it when receiving streams may accommodate the load still remains.



highest

Impact

lowest

### Openness and Adaptability

- Reforestation or Rehabilitation of Deforested areas.

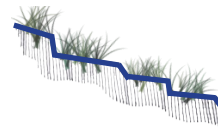
1



### Change at the Margins

- Additional Erosion Control in Denuded Areas.

2

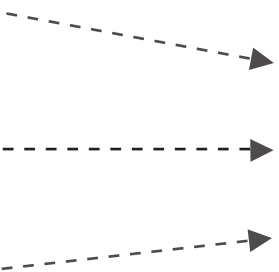
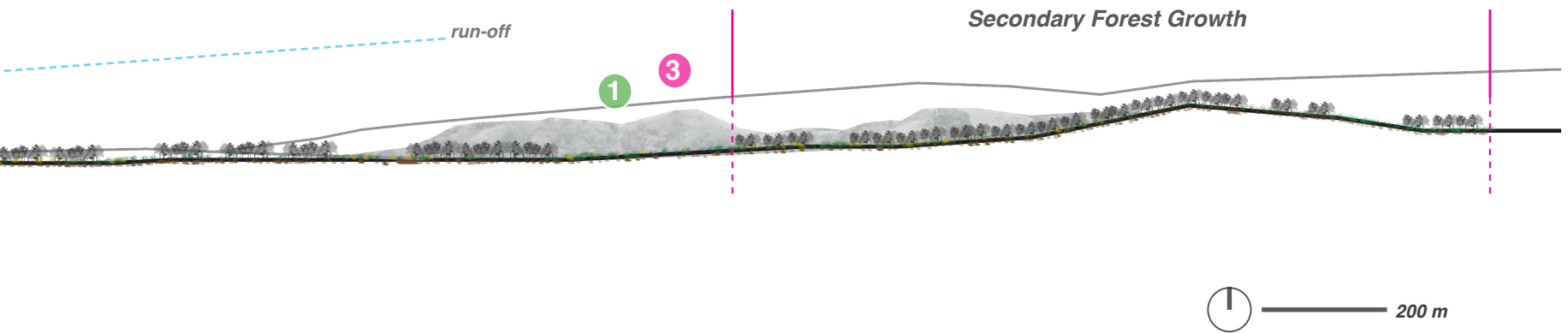


### Resistance and Maintenance

- Reinforce Landslide Prevention Retaining Walls.

3





**Resilient**

*Section 1 - To help control the flow of water that travel through a denuded valley, methods that are specific in slowing the movement towards the rivers and streams are chosen. In this case, erosion control methods are used to prevent the further collapse of soil and also control water flow. By reforesting the area would allow for a long-term control.*



highest  
 Impact  
 lowest

### Openness and Adaptability

- Enforcement of Watershed Protection Laws. (Protection Against Logging and Further Expansion of Agriculture Lands)

- Reforestation or Rehabilitation of Deforested areas.

### Change at the Margins

- Erosion Control in Denuded Areas.

### Resistance and Maintenance

- Floodproofing properties

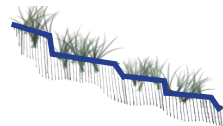
1



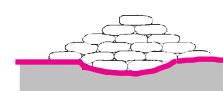
2



3



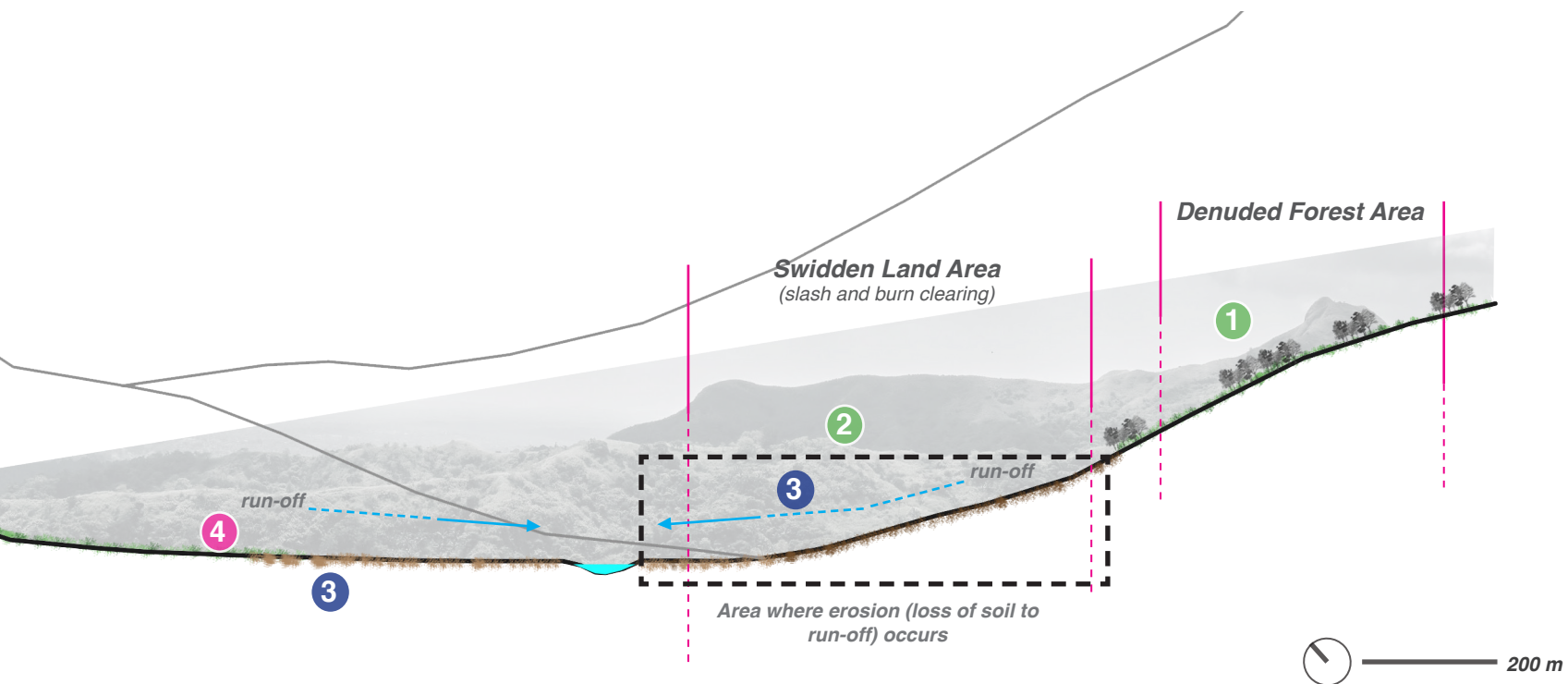
4



Denuded Forest Area

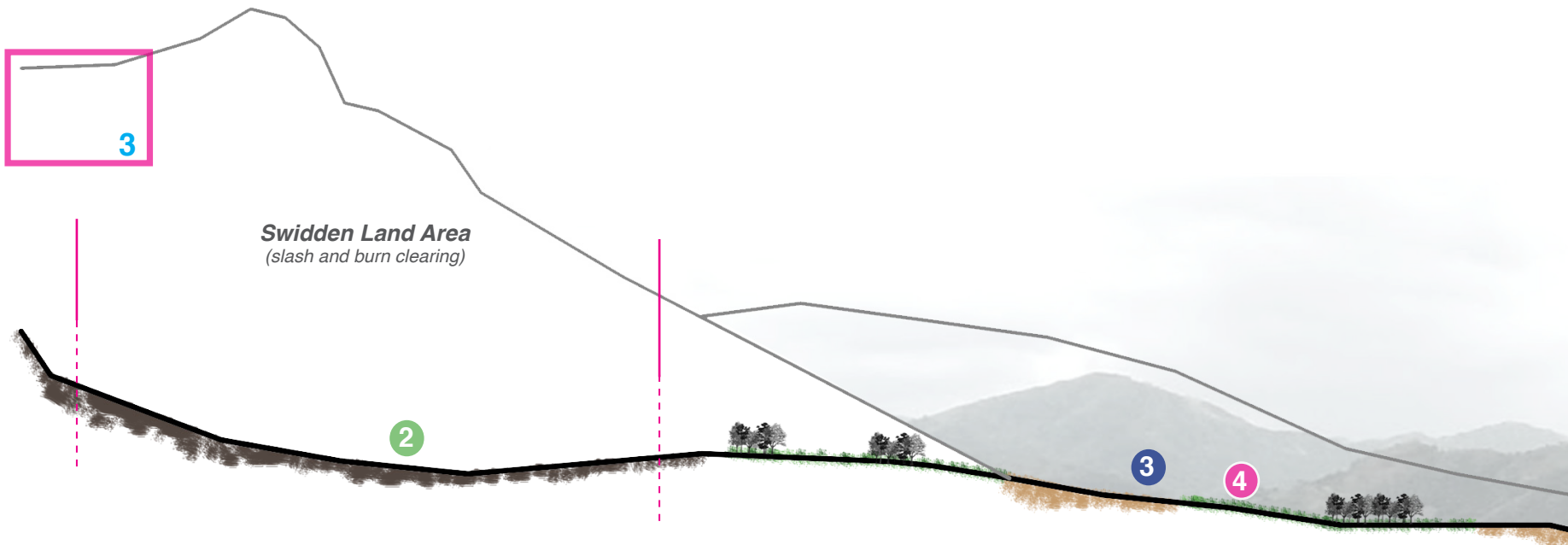
1

2



**Resilient**

*Section 2- Areas that have been subjected to slash-burn clearing must be placed under rehabilitation in order to allow the damaged soil to be able to grow vegetation. Erosion control is used in these areas to help stabilized the soil and control overland water flow. Floodproofing of properties are encouraged to prevent damages.*



highest



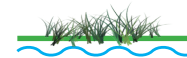
Impact

lowest

### Openness and Adaptability

- Proper Irrigation in Rice Cultivation

1



- Reforestation or Rehabilitation of Deforested areas.

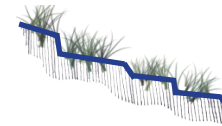
2



### Change at the Margins

- Erosion Control in Denuded Areas.

3



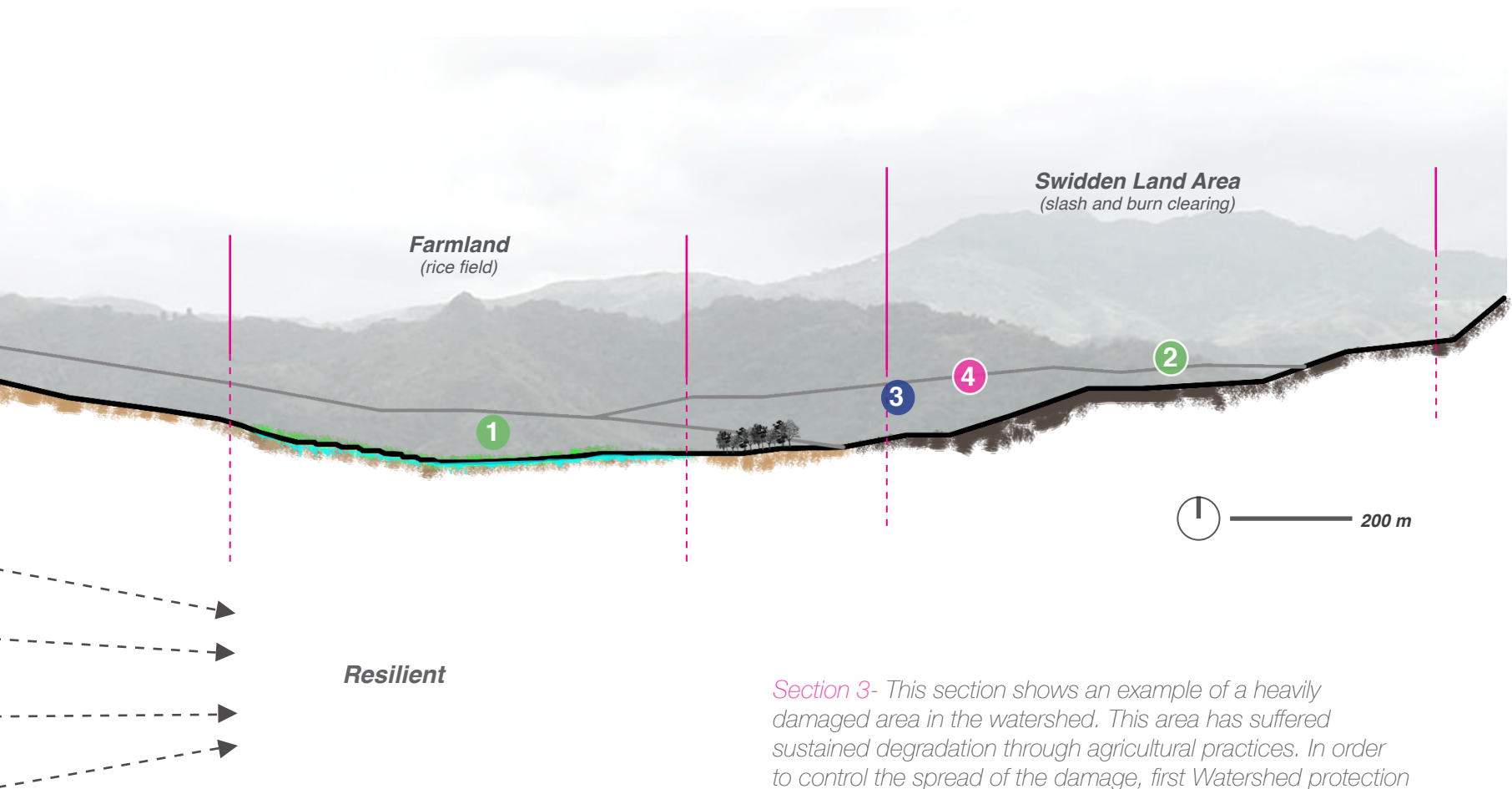
### Resistance and Maintenance

- Reinforce Landslide Prevention Retaining Walls.

4







*Section 3- This section shows an example of a heavily damaged area in the watershed. This area has suffered sustained degradation through agricultural practices. In order to control the spread of the damage, first Watershed protection laws must be enforced before any type of rehabilitation process and control methods be placed.*

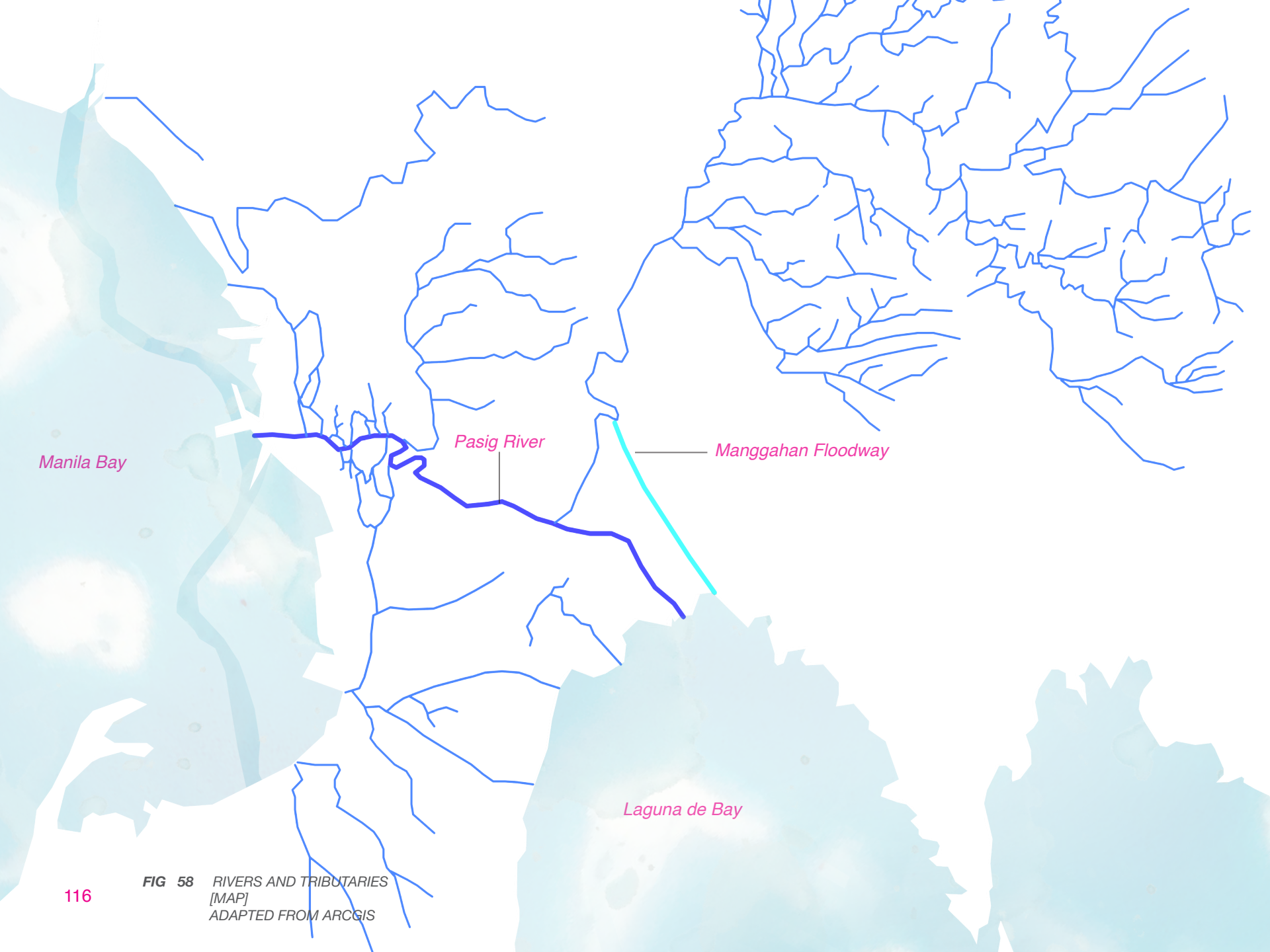


The contributing factors that has led to the sustained degradation of the watershed are related to practices in Land Use. The Openness and Adaptability resiliency type focuses on correcting the cause of these issues. Proper Irrigation Management of cultivated areas, specifically rice cultivation can have a great impact on the use of water within the watershed. The efficient use of water for rice cultivation can maximize yield and the effectiveness of proper retention of water in rice fields would alleviate some surface run-off and lessen the use of groundwater. Another step that should be adhered to is the protection of the watershed basin from additional degradation. By enforcing the laws that prevent practices that are harmful (logging, clearing of forests through burning) to the watershed and placing a boundary between protected and cultivated lands would begin to ensure this. To counteract the loss of soil and the increase of water run-off from affected parts of the

area, rehabilitation or reforestation is the proposed method. Vegetation is a natural erosion control method, and if parts of the denuded forest were to be reestablished it would greatly ensure infiltration and decrease overland flow of run-off.

Although Openness and Adaptability is the most desirable type of resiliency, it is a long term endeavor and would be hard to implement, for it directly challenges practices in the social system. Each of the three types of resiliency would achieve a certain type of tolerance to the disturbance even if they were realized on there own. But within the Upper Marikina Watershed, all three, cross-referenced to one another, and realized together would ensure a more resilient system. Having methods that immediately alleviate the symptoms would allow the establishment of methods that possibly guarantees long - term resiliency.





**FIG 58** RIVERS AND TRIBUTARIES  
[MAP]  
ADAPTED FROM ARCGIS

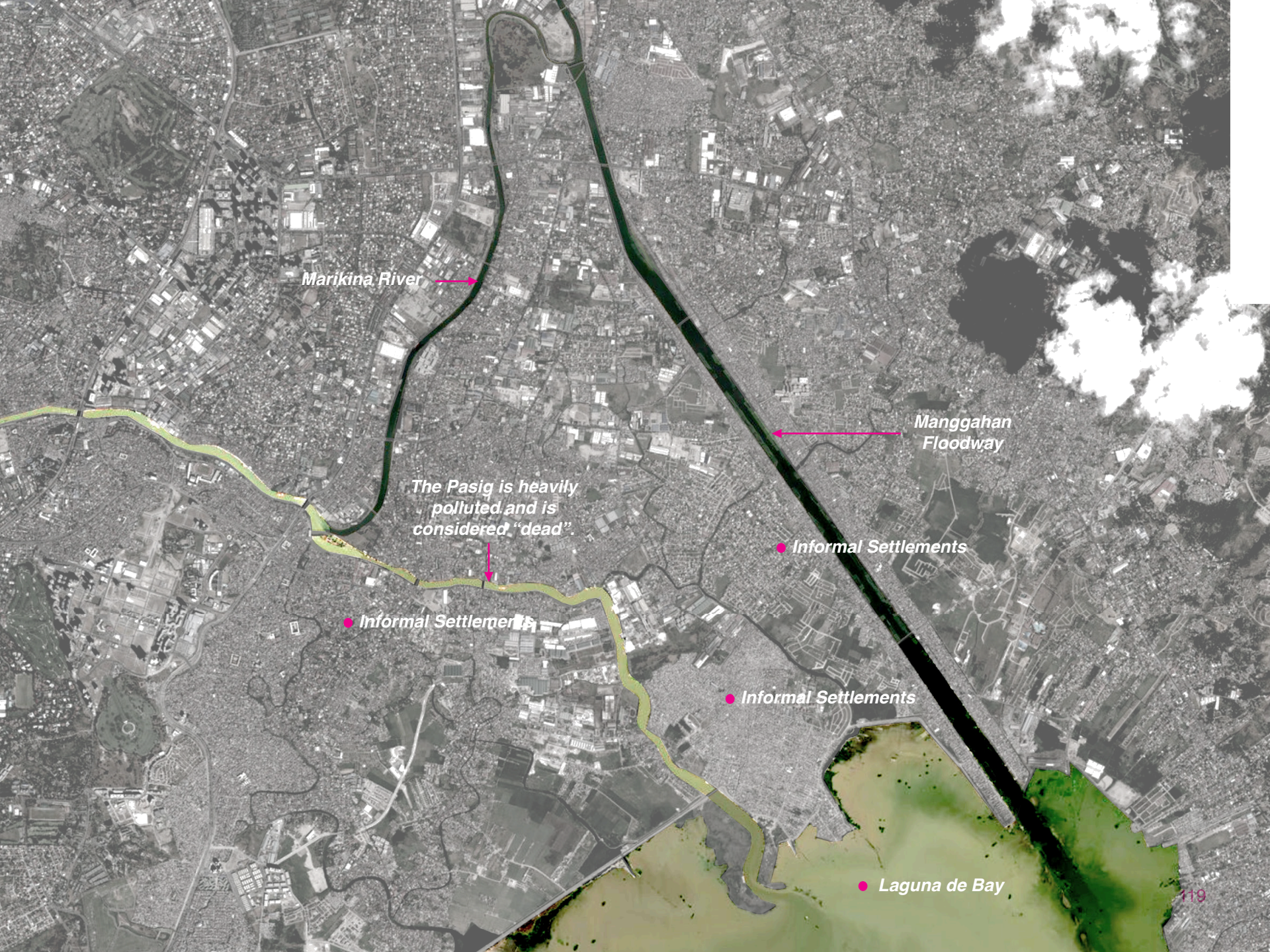
### **City Scale: Pasig River - Tributaries**

Broad and serpentine, the Pasig River is the main “trunk of a network of water-ways that twist across much of Metropolitan Manila.”<sup>13</sup> Twenty- five kilometres long, it connects two great bodies of water, Manila Bay and Laguna de Bay. Remembered for being an idyllic place, the Pasig River banks was once inhabited by a mangrove ecosystem, specifically *Scyphiphora hydrophyllacea* which is locally known as nilad<sup>14</sup> and like provincial rivers, had been the place where people could still fish and to drink from its waters was still possible.<sup>15</sup> During the industrialization period, these where no longer true, the mangrove ecosystem is all but erased, leaving only pockets of forested areas along Manila Bay, and the river has become a dumping ground for “waste ranging from untreated sewage to industrial run-off.”<sup>16</sup> Today the river is regarded as “dead”, where organism can no longer thrive, its waters murky and sluggish that it seems the term waterway is in name only.<sup>17</sup>









Marikina River

The Pasig is heavily  
polluted and is  
considered "dead".

Manggahan  
Floodway

Informal Settlements

Informal Settlements

Informal Settlements

Laguna de Bay



**Issues:**

*Tidal Estuary*

*Informal Settlements blocks water discharge.*

*Easily inundated - carrying run-off from surrounding urban areas and from its tributaries.*

The Pasig River is also part of a tidal estuary, “crossing the narrow waist of land that rises between Manila Bay and Laguna de Bay,”<sup>18</sup> its directional flow is dependent on the water level of the two great bodies of water. When the water level in Laguna de Bay is lower the waters of Pasig moves towards that direction, this usually transpires during the drier months of April and May. During the wetter seasons the reverse is true, the water flows from Laguna de Bay towards Manila Bay. Its waters are brackish, a mixture of the lake's freshwater and the sea's saline. The river is also somewhat stagnant and heavily polluted and is easily inundated during a heavy rainfall because it could not, on its own, discharge water out of the area fast enough to hold the rising water levels.

The river receives water from the canals and tributaries that connects to it, the main one being the Marikina River which brings water from the Upper Marikina Watershed. Due to the high volume of water received from the Marikina River during the rainy season the Manggahan Floodway was built in the 1980s, to lessen the flooding that would occur in the Pasig. The Marikina Flood Control Structure is a diversion dam that re-directs excess water flow from Marikina River into the floodway and releases it into Laguna de Bay.<sup>19</sup> Where the Marikina River overlaps with the Pasig a spillway dam, Napidan Hydraulic Control Structure, is placed to regulate the water coming in from Laguna de Bay and effectively hold back water flow towards the Pasig effectively making Laguna de Bay a reservoir during periods of inundation. This structure also controls the flow of saline water of the Pasig from entering into the

lake.<sup>20</sup> When the Laguna de Bay's capacity has been reached, the Marikina Flood Control Structure would close to prevent any water from Marikina River to enter the floodway.<sup>21</sup>

The whole flood protection infrastructure was designed to only accommodate moderate level of flooding up to 1/30 year floods.<sup>22</sup> With the escalating number of devastating floods that have happened in recent years, this is no longer sufficient. Include the problem of informal settlement further hindering the carrying capacity of the canals and the rivers, it is a tragedy waiting to re-occur.



Manila Bay

***Tidal Estuary** - The flow to the Pasig River is dependent on the tides between Manila Bay and Laguna de Bay. The water would reverse its flow towards the one with the lower tide.*



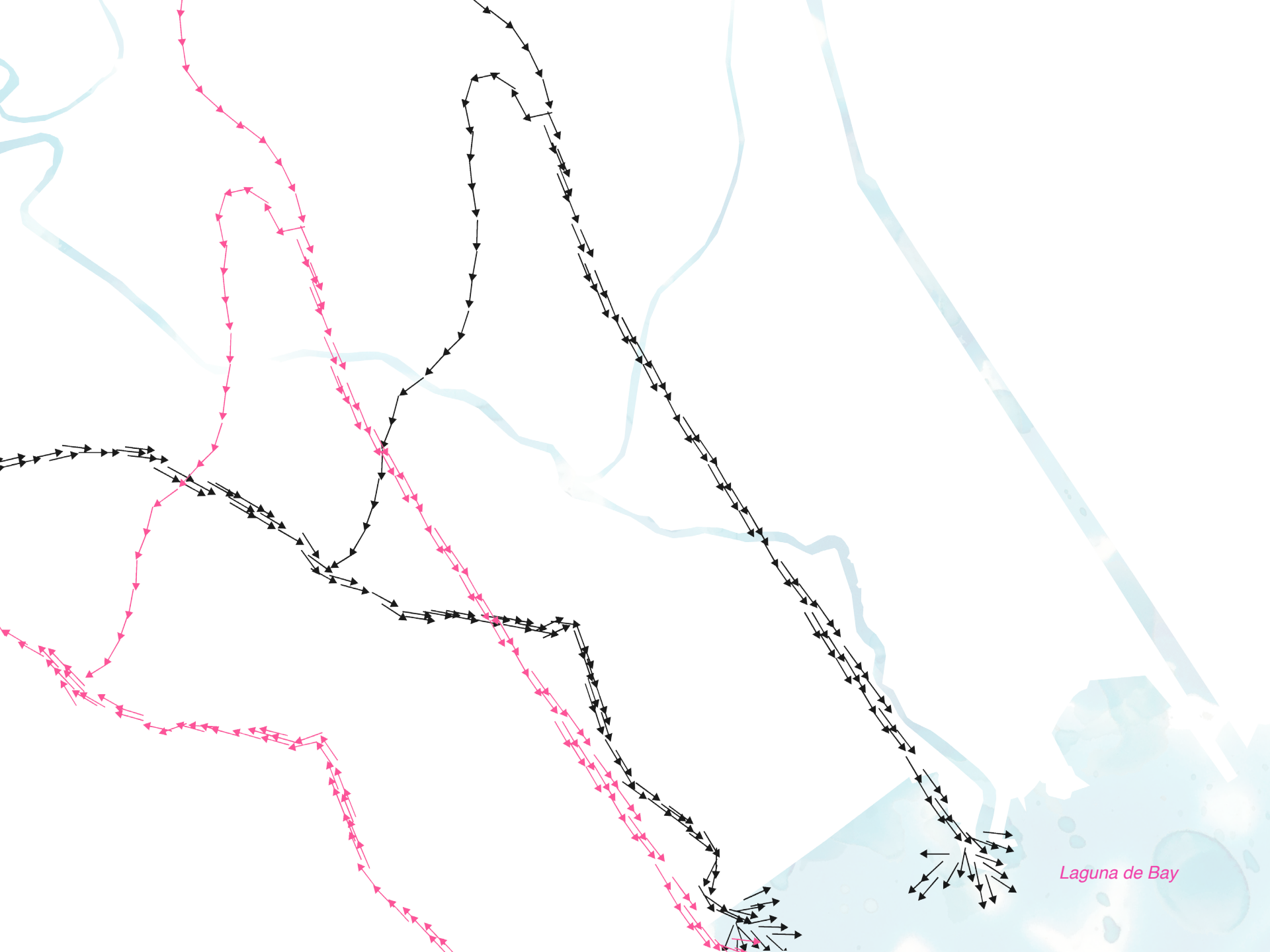
*Dry Season - water flows from Manila Bay to Laguna de Bay (April to May).*



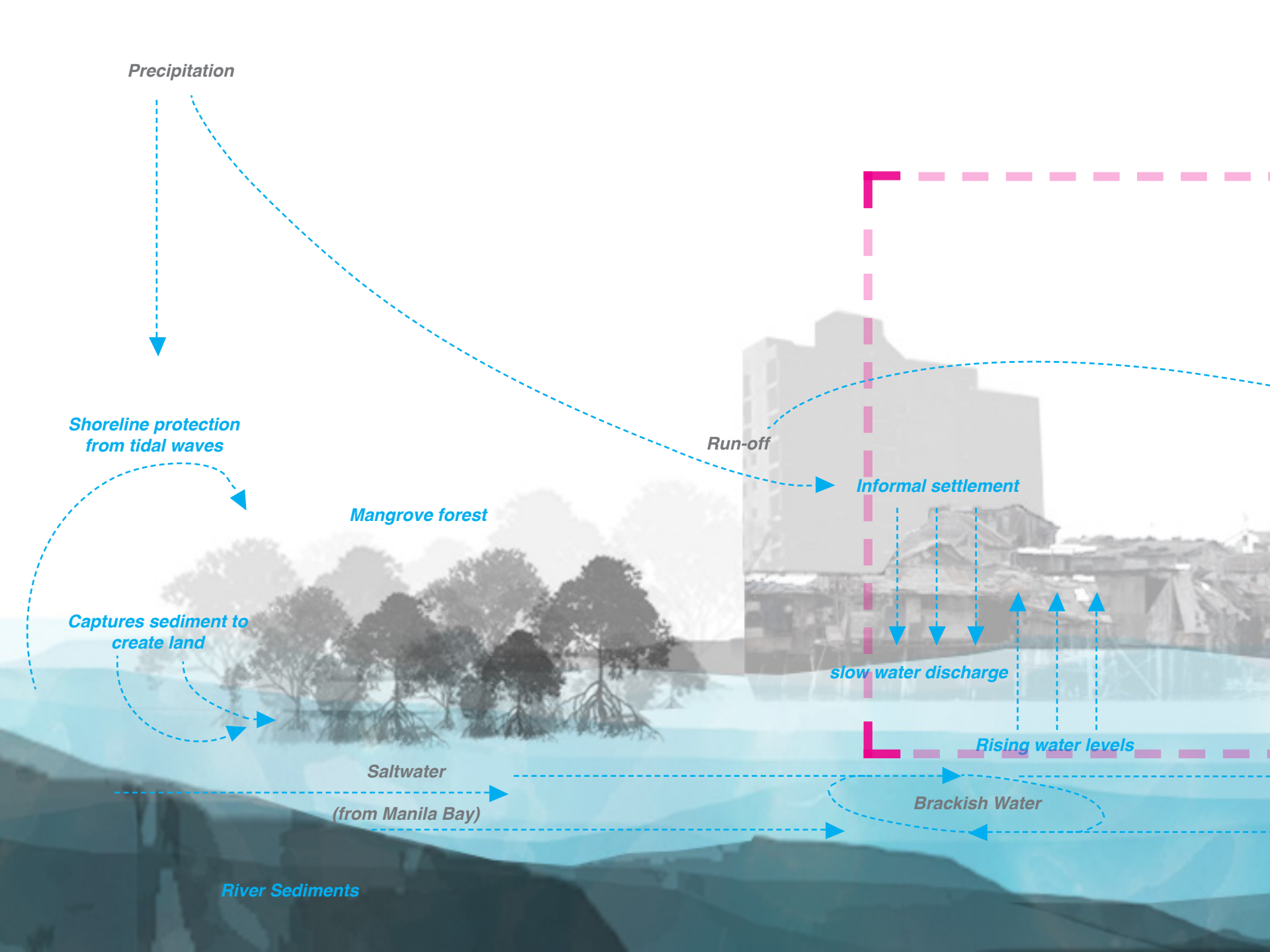
*Wet Season - water flows from Laguna de Bay to Manila Bay.*



1000m

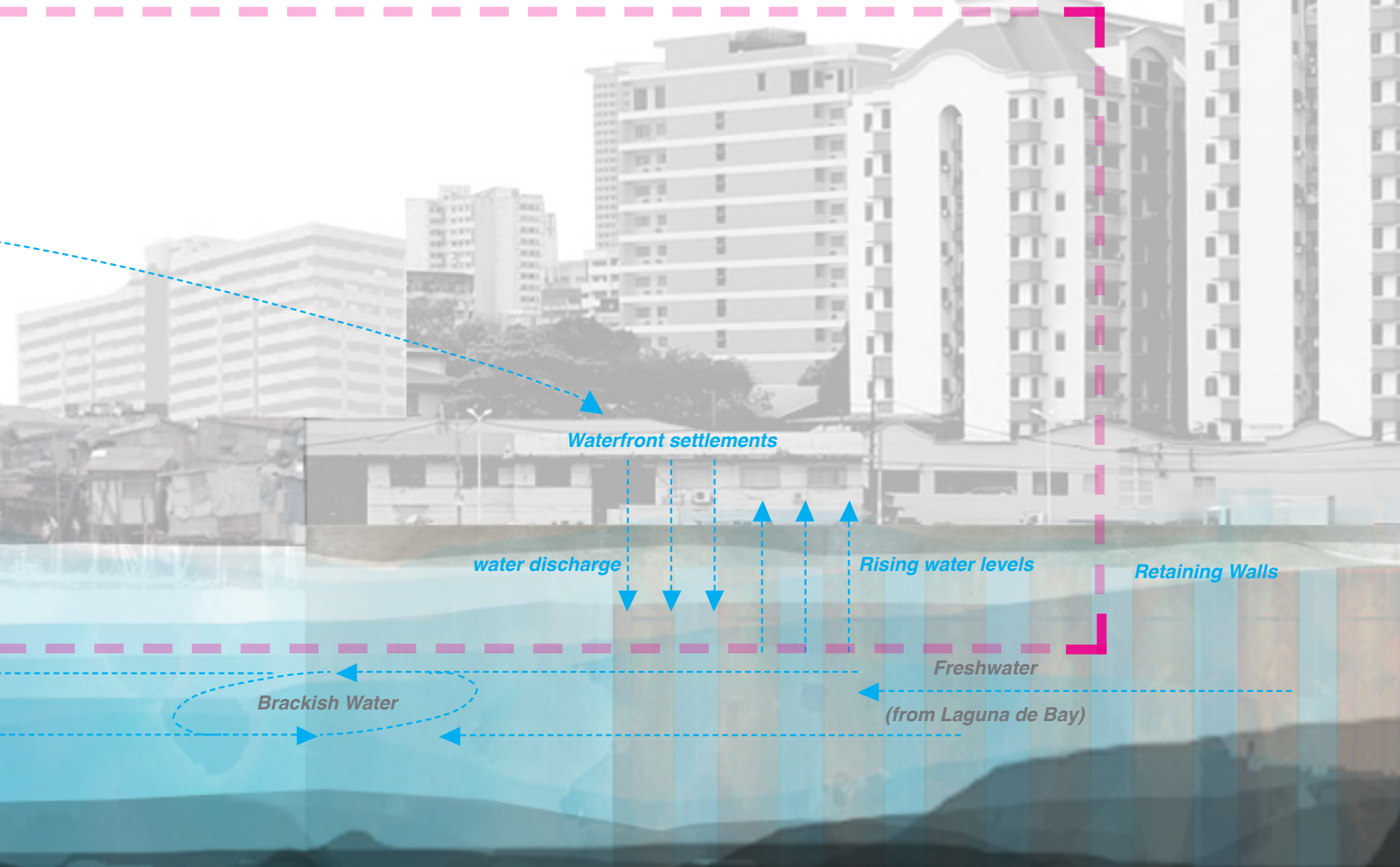


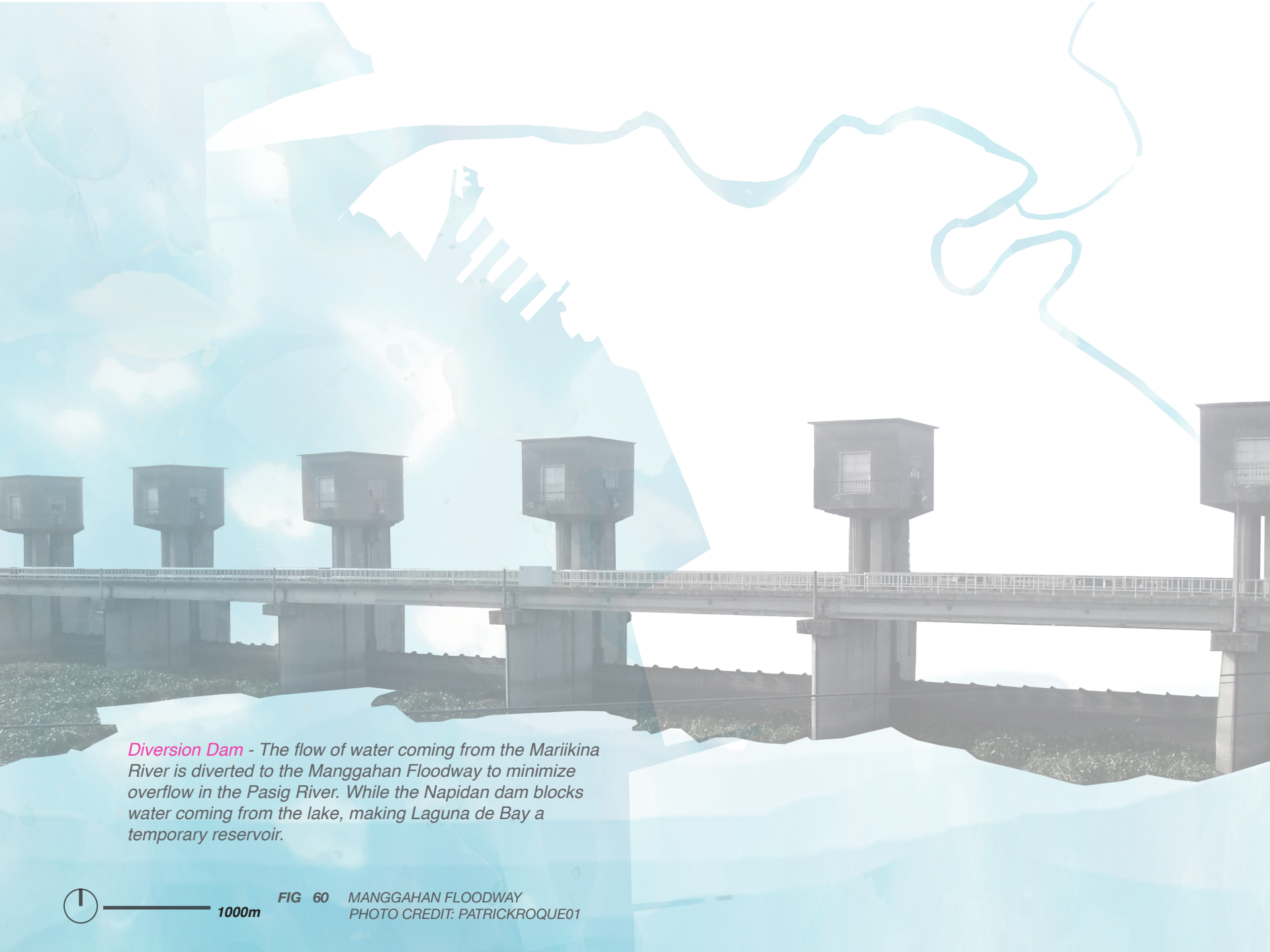
Laguna de Bay





## *Pasig River (Tidal Estuary System Process)*





**Diversion Dam** - The flow of water coming from the Mariikina River is diverted to the Manggahan Floodway to minimize overflow in the Pasig River. While the Napidan dam blocks water coming from the lake, making Laguna de Bay a temporary reservoir.



1000m

**FIG 60** MANGGAHAN FLOODWAY  
PHOTO CREDIT: PATRICKROQUE01



**Marikina Flood Control Structure**  
*(diversion dam)*

**Napidan Hydraulic Control Structure**



## Resiliency Framework: City Scale (Pasig River - Tributaries)

|                                                                                                                                                                                | Methods                                                                                                                                                                                                                                                | Advantages                                                                                                                                                                                                                                                                                             | Disadvantages                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Resistance and Maintenance</b><br><br><i>maintains the current resisting measures at the expense of enormous resources.<br/>(denial that a problem exist)</i>               | <ul style="list-style-type: none"> <li>- Maintain current Flood Protection Infrastructure.</li> <li>- Building up (Floodproofing)</li> <li>- Dike/ Levees.</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>- System already in place, just maintain it.</li> <li>- Specifically areas near the banks of the Pasig, raising up residential areas would protect properties.</li> <li>- Protects the city from River Inundation.</li> </ul>                                   | <ul style="list-style-type: none"> <li>- Is not flexible to conform with the ever-changing intensity of hazards.</li> <li>- This method of flood protection has a short durability.</li> <li>- Static and short term protection.</li> </ul>                                                                  |
| <b>Change at the Margins</b><br><br><i>minor changes - essential to mitigate symptoms. a false sense of security that the threat is neutralized.<br/>(incremental changes)</i> | <ul style="list-style-type: none"> <li>- Dredging Laguna de Bay, and the Pasig-Marikina waterways.</li> <li>- Expand the Carrying Capacity through further Channel Improvements.</li> <li>- Regulate Flow (Diversion and Pumping Stations).</li> </ul> | <ul style="list-style-type: none"> <li>- Increase the rivers and lake's carrying capacity.</li> <li>- Increases the flood plain capacity. Able to regulate 1/100 year floods.</li> <li>- Additional pumping stations and redirection of water flow out of the basin, regulates water level.</li> </ul> | <ul style="list-style-type: none"> <li>- The process of dredging may cause irreparable change in the river ecosystem.</li> <li>- Costly and become static in future inundation.</li> <li>- Cannot predict the volume of water discharge. May become overburdened.</li> </ul>                                 |
| <b>Openness and Adaptability</b><br><br><i>this resiliency type ask to abandon current practices. long-term flexibility.<br/>(targets underlying problems)</i>                 | <ul style="list-style-type: none"> <li>- Rehabilitation of the Pasig River (Waterways).</li> <li>- Enforcement of Land Use in the River Banks.</li> <li>- Management of Waterway Systems. (Stewardship)</li> </ul>                                     | <ul style="list-style-type: none"> <li>- Would allow flexibility in the river dynamics.</li> <li>- Clear the available waterways. Lessens the burden of the infrastructure.</li> <li>- Educate people the proper management of the waterways.</li> </ul>                                               | <ul style="list-style-type: none"> <li>- Long, drawn out process and again contest current practices in the social system.</li> <li>- Hard to implement. Change must come from the social system.</li> <li>- Actions for changes in the proper treatment of waste products are hard to implement.</li> </ul> |

Following the Resiliency framework, methods that are considered to be of the Resistance and Maintenance type are those that keep stability through the maintenance of current methods. At this scale, working with the current infrastructure and maintain it to prevent inundation in the city is one approach. Another is the flood proofing of properties by the waterfront to avoid property loss. Building up, to make certain that the high levels of water does not reach properties, is another sort of flood proofing. To restrain the entry of water in low-lying areas (areas by the canals and the river), dyking or the use of levees are reasonable structural methods that can be applied.

For Change at the Margins type the expansion of the Pasig-Marikina River system through channelization would increase the flow and velocity of the water course, stabilize the banks and improves the channel capacity. Furthermore, dredging Laguna de Bay, ensures that its carrying capacity as a reservoir would be able to store large volumes of excess water during periods of inundation. Methods, such as redirecting the flow of water and pumping water out of the basin both have advantages in regulating the level of water. Together, the improvement of the flood infrastructure system would mitigate inundation at

city level. However, methods that are under Change at the Margins only response to the elimination of symptoms and may fail because they are considered static during periods of uncertainty.

Methods of an Openness and Adaptability focus on changes that come from within, in order to adapt with the shifting nature of the disturbance. Practices that has a hand in the deficiency of the waterways (canals and the river system) must be manage or all together be discontinued. Methods that are regarded as open and adaptable are those that deal with the issue of vulnerability. Rehabilitating the river, managing its waterways and enforcing proper land use are some strategies that can help the social and river system to be flexible and able to conform to the ever-increasing nature of floods.

The most efficient way to immediately stabilize and reduce inundation in flood prone areas is to follow a change at the margins type methods, of purely using engineered (infrastructural) solutions to eliminate risk. But as was said before, following this type of resilience does not have great flexibility when circumstances change. Structural defenses are reliable in promoting stability in the system, but the longevity of resiliency may be better served by integrating methods from the three resiliency types.

**Residential**

**Terrace**

**Terrace**

3

100 year frequency

1

2

regular river levels

3

highest



Impact

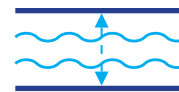


lowest

### **Change at the Margins**

- Expand the Carrying Capacity through further Channel Improvements.

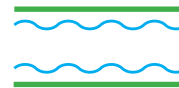
1



### **Openness and Adaptability**

- Rehabilitation of the Pasig River (Waterways).

2



### **Resistance and Maintenance**

- Maintain current Flood Protection Infrastructure.

3

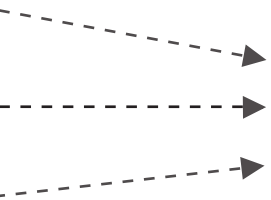




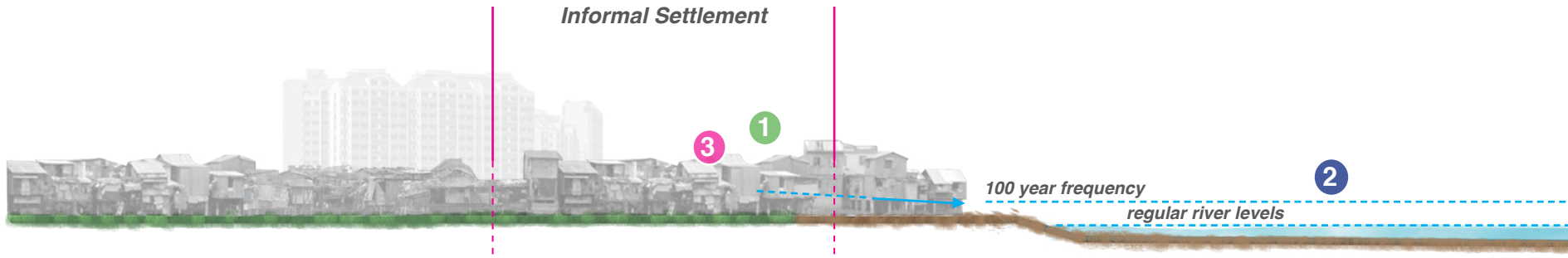
### ***Commercial/ Residential District***



### ***Resilient***



*Section 1 - This section shows an urbanized part of the River Pasig. The materials used nearby are non-permeable, increasing the amount of overland flow and makes its way towards the river. Methods that can be applied are those that encourages the expansion of the carrying capacity of the river. While supporting these are methods that help decrease overland flow.*



highest

Impact

lowest

### Openness and Adaptability

- Enforcement of Land Use in the River Banks.

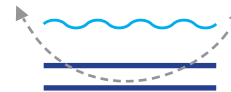
1



### Change at the Margins

- Dredging Laguna de Bay, and the Pasig-Marikina waterways.

2

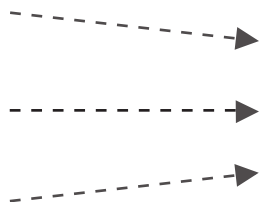
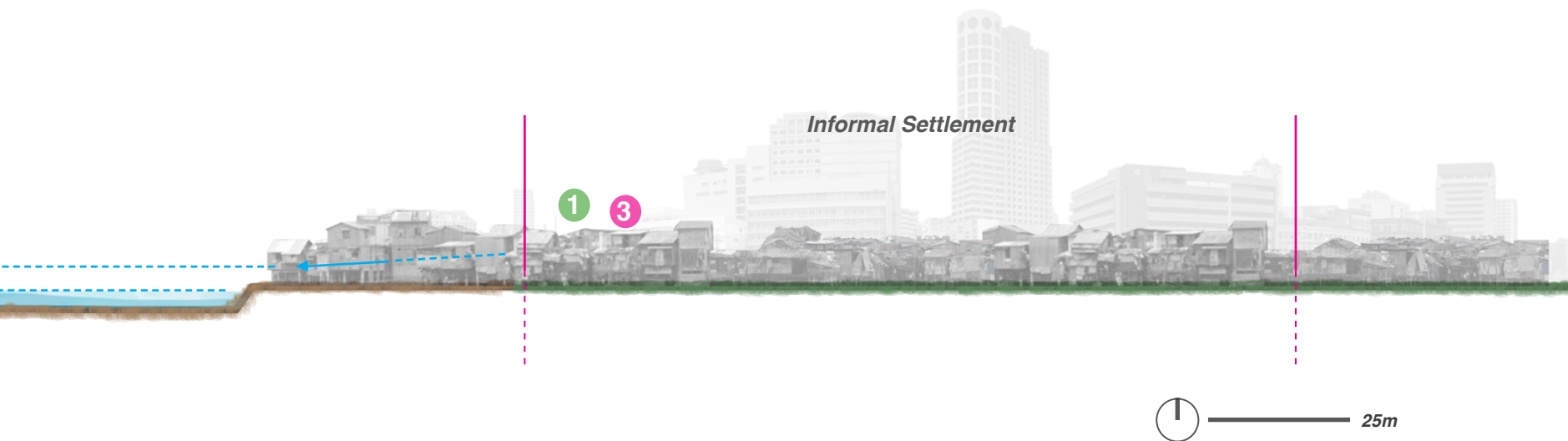


### Resistance and Maintenance

- Building up (Floodproofing)

3





**Resilient**

*Section 2- In some areas, by the banks of the Pasig River are informal settlements. Most of the people who lives in these areas are subjected to the destructive nature of flood events. The methods that are encouraged to use in these types of areas fall within the Openness and Adaptability type. Land use Management being one of them.*





Manila Bay

Laguna de Bay

**FIG 61** MAJOR ROADS AND STREETS  
[MAP]  
ADAPTED FROM ARCGIS



1:200,000

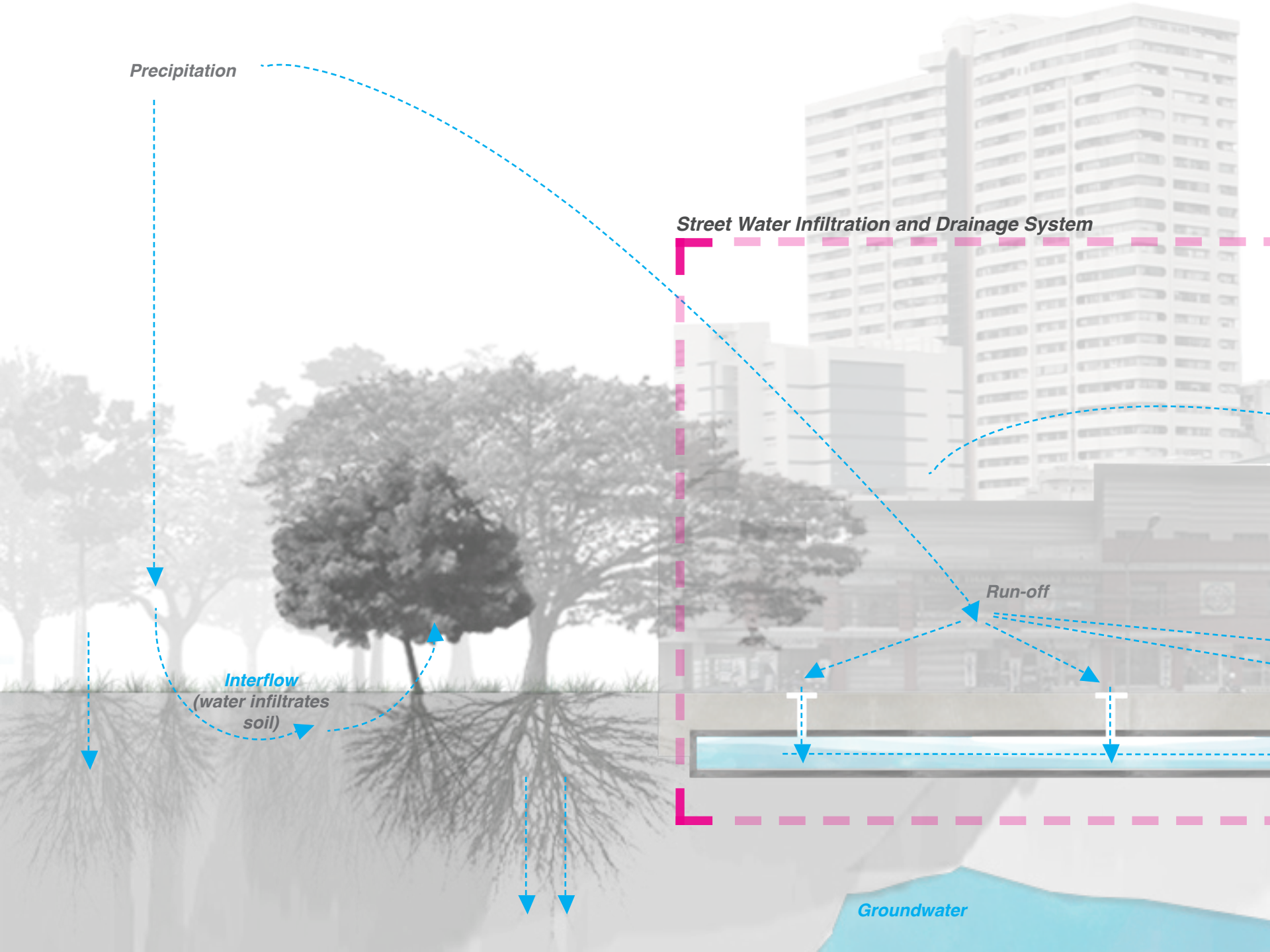


3500m

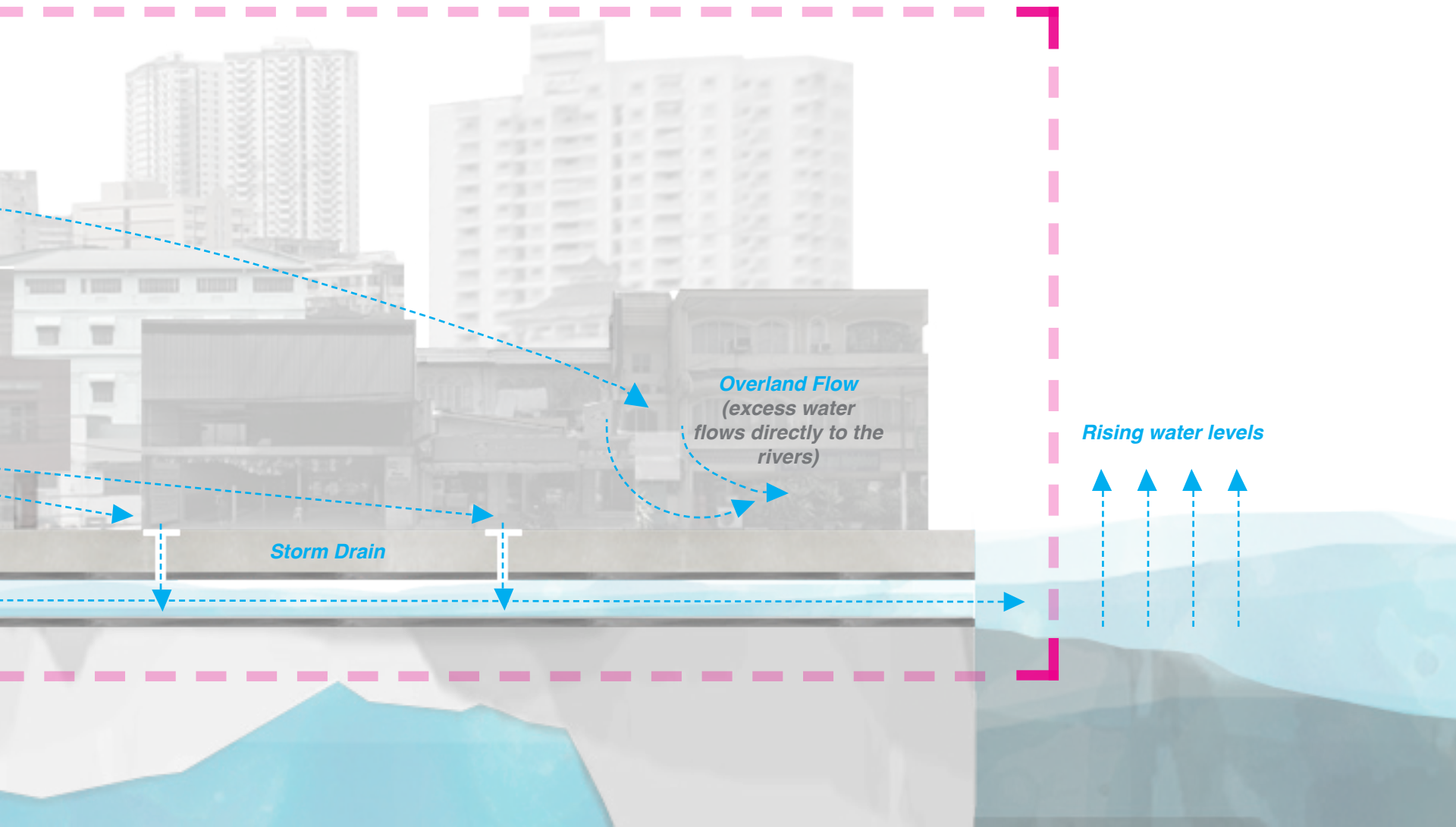
### **Street Scale: Road and Street Infrastructure**

Metropolitan Manila is extremely urbanized. The population growth has put a heavy burden on the current infrastructure, limiting its usefulness and durability in times of exposure to hazards. This unprecedented growth has left parts of the metropolitan area unplanned and unmanaged, mostly leading to the formation of informal settlements. Proper infrastructure, such as drainage systems are almost non-existent in these areas, therefore the inhabitants of these places find themselves casting waste into the already encumbered canals and rivers. Non-permeable materials, such as concrete and bitumen that dominates the metropolitan's ground cover, amplifying the volume of run-off, and significantly augmenting the metropolitan area's susceptibility to inundation.

Long, short, wide, narrow, winding, and congested, the streets of Metropolitan Manila vary in size and density, yet they are all found lacking in sense of security during an inundation. Sewers and drains occasionally cannot take all of the run-off, because of its immeasurable volume or that the drainage systems are slowed down by waste products, further hindering the system to carry discharge. The infrastructures in place are overused and neglected even when there is a need for them to be enhanced. "Often the resources for the maintenance of the infrastructure are diverted to wealthy residential villages"<sup>23</sup> and commercial districts further expanding the gap between the disparity of living. Even so, this is not sufficient to ease these areas from the magnitude of the floods that has lately taken place in the metropolis.







## Resiliency Framework: Street Scale

|                                                                                                                                                                                | Methods                                                                                                                                                                                       | Advantages                                                                                                                                                                                                                                                                                                                  | Disadvantages                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Resistance and Maintenance</b><br><br><i>maintains the current resisting measures at the expense of enormous resources.<br/>(denial that a problem exist)</i>               | <ul style="list-style-type: none"> <li>- Maintain current Drainage Syatem</li> <li>- Building up (Raise Street Level)</li> <li>- Anticipatory Planning (Evacuation Procedures).</li> </ul>    | <ul style="list-style-type: none"> <li>- System already in place, just maintain it.</li> <li>- Specifically flood prone areas.</li> <li>- Prepares individuals for any uncertainty.</li> </ul>                                                                                                                              | <ul style="list-style-type: none"> <li>- Proven ineffective on recent inundation periods.</li> <li>- Delays the inevitable. Short-term security.</li> <li>- Displaces individuals after the event.</li> </ul>                                                                  |
| <b>Change at the Margins</b><br><br><i>minor changes - essential to mitigate symptoms. a false sense of security that the threat is neutralized.<br/>(incremental changes)</i> | <ul style="list-style-type: none"> <li>- Storage (Storm Water Detention Basins)</li> <li>- Improve the Quality of the Drainage and Sewer Systems.</li> <li>- Increase Infiltration</li> </ul> | <ul style="list-style-type: none"> <li>- Regulate the amount of water that gets released.</li> <li>- Expands the drainage capacity of the area. Transport of overland flow in a controlled manner.</li> <li>- Increasing the porosity of urban areas will allow Groundwater Recharge and decrease overland flow.</li> </ul> | <ul style="list-style-type: none"> <li>- This process cannot fully prevent inundation near flood prone areas.</li> <li>- Costly to install the larger pipes (that can carry high volumes of water).</li> <li>- Would not be effective unless done at a large scale.</li> </ul> |
| <b>Openness and Adaptability</b><br><br><i>this resiliency type ask to abandon current practices. long-term flexibility.<br/>(targets underlying porblems)</i>                 | <ul style="list-style-type: none"> <li>- Enforcement of Proper Waste Management.</li> <li>- Land Management Change</li> <li>- Sterwardship (Education)</li> </ul>                             | <ul style="list-style-type: none"> <li>- To not further hinder discharge. Reduce the probability of back-flow.</li> <li>- The wide-spread urbanization impacts must be manage. A balance between built and natural environments.</li> <li>- Education/ Awareness is essential to ensure change in the system.</li> </ul>    | <ul style="list-style-type: none"> <li>- A major change in social practices.</li> <li>- The process would take time to implement and achieve.</li> <li>- Hard to implement.</li> </ul>                                                                                         |

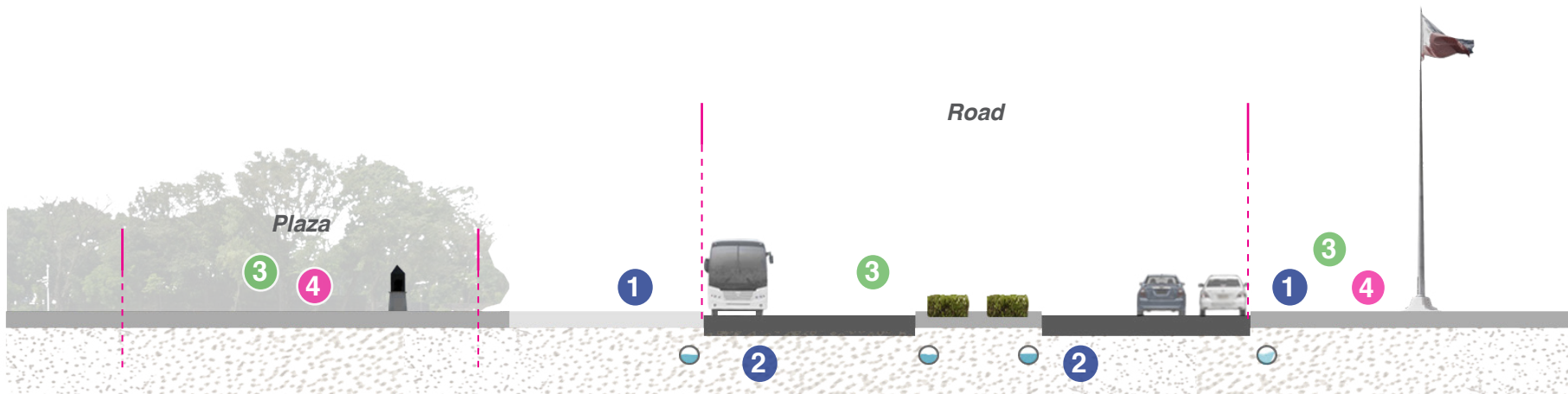
***Issues:***

*Inadequate drainage infrastructure.*

*Concrete and asphalt surfaces increases water run-off.*

To accomplish resiliency at the local level requires improvements in the drainage system and drastic changes on how Manilaños develop land. Again, at this scale, Resistance and Maintenance requires no change in the current circumstances, thus methods that fall within this type are those that 'resist' and 'prevent' damages to properties during flooding events. Raising houses and buildings above the street level to prevent flood water damage is one method of flood proofing. Other methods that can be characterized as Resistance and Maintenance are those that 'anticipate' the event and rather than change the circumstances, removes those who would be affected from harm.





highest  
↑  
Impact  
↓  
lowest

### Change at the Margins

- Storage (Detention Basins)

- Improve the Quality of the Drainage and Sewer Systems.

### Openness and Adaptability

- Land Management Change

### Resistance and Maintenance

- Building up (Floodproofing)

1



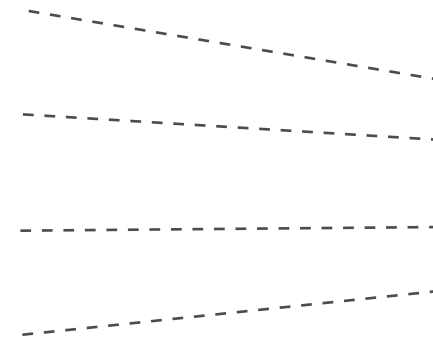
2

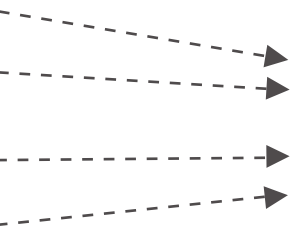
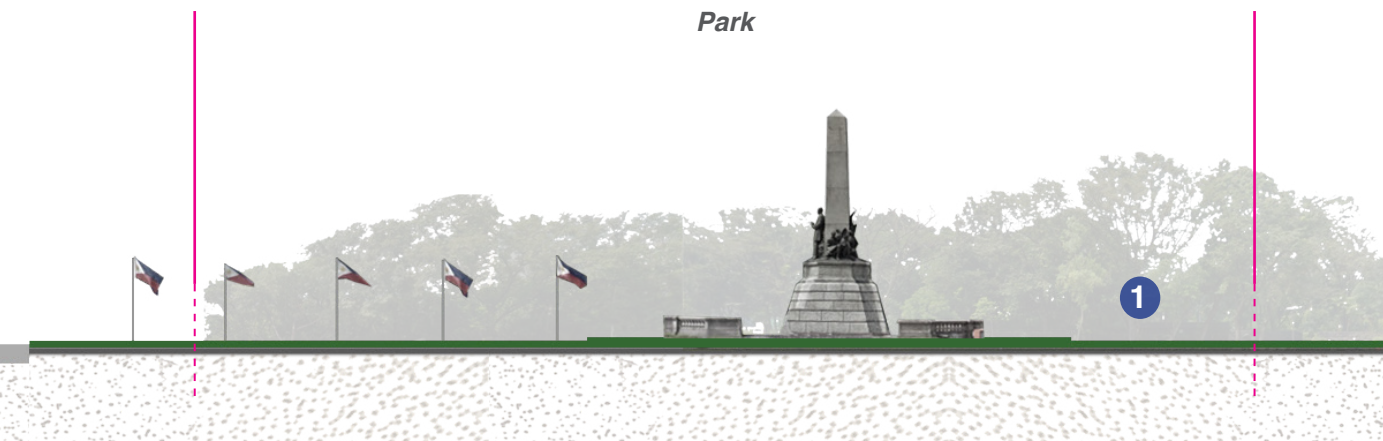


3



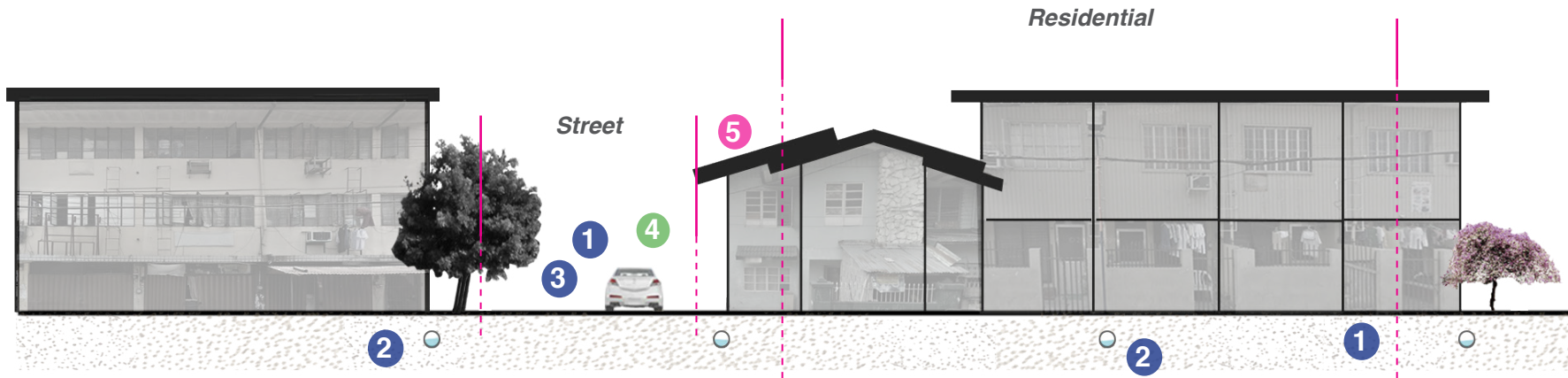
4





**Resilient**

*Section 1 - Streets are important in the overall resiliency of Metro Manila to flooding events. By establishing methods that control the flow of water towards receiving streams and rivers at the street level allows to alleviate further harm to the surrounding areas and properties.*



highest  
↑  
Impact  
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lowest

### Change at the Margins

- Storage (Detention Basins)
- Improve the Quality of the Drainage and Sewer Systems.
- Increase Infiltration

### Openness and Adaptability

- Land Management Change

### Resistance and Maintenance

- Building up (Raise Street Level)

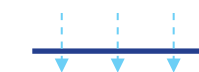
1

2

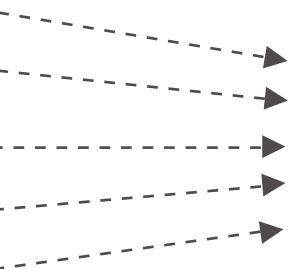
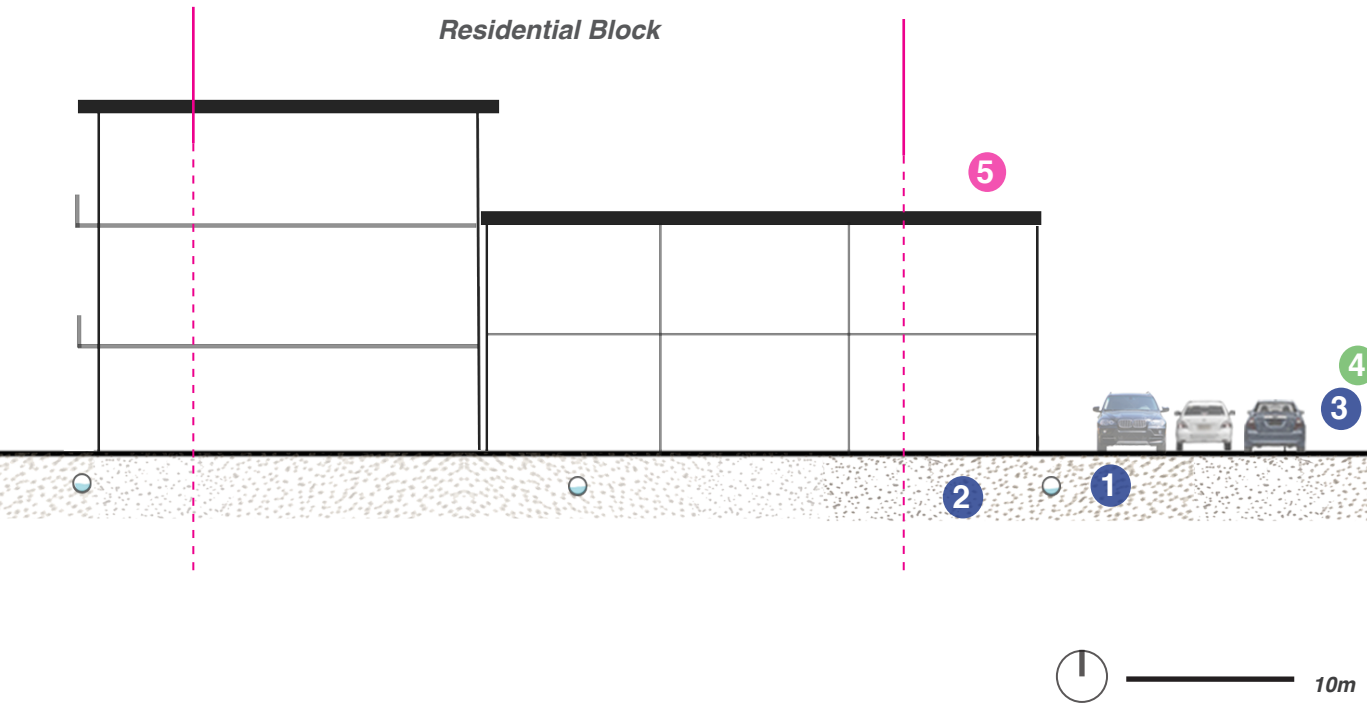
3

4

5







## Resilient

*Section 2 - By collecting, storing and draining water at a controlled environment and immediately at the street scale would decrease overland flow by a margin. When this is established, consideration regarding Land Management Use would further make Metropolitan Manila resilient to floods.*

Change at the Margins type of methods are most suited at this scale, providing security, however short, to help alleviate the flooding of streets. Since water infiltration is low within the urban areas it is important to have an alternative way of slowing the rate of water run-off. One method is to store the excess water on site before slowly releasing it to be discharged. Examples of this are detention basins and swales. To further the effectiveness of these methods the drainage system must be fitted to accommodate high volumes of water and discharge it at a controlled rate. Overall, Change at the Margins methods are geared towards the mitigation of flood symptoms at this level.

For Openness and Adaptability, the flexibility of streets during the onslaught of a flood event relies on the proper management and development of the land. The use of permeable materials for surfaces wherever possible and the balance between developed areas to open spaces (green spaces) are methods that could increase the porosity of urban streets. Strategies under the Openness and Adaptability type pay due attention to the storm water

problem, rather than focusing on the pace of water discharge it tries to resolve the issue of the increase of run-off.

At a street level Change at the Margins type methods would have an immediate impact to tolerate flooding events. It has the highest probability of eliminating risk but to achieve long-term flexibility and fill in the inconsistencies for following one type of resiliency.

## Endnotes:

1. Barbara Goldoftas, *The Green Tiger: The Cost of Ecological Decline in the Philippines* (Oxford: University Press, 2006), 209.
2. Goldoftas, *The Green Tiger*, 210.
3. Ibid, 210.
4. Ibid, 219.
5. Ibid, 210.
6. Doracie Zoleta-Nantes, "Flood Hazards in Metro Manila: Recognizing Commonalities, Differences and Course of Action," *Social Science Dilliman*, 2006, 66, accessed May 12, 2015, <http://www.journals.upd.edu.ph/index.php/socialsciencedilliman/article/viewFile/36/7>.
7. William Marsh, *Landscape Planning: Environmental Applications* (New York: John Wiley and Sons Inc., 1991), 146.
8. Marsh, *Landscape Planning*, 146.
9. Ibid.
10. Ibid, 147.
11. Goldoftas, *The Green Tiger*, 29.
12. Ibid.
13. Ibid, 184.
14. Peter Saenger, *Mangrove Ecology, Silviculture and Conservation* (Berlin: Springer Science and Business Media, 2002), 19, doi 10.1007/978-94-015-9962-7.
15. Goldoftas, *The Green Tiger*, 184.
- 16 -18. Ibid, 184.
19. Zoleta-Nantes, "Flood Hazards in Metro Manila," 70.
- 20 - 21. Ibid.
22. Zoran Vojinovic, *Flood Risk: The Holistic Perspective* (London: IWA publishing, 2015), 182.
23. Zoleta-Nantes, "Flood Hazards in Metro Manila, 70.



***Conclusion***





Metropolitan Manila is naturally susceptible to flooding hazards due to being in a flood plain environment, but it is the complexity between interrelating socio-economic (human-induced activities) factors, such as the effect of population overgrowth, land use practices, and environmental policies, that pose such a risk to the area. Flooding in metropolitan Manila is unavoidable and cannot be fully resolved. Rather this practicum explores resiliency as a necessary component to withstand the phenomenon at various levels of overlapping systems (ecological, economic, and social systems).

By using the resiliency framework we begin to understand that to favour one resiliency type alone does not provide great flexibility for a system to withstand a disturbance. For instance, the current practice to mitigate flooding uses primarily methods from 'Change at the Margins' that would alleviate symptoms without drastically changing the system to have stability. In terms of Metropolitan Manila this shows that this type prioritize an Economic and Social stability over Ecological stability. Rather than a 'one-design-fits all', this practicum proposes a range

of methods and strategies from the three types of resiliency to achieve flexibility at all levels, whether they be for a short or long term. Upon further reflection the idea of *transformation*, the introduction of new components and necessary attributes, became a valuable part of this process of achieving the desirable regime to create a fundamentally resilient system.<sup>1</sup>

Within the scope of this practicum it became evident that engineering solutions are more effective if use in conjunction with ecological thinking. That to truly achieve a resilient city it is significant to acknowledge that processes that are usually categorized as separate are not. Instead, these 'seemingly opposing' forces must be seen as parts of a whole that must coexist and interact with one another.<sup>2</sup>

#### Endnotes:

1. Jianguo Wu and Tong Wu, "Ecological Resilience as a Foundation for Urban Design and Sustainability," in *Resilience in Ecology and Urban Design: Linking Theory and Practice for Sustainable Cities*, ed. M.L. Cadenasso, Brian McGart, and S.T.A. Pickett (New York, Springer, 2013), 224.

2. Jianguo Wu and Tong Wu. "Ecological Resilience as a Foundation for Urban Design and Sustainability," 226.



## ***Reference***



## Image Reference List:

page i *Flood Location Map 2007*. Adapted from Dartmouth Flood Observatory, <http://www.dartmouth.edu/~floods/Archives/GlobalFloods1985-2007.gif> (accessed May 7, 2015). Created and Edited with Adobe Photoshop CS6

Fig 01 Roberto Verzo, *Monsoon*, 2012. Available from: Flickr Commons, <https://www.flickr.com/photos/verzo/7738802596/in/photolist> (accessed December 3, 2015). Edited with Adobe Photoshop CS6.

Fig 02 AusAID, *Flood damage in Manila*. Available from: Flickr Commons, <https://www.flickr.com/photos/dfataustraliaid/10695594406/in/photostream/> (accessed December 4, 2015). Edited with Adobe Photoshop CS6.

Fig 03 ace\_alejandro, *Man Made Mahogany Forest*. Available from: Flickr Commons, [https://www.flickr.com/photos/ace\\_alejandro/4708871167/in/photolist](https://www.flickr.com/photos/ace_alejandro/4708871167/in/photolist) (accessed December 13, 2015). Edited with Adobe Photoshop CS6.

Fig 07 jojo nicdao. Available from: Flickr Commons, <https://www.flickr.com/photos/jonidao/8991249737/in/photolist> (accessed December 6, 2015). Edited with Adobe Photoshop CS6.

Fig 09 brownpau. *Low clouds over Metro Manila*. Available from: Flickr Commons, <https://www.flickr.com/photos/brownpau/16092787002/in/album-72157649478106580/> (accessed December 7, 2015). Edited with Adobe Photoshop CS6.

Fig 15 John Tewell. *An early view of the mouth of Pasig River*. 1800. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/9369557864/in/photolis> (accessed May 7, 2015).

Fig 16 John Tewell. *Rosario Street and Binondo Church in the distance*. 1899. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/9947116434/in/photolis> (accessed May 7, 2015).

Fig 17 John Tewell. *Manila, Philippines*. 1920. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/15623771269/in/photolist> (accessed May 7, 2015).

Fig 18 *Metro Manila*, Sattelite Map. ArcGIS® software by Esri (accessed March 10, 2016). Edited with Adobe Photoshop CS6.

Fig 19 traveloriented. *Life along the estero*, Available from: Flickr Commons, <https://www.flickr.com/photos/traveloriented/16028607836> (accessed December 12, 2015). Edited with Adobe Photoshop CS6.

Fig 20 Jesse Allen. *Mitag and Hagibis*. NASA Image. Available from: Wikimedia Commons, [https://upload.wikimedia.org/wikipedia/commons/1/14/Mitag\\_and\\_Hagibis\\_25\\_nov\\_2007\\_0245Z.jpg](https://upload.wikimedia.org/wikipedia/commons/1/14/Mitag_and_Hagibis_25_nov_2007_0245Z.jpg) (accessed December 11, 2015). Edited with Adobe Photoshop CS6.

Fig 21 John Tewell. *Street Flooding after Typhoon*. 1905. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/11200922283/in/photolist> (accessed May 7, 2015).

Fig 22 John Tewell. *Manila Flood, three women in a tub*. 1915. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/9532392340/in/photolist> (accessed May 7, 2015).

Fig 23 John Tewell. *Flooded street of Bilibid Viejo*. 1915. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/9532390912/in/photolist> (accessed May 7, 2015).

Fig 24 NOAA. *Super Typhoon Maysak Strengthening in Western Pacific Region*. Available from: NOAA, <http://www.nnvl.noaa.gov/MediaDetail2.php?MediaID=1686&MediaTypeID=1> (accessed May 7, 2015).

Fig 25 Data courtesy of Joint Typhoon Warning Center. [http://weather.unisys.com/hurricane/w\\_pacific/](http://weather.unisys.com/hurricane/w_pacific/) (accessed March 23, 2015).

Fig 26, 27, 28, 29, 32 Adapted from NOAH. Available from: <http://noah.dost.gov.ph/#/> (accessed March 10, 2015). Edited with Adobe Photoshop CS6.

Fig 30 Robin Zebrowski. *Flooded Manila*. Available from: Flickr Commons, <https://www.flickr.com/photos/firepile/7092001371/in/photolist> (accessed December 11, 2015). Edited with Adobe Photoshop CS6.

Fig 31 Kris Carillo. *Just Falling Rain*. 2009. Available from: Flickr Commons, [https://www.flickr.com/photos/reckless\\_sniper/3955271670/in/photolist](https://www.flickr.com/photos/reckless_sniper/3955271670/in/photolist) (accessed December 7, 2015). Edited with Adobe Photoshop CS6.

Fig 33 Patrick Roque. *Aerial view of Avenida area*. 2015. Available from: Wikimedia Commons, [https://en.wikipedia.org/wiki/File:Pic\\_geo\\_photos\\_-\\_ph%3Dmm%3Dmanila%3Dsanta\\_cruz%3Davenida\\_area\\_-\\_aerial\\_shot\\_from\\_riverview\\_mansion\\_philippines--2015-0624--Is-.JPG](https://en.wikipedia.org/wiki/File:Pic_geo_photos_-_ph%3Dmm%3Dmanila%3Dsanta_cruz%3Davenida_area_-_aerial_shot_from_riverview_mansion_philippines--2015-0624--Is-.JPG) (accessed December 17, 2015). Edited with Adobe Photoshop CS6.

Fig 34 BBC World Service. *Looking out from San Miguel de Estero*. Available from: Flickr Commons, <https://www.flickr.com/photos/bbcworldservice/6055124505/in/photolist> (accessed May 7, 2015). Edited with Adobe Photoshop CS6.

Fig 35 Data courtesy of DLR-DFD. <http://earthzine.org/2011/07/20/remote-sensing-an-effective-data-source-for-urban-monitoring/> (accessed March 23, 2015).

Fig 36 Goya Bauwens. *Manila*. Available from: Flickr Commons, <https://www.flickr.com/photos/goya/3352616375/in/photolist> (accessed December 10, 2016). Edited with Adobe Photoshop CS6.

Fig 37 jojo nicdao. *Mt. Batulao Panorama*. Available from: Flickr Commons, <https://www.flickr.com/photos/jonicdao/8090215090/in/photolist> (accessed December 10, 2015). Edited with Adobe Photoshop CS6.

Fig 38 Francesco Veronesi. *Deforestation*. Available from: Flickr Commons, [https://www.flickr.com/photos/francesco\\_veronesi/3941542160/in/photolist](https://www.flickr.com/photos/francesco_veronesi/3941542160/in/photolist) (accessed December 7, 2015).



Fig 41 Miguel Castaneda. *Home along the river*. Available from: Flickr Commons, [https://www.flickr.com/photos/migee\\_castaneda/4506394201/in/photolist](https://www.flickr.com/photos/migee_castaneda/4506394201/in/photolist) (accessed January 29, 2016). Edited with Adobe Photoshop CS6.

Fig 43 Daniel Go. *Standing in the Rain*. Available from: Flickr Commons, <https://www.flickr.com/photos/danielygo/7937342172/in/photolist> (accessed January 28, 2016). Edited with Adobe Photoshop CS6.

Fig 44 Aldrich Lim. *Water World*. Available from: Flickr Commons, <https://www.flickr.com/photos/diveclimbsurf/3974406142/in/photolist> (accessed January 28, 2016). Edited with Adobe Photoshop CS6.

Fig 46 Goya Bauwens. *Manila*. Available from: Flickr Commons, <https://www.flickr.com/photos/goya/3353438570/in/photolist> (accessed January 29, 2016). Edited with Adobe Photoshop CS6.

Fig 50 (From Left to Right)

Francesco Veronesi. *Deforestation*. Available from: Flickr Commons, [https://www.flickr.com/photos/francesco\\_veronesi/3941542160/in/photolist](https://www.flickr.com/photos/francesco_veronesi/3941542160/in/photolist) (accessed December 7, 2015). Edited with Adobe Photoshop CS6.

European Commission DG Echo. *Barangay Kalayaan*. Available from: Flickr Commons, *Deforestation*. Available from: Flickr Commons, [https://www.flickr.com/photos/francesco\\_veronesi/3941542160/in/photolist](https://www.flickr.com/photos/francesco_veronesi/3941542160/in/photolist) (January 31, 2016). Edited with Adobe Photoshop CS6.

(continuation of Fig 50)

Francesco Veronesi. *Deforestation*. Available from: Flickr Commons, [https://www.flickr.com/photos/francesco\\_veronesi/3941542160/in/photolist](https://www.flickr.com/photos/francesco_veronesi/3941542160/in/photolist) (accessed December 7, 2015). Edited with Adobe Photoshop CS6.

Robin Zebrowski. *Pasig River poverty in the Philippines*. Available from: Flickr Commons, <https://www.flickr.com/photos/firepile/7088728855/in/photolist> (accessed January 28, 2016). Edited with Adobe Photoshop CS6.

Fig 51 (From Left to Right)

Regional:

Rodriguez. *Rizal*. Available from: Wikimedia Commons, [https://upload.wikimedia.org/wikipedia/commons/1/1b/Rodriguez%2CRizaljf5917\\_09.JPG](https://upload.wikimedia.org/wikipedia/commons/1/1b/Rodriguez%2CRizaljf5917_09.JPG). (accessed March 14, 2016). Edited with Adobe Photoshop CS6.

City:

John Tewell. *Rizal*. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/11004598453/in/photolist>. (accessed March 15, 2016). Edited with Adobe Photoshop CS6.

BBC World Service. *Looking out from San Miguel de Estero*. Available from: Flickr Commons, <https://www.flickr.com/photos/bbcworldservice/6055124505/in/photolist> (accessed May 7, 2015). Edited with Adobe Photoshop CS6.

Local:

NCCA Official. *PH Arts Fest 2014 on the street of Manila*. Available from: Flickr Commons, <https://www.flickr.com/photos/nccaofficial/13115896485/in/photolist>. (accessed March 15, 2016). Edited with Adobe Photoshop CS6.

(continuation of Fig 51)

John Tewell. Available from: Flickr Commons, <https://www.flickr.com/photos/johntewell/5130845290/in/photolist>. (accessed March 15, 2016). Edited with Adobe Photoshop CS6.

Dennison Uy. Available from: Flickr Commons, <https://www.flickr.com/photos/dennisonuy/3832546357/in/photolist> (accessed March 15, 2016). Edited with Adobe Photoshop CS6.

Fig 52 *Regional Watershed*, Map. Data from ArcGIS® software by Esri (accessed March 10, 2016). Edited with Adobe Photoshop CS6.

Fig 54 *Upper Marikina Watershed*, Sattelite Map. ArcGIS® software by Esri (accessed March 15, 2016). Edited with Adobe Photoshop CS6.

Fig 55, 56, 57

Sattelite Maps. Imagery Aerometrex. Google Earth 2016. (accessed March 17, 2016). Edited with Adobe Photoshop CS6.

Fig 58 *Rivers and Tributaries*, Map. Data from ArcGIS® software by Esri (accessed March 10, 2016). Edited with Adobe Photoshop CS6.

Fig 59 Map. *Pasig River Area*. Imagery Aerometrex. Google Earth 2016. (accessed March 19, 2016). Edited with Adobe Photoshop CS6.

Fig 60 Patrickroque01. *Manggahan Floodway, Pasig City*. Available from: Wikimedia Commons, <https://en.wikipedia.org/wiki/File:Pasig-manggahan-floodway-2013-01.JPG> (accessed March 21, 2016). Edited with Adobe Photoshop CS6.

Fig 61 *Major Roads and Streets*, Map. Data from ArcGIS® software by Esri (accessed March 10, 2016). Edited with Adobe Photoshop CS6.

## Bibliography:

Agoncillo, Teodoro. *A Short History of the Philippines*. New York: The New American Library, 1975.

Alvarez, M. *Floodplains: Physical Geography, Ecology and Societal Interactions*. New York: Nova Science Publishers, 2011.

Arnold, Margaret, Anne Carlin and Alcira Kreimer, eds. *Building Safer Cities: The Future of Disaster Risk*. Washington D.C.: World Bank, 2003.

Bankoff, Greg. *Cultures of Disaster: Society and natural hazard in the Philippines*. London: RoutledgeCurzon, 2003.

Bankoff, Greg. "Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila." *Disasters* 27, no 3 (2003): 95-109. doi: 10.1111/1467-7717.00230

Bankoff, Greg, Georg Frerks and Dorothea Hilhorst, eds. *Mapping Vulnerability: Disasters, Development, and People*. London: EarthScan Publications Limited, 2004.

Cook, Robert. "Do Landscapes Learn?: Ecology's New Paradigm and Design in Landscape Architecture." 1-31. Accessed January 15, 2016. [http://www.responsivelandscapes.com/readings/ecology/COOK\\_DoLandscapesLearn.pdf](http://www.responsivelandscapes.com/readings/ecology/COOK_DoLandscapesLearn.pdf)

Corner, James. "Ecology and Landscapes as Agents of Creativity." *The Landscape Imagination: Collected Essays of James Corner 1990 -2010*, ed. James Corner and Alison Bick Hirsch, 256-279. New York: Princeton Architectural Press, 2014.

Corner, James. "Not Unlike Life Itself: Landscape Strategy Now." *The Landscape Imagination: Collected Essays of James Corner 1990 -2010*, ed. James Corner and Alison Bick Hirsch, 285-289. New York: Princeton Architectural Press, 2014.

Cutter, Susan, Lindsey Barnes, Melissa Berry, Christopher Burton, Elijah Evans, Eric Tate, and Jennifer Webb, "A place-based model for understanding community resilience to natural disasters," *Global Environmental Change* 18 (2008): 598 -606. Accessed September 14, 2015. <http://lbr.covalentwords.com/assets/docs/33.pdf>

Girot, Christophe, Annette Freytag, Albert Kirchengast and Dunja Ritcher, eds. *Topology*. Berlin: Jovis Verlag GmbH, 2013.

Goldoftas, Barbara. *The Green Tiger: The Cost of Ecological Decline in the Philippines*. Oxford: University Press, 2006.

Gutierrez, Jason. "Thousand Flee Flooding in Manila." *Sydney Morning Herald*, 2013. Accessed November 25, 2013. <http://www.smh.com.au/world/thousands-flee-flooding-in-manila-20130820-2s9la.html>.

- Handmer, John, and Stephen Dovers, "A Typology of Resilience: Rethinking Institutions for Sustainable Development," *Organization and Environment* 9, no.4 (1996): 482-511. Accessed January 7, 2016. doi: 10.1177/108602669600900403.
- Hernandez, Carolina. "Philippines". *Encyclopedia Britannica*. Accessed May 5, 2015. [www.britannica.com/EBchecked/topic/456399/Philippines](http://www.britannica.com/EBchecked/topic/456399/Philippines).
- Hine, Thomas. "The Imperial Façade: Daniel H. Burnham and American Architectural Planning in the Philippines." *Pacific Historical Review*, 41, no.1 (1972): 33-63. Accessed October 27, 2015. <http://www.jstor.org/stable/3638224>.
- Jackson, John. *Discovering the Vernacular Landscapes*. New Haven: Yale University, 1984.
- Klein, Richard J. T. Robert J. Nicholls, and Frank Thomalla, "The Resilience of Megacities to Weather-Related Hazards." In *Building Safer Cities: The Future of Disaster Risk*. Edited by Arnold, Margaret, Anne Carlin and Alcira Kreimer. Washington D.C.: World Bank, 2003. 101- 118.
- Liao, Kuei-Hsien. 2012. "A Theory on Urban Resilience to Floods—A Basis for Alternative Planning practices." *Ecology and Society*, 17(4), 48 (2012). <http://dx.doi.org/10.5751/ES-05231-170448>
- Mossop, Elizabeth. "Landscapes of Infrastructure." *The Landscape Urbanism Reader*, ed. Charles Waldheim. New York: Princeton Architectural Press, 2006. 163 - 177.
- Oliver-Smith, Anthony. "Theorizing Vulnerability in a Globalized World: A Political Ecological Perspective." In *Mapping Vulnerability: Disasters, Development and People*, ed. Greg Bankoff, Georg Frerks and Dorothea Hillhorst. London: EarthScan Publications Limited, 2004.
- Pender, Gareth and Hazel Faulkner, eds. *Flood Risk Science and Management*. New Jersey: Wiley-Blackwell, 2011.
- Reed, Robert. *Colonial Manila: The Context of Hispanic Urbanism and Process of Morphogenesis*. Berkeley: University of California Press, 1978.
- Saenger, Peter. *Mangrove Ecology, Silviculture and Conservation*. Berlin: Springer Science and Business Media, 2002. Accessed March 23, 2016. doi 10.1007/978-94-015-9962-7.
- Timmerman, Peter. "Vulnerability, Resilience and the Collapse of Society: A Review of Models and Possible Climatic Applications." *Environmental Monograph* 1 (1981): 1-46. Accessed January 7, 2016. <http://www.ilankelman.org/miscellany/Timmerman1981.pdf>



- Tower, Walter. "The Climate of the Philippines." *Bulletin of the American Geographical Society* 35, no. 3 (1903): 258, doi: 10.2307/197391
- Van Der Ryn, Sim, and Stuart Cowan. *Ecological Design*. Washington D.C.: Island Press, 1996.
- Vojinovic, Zoran. *Flood Risk: The Holistic Perspective*. London: IWA publishing, 2015.
- Watson, Donald and Michele Adams. *Design for flooding: Architecture, Landscape, and Urban Design for Resilience to Flooding and Climate Change*. New Jersey: John Wiley and Sons, 2011.
- Wernstedt, Frederick, J.E. Spencer. *The Philippine Island World: A Physical, Cultural, and Regional Geography*. Berkeley: University of California Press, 1967.
- World Bank. "Average Precipitation per Year." *The World Bank*. Accessed April 30, 2015 <http://data.worldbank.org/indicator/AG.LND.PRCP.MM>.
- Zoleta-Nantes, Doracie. "Flood Hazards in Metro Manila: Recognizing Commonalities, Differences and Course of Action." *Social Science Dilliman*, 2006. Accessed May 12, 2015. <http://www.journals.upd.edu.ph/index.php/socialsciencediliman/article/viewFile/36/7>.
- Wu, Jianguo and Tong Wu. "Ecological Resilience as a Foundation for Urban Design and Sustainability." *In Resilience in Ecology and Urban Design: Linking Theory and Practice for Sustainable Cities*. ed. M.L. Cadenasso, Brian McGart, and S.T.A. Picket. New York:, Springer, 2013. 211- 229.

