PART 5: DISASTER RISK REDUCTION AND CLIMATE CHANGE ADAPTATION PROFILE

5.1. BASIC TERMINOLOGIES

RISK. It is the combination of the probability of an event and its negative consequences. The word risk has two distinctive connotations:

Popular usage. The emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident".

Technical settings. The emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period.

Risk is composed of three components, namely:

a.) **Exposure.** This includes the elements present in hazards such as people, property, systems and others that are subject to potential losses. Measures of exposure can include the number of people or types of assets in an area.

b.) **Hazard.** This is a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption or environmental damage.

c.) **Vulnerability.** This describes the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability arising from various physical, social, economic and environmental factors.

Vulnerability and Hazards are not dangerous, if taken separately. But if they come together, they become a risk. These two must be simultaneously present at the same location to give rise to risk which then becomes a disaster if the event actually occurs. Thus, risk can be expressed as the product of hazard, vulnerability and exposure or in other words **Risk= Hazard x Exposure x Vulnerability**. (UNISDR, 2010)

RISK ASSESSMENT. It is a methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend. This includes a review of technical characteristics of hazards such as their location, intensity, frequency and probability. (UNISDR, 2010)

DISASTER. It is a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts which exceeds the ability of the affected community or society to cope using its own resources.

It is a result of a combination of:

1. Exposure to hazard;
2. Conditions of vulnerability that are present; and
3. Insufficient capacity or measures to reduce or cope with the potential negative consequences.

DISASTER RISK. This includes the potential losses in lives, health status, livelihood, assets and services which could occur to a particular community or a society over some specified future period of time. It reflects the concept of disasters as an outcome of continuously present conditions of risk.

DISASTER RISK ASSESSMENT. This is a set of ideal processes prescribed and tested by NEDA-UNDP-AusAID, including:

a) **Hazard Characterization.** Includes assessment of susceptibility to natural hazards affecting the planning area based on past disaster events and current observations to determine if the same pattern of susceptibility will remain over time.

b) **Consequence Analysis.** Involves the determination or definition of the elements at risk from a given hazard and defining their vulnerability. This helps us to understand what is at risk (exposure) and identify the root causes of elements at risk and why these can be damaged (vulnerability).

c) **Risk Estimation.** Encompasses the assimilation of the results of the hazard assessment and consequence analysis to derive an overall measure of risk.

d) **Risk Evaluation.** Guided by the results of risk analysis, decision-makers will now have to evaluate the level of acceptability of risks.

WEATHER. The state of the atmosphere at a place and time as regards to heat, dryness, sunshine, wind, and rain.

CLIMATE CHANGE. It is thechange in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.

CLIMATE. It is the average course or condition of the weather at a place usually over period of years as exhibited by temperature, wind velocity, and precipitation.

CLIMATE CHANGE ADAPTATION. This is the efforts by society or ecosystems to prepare for or adjust to future climate change. (US-EPA, 2010)

CLIMATE CHANGE MITIGATION. It refers to any strategic intervention and/or anthropogenic action taken to remove the greenhouse gases (GHG) released into the atmosphere, or to reduce their amount, to reduce any risk and hazards of climate change to human life and the environment.

5.2. CLIMATE DATA

The climate of the City of Navotas is classified as Type 1 under Corona's classification used by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), wherein it is characterized by two pronounced seasons; rainy season from May to October and dry season from January to April.

Navotas has a hot, humid weather all year round with average relative humidity of 81%, although, it is generally cooler between the months of November and February. The hottest month is May, when the temperature averages 28°C. The rainy season is between June and October, although some precipitation is possible all throughout the year. The average annual rainfall is approximately 2,000 mm with a peak of at least 400 mm in August and a low of 4 mm in March.

To further understand the climate of Navotas, the table below shows the Observed Baseline and Climate Projection data for Metro Manila based on studies done by PAGASA.

Table 5.1. Seasonal Temperature Increases (in °C) in 2020 and 2050 Under Medium-range Emission Scenario in Provinces in NCR

	OBSERVED BASELINE (1971-2000)				CHANGE IN 2020 (2006-2035)				CHANGE IN 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
NCR												
METRO MANILA	26.1	28.8	28.0	27.4	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9

There will be a slightly warmer temperature throughout the year, especially during the summer season on the months of March, April, and May.

Table 5.2. Seasonal Rainfall Change (in %) in 2020 and 2050 Under Medium-range Emission Scenario in Provinces in NCR

	OBSERVED BASELINE (1971-2000)				CHANGE IN 2020 (2006-2035)				CHANGE IN 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
NCR												
METRO MANILA	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7

It can be observed that there is a decrease in rainfall amount from December to May (during Northeast monsoon) and an increase in rainfall amount from June to November (during Southwest monsoon).

Table 5.3. Frequency of Extreme Events in 2020 and 2050 Under Medium-range Scenario in Provinces in NCR

Provinces	Stations	No. of days w/Tmax >35°C			No. of dry days			No. of days with rainfall >200mm		
		OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
METRO MANILA	Port Area	299	1176	2118	7380	6445	6382	12	12	13
	Science Garden	1095	1984	3126	7476	6302	6220	9	13	17

Source: Philippine Atmospheric Geophysical and Astronomical Administration (PAGASA)

The climate data from PAGASA shows future projections for the years 2020 and 2050 under the medium-range emission scenario for Metro Manila. The climate change data derived from the tables are the seasonal temperature increase (in °C), the seasonal rainfall change (in %),and the frequency of extreme events (Port Area). Based on the PAGASA data, the table below shows the summary of climate changes and its projected effect on the seasonal patterns.

Table 5.4. Summary Table of Climate Change Projection

Climate variable	General Changes Expected in Climate Variables	Specific Change Expected and Reference Period				Information about seasonal patterns of change
Temperature	Increase	+0.9 to 1.1 °C (2020) +1.8 to 2.1 °C (2050)				slightly warmer temperatures through out
Rainfall	Seasonal increase or decrease	Amount of Rainfall (mm.)				Decrease of rainfall from December to May (during Amihan)
		Season	OBS	2020	2050	
		DJF	107.5	93.74	88.9	
		MAM	198.5	132.40	122.08	Increase of rainfall from June to November (during Habagat)
		JJA	1170.2	1269.67	1419.45	
		SON	758.7	758.7	786.77	
Extreme Events (Port Area)	Increasing number of hot days (exceeding 35°C)	1176 days exceeding 35°C in years 2006-2035 2118 days exceeding 35°C in years 2036-2065 from OBS of 299				
	Decreasing number of dry days (<2.5 mm of rain)	6446 dry days in years 2006-2035 6382 dry days in year 2065 from OBS of 7476 days				
	Slight increase of number of days with heavy rainfall (>200 mm)	12 days with heavy rainfall 13 days with heavy rainfall from OBS of 12 days				

5.2.1. Climate Change Impacts

The change in our climate conditions creates tremendous impacts on the city's natural ecosystems, economy, and communities. As seen in the data presented in table 5.4, the city may experience the following impacts of climate change:

- Intensification of Rainfall, River flow, and Flooding – The increase in the rainfall amount from June to November or during Habagat (Southwest Monsoon) may greatly affect the city because of the increase not only in the frequency but also in the degree of the severity of flooding.

- Decrease of Rainfall from December to May – The decrease in the rainfall amount from the months of December to May or during Amihan (Northeast Monsoon) can lead to abnormally dry conditions which can intensify the effects of the El Niño phenomenon.

- Increase in Mean Temperature – The estimated increase of 0.9°C to 1.1°C in 2020 and 1.8°C to 2.1°C from the present mean temperature gives rise to a number of phenomena like sea level rise, an increase in the sea surface temperature, and stronger typhoons. It should be noted that there are still no studies conducted regarding the sea level rise in the city.

5.3. DISASTER RISK ASSESSMENT

The City of Navotas is geographically located at the extreme northwest shore of Metro Manila. It is an elongated island strip having an aggregate shoreline of approximately 12.5 kilometers fronting the Manila Bay.

It is bounded on the north by the Municipality of Obando in Bulacan; on the east by a system of riverways comprised of the Binuangan river, the Daang Cawayan river, the Dampalit river, the Batasan river, the Navotas river, the Bangkulasi channel, the Malabon channel and the Estero de Maypajo; on the south by the City of Manila; and on the west by the Manila Bay.

Given the above conditions, the City of Navotas is exposed to the elements of risks, especially during typhoons, heavy monsoon rains and tidal inundations.

5.3.1. Hazard Identification

Based on the experiences of the citizens and available historical data, several hazards were identified that may affect the exposed elements, i.e. urban areas, infrastructures, critical facilities, fishery production areas, and the people.

The following table shows the different hazards affecting Navotas City. These are generally categorized as geologic and hydro-meteorological hazards. Geologic hazards are seldom experienced in the City unlike the hydro-meteorological hazards that are perennially felt throughout the year. Records show, however, that the City is vulnerable to ground shaking as well as liquefaction and tsunami if and when an earthquake occurs. Generally, all barangays of Navotas would experience six (6) types of hazards, but to certain and differing extents due to its location and physical conditions. In terms of hydro-meteorological hazards, the City is most vulnerable to floods due to tidal inundations and severe winds brought about by typhoons and heavy monsoon rains.

Table 5.5.Exposure to Hazards of the Fourteen (14) Barangays

BARANGAY		EXPOSURE TO HAZARD									
		GEOLOGIC HAZARD					HYDRO-METEOROLOGICAL HAZARD				TOTAL
		GROUND SHAKING	GROUND RUPTURE	LIQUEFACTION	LANDSLIDE	TSUNAMI	FLOOD	RAINFALL INDUCED LANDSLIDE	SEVERE WIND	STORM SURGE	
1.	*San Rafael Village*	√	X	√	X	√	√	X	√	√	**6**
2.	*North Bay Blvd. South*	√	X	√	X	√	√	X	√	√	**6**
3.	*North Bay Blvd. North*	√	X	√	X	√	√	X	√	√	**6**
4.	*Bangkulasi*	√	X	√	X	√	√	X	√	√	**6**
5.	*Bagumbayan South*	√	X	√	X	√	√	X	√	√	**6**
6.	*Bagumbayan North*	√	X	√	X	√	√	X	√	√	**6**
7.	*Navotas East*	√	X	√	X	√	√	X	√	√	**6**
8.	*Navotas West*	√	X	√	X	√	√	X	√	√	**6**
9.	*Sipac-Amacen*	√	X	√	X	√	√	X	√	√	**6**
10.	*San Jose*	√	X	√	X	√	√	X	√	√	**6**
11.	*Daanghari*	√	X	√	X	√	√	X	√	√	**6**
12.	*San Roque*	√	X	√	X	√	√	X	√	√	**6**
13.	*Tangos*	√	X	√	X	√	√	X	√	√	**6**
14.	*Tanza*	√	X	√	X	√	√	X	√	√	**6**
TOTAL		**14**	**0**	**14**	**0**	**14**	**14**	**0**	**14**	**14**	

5.3.1.1. Hazard Profile

5.3.1.1.1. Flood

The City of Navotas experiences frequent flooding during high tides, typhoons and heavy monsoon rains, especially in areas located near Manila Bay, near the fishponds, and areas located along the waterways. Almost 90% of the City is at risk for flooding, when, in a worst case scenario these bodies of water rise and reach an increased flood height level of two (2) meters. But that was before the institution of several mitigating programs that up to the present continue to address the issue on flooding.

The City's flood mitigating programs have been tested and proven effective since it experienced what was thought to be the worst flooding occurred in September 2011 brought by Typhoon Pedring.

The MGB map below (Map 5.1) is a composite of both Typhoon Ondoy and Habagat (Southwest Monsoon). Studies were conducted on the conditions of the affected areas, quantifying the amount of rainfall released by Ondoy and its extent. The result showed that typhoon Ondoy has an AEP of 50-120 return period and within 6-8 hours, released an approximate of 400mm of rainfall while Habagat released almost the same amount but over a span of three (3) days.

Part of the MGB study reveals that the northern portion of Navotas, specifically barangay Tanza, has very high susceptibility to flooding due to its location. Areas along the Tanza River and the Navotas River are also observed to have a high susceptibility to flooding, as well as the areas located along the Manila Bay. The rest of Navotas would only experience low to moderate susceptibility to flooding.

While the MGB Map shows typhoon Ondoy in September of 2009 and Habagat in August 2012 as the worst-case scenario, however, Navotas has experienced stronger effects and damages during Habagat in 2012 and Typhoon Pedring.

Map 5.1. Navotas City Barangays Susceptible to Flooding

5.3.1.1.1.1. Historical Flood Events

1. Typhoon Ondoy, September 26, 2009

During the onslaught of Typhoon Ondoy, the flood within the city was recorded to be only about one foot high because there was no high tide on that day. Correspondingly, there were no recorded damages to properties and casualties.

2. Typhoon Pedring, September 27, 2011

During Typhoon Pedring, the city was affected by flooding because of high tide and heavy rains. Structures and houses along the coastline were washed out and about 3,000 families were affected, left homeless and were brought to different evacuation centers within the City. Basketball courts and other government facilities were used as temporary shelters for affected families. The flood height recorded at Barangays Navotas East and Navotas West were 0.4 meters; Barangays San Jose, Sipac-Almacen, San Rafael Village, San Roque and Tangos were at 0.5 meter while Barangays Daanghari, NBBS and Tanza recorded a flood height at 1.0 meter.

3. Habagat and Typhoon Gener (Southwest monsoon), August 7, 2012

The southwest monsoon rains or Habagat as commonly called, affected 180 families along the coastal area. The flood reached as high as 1 meter in some barangays due to high tide and heavy rain. Compared to typhoon Pedring, flood height during Habagat was much higher. But due to the presence of pumping stations and other flood control mechanisms, lesser effect was recorded. It can also be accounted that the affected families was lesser because the families affected previously by typhoon Pedring were already relocated. There were no recorded damages to houses and structures.

Typhoon Gener also brought floods within the City at waist deep level and affected 700 families in some barangays. The increase in the number of affected families was due to the preemptive evacuation conducted by the city government in anticipation of the adverse effect of the typhoon. These affected families were brought to evacuation centers. Affected barangays include; Tanza with recorded flood height of 1 meter; Sipac-Almacen and San Jose with 0.5 to 1.0 meter; Tangos, San Roque, Bagumbayan South, Navotas East, and Navotas West with 0.5 meters; and Bangkulasi with 0.2 meters

The map on the next page illustrates the areas affected by typhoon Pedring.

Map 5.2. Navotas City Flood Map: Tropical Storm Pedring (September 2011)

Table 5.6. Record of Flood Events that Affected the City

Flood Events and Description	Affected Barangays	Observed Water level (meters)	Observed Daily Rainfall (mm)	No. of Casualties			No. of Affected		No. Of Houses		Estimated Damaged to Properties					Source of information
				Dead	Injured	Missing	Persons	Families	Partially Damaged	Totally Damaged	Infrastructure	Residential	Institutional	Private/ Commercial	TOTAL	
Typhoon Pedring, September 2011	Daanghari NBBS Tanza San Jose, Sipac San Rafael Village San Roque Tangos Navotas East Navotas West	1.0 1.0 1.0 0.5 0.5 0.5 0.5 0.5 0.4 0.4	No Data	No Casualties			No Data	3,000+	None	2,000+	No Data					MGB-DENR CEO/ CSWDO
Habagat(Southwest monsoon) and Typhoon Gener, August 2012	Bangkulasi Navotas East Navotas West San Jose Sipac San Roque Tangos Bagumbayan South Tanza	0.2 0.5 0.5 0.5-1.0 0.5-1.0 0.5 0.5 0.5 1.0	No Data	No Casualties			No Data	None	None	None	No Data					CSWDO

5.3.1.1.1.2Affected Population

Based on the susceptibility maps generated by MGB, it was identified that around 9,161 and 9,917 individuals have the potential of being affected by very high and high susceptibility to flooding, respectively. The said individuals are concentrated in three barangays, namely Tanza, Bangkulasi and North Bay Boulevard South and may cover almost 30 hectares of land area. The potentially affected individuals in places where there is low to medium susceptibility to flooding was not calculated considering that such flood height can be easily thrown back to the sea through the Bombastik pumping stations. Moreover, the land area included in the data comprised only of residential and informal settlement areas where most of the population is concentrated.

Likewise, it can be observed from the map that Barangay Tanza is very highly susceptible to flooding, as well as parts of Barangays North Bay Boulevard South

(NBBS), San Rafael Village, and Bangkulasi while the rest of the barangays are either exposed to low or moderate susceptibility to flooding.

Comparing the projected flood susceptibility to population density derived from Table 5.7, it will show that Barangay Tanza is the least dense barangay because approximately 50% of the land area of barangay is composed of fishponds wherein there is no inhabitant and that its high susceptibility to flooding is due to its geophysical condition. Meanwhile, Barangays NBBS, San Rafael Village and Bangkulasi are also among the barangays with low population density and that their very high susceptibility to flooding is due to their geographical location, being low-lying areas lodged near the river and other bodies of water. Despite their very high susceptibility, these barangays in turn have lower vulnerability as a result of stronger adaptive capacity in the affected barangays.

On the other hand, Barangay Navotas West, which is the densest barangay, is highly vulnerable due to the presence of informal settler families along the coastline.

Using the susceptibility map generated by the MGB, the following exposure estimates were identified:

Table 5.7. Number of Potentially Affected Persons

Barangay	*Very High Susceptibility*		*High Susceptibility*	
	No. of Individuals	*Area in Hectares*	*No. of Individuals*	*Area in Hectares*
Tanza	*6,073*	*12.4240*	*3,535*	*7.2307*
Bangkulasi	*598*	*0.4042*	-	-
North Bay Boulevard South	*2,489*	*3.0832*	*6,382*	*7.9045*
TOTAL	***9,161***	***15.9114***	***9,917***	***15.1352***

5.3.1.1.1.3. Built-Structure Exposure, Sensitivity, and Vulnerability

Aside from looking at the vulnerability of the population, it is also important to take into consideration the possible exposure of built-structures in the city for this will also serve as a significant input in planning. In terms of land use, residential and commercial land uses are exposed to high and very high susceptibility to flooding to the residential area–both formal and informal settlements – that will be mostly affected. Industrial areas are exposed only to low or moderate susceptibility to flooding.

Table 5.8. Susceptibility to Flooding per Land Use (2014)

Land Use	Very High Susceptibility Area (has)	High Susceptibility Area (has)	Moderate Susceptibility Area (has)	Low Susceptibility Area (has)
Residential				
Formal Settlement	10.321	12.458	165.547	35.79
Informal Settlement	2.902	2.822	16.842	5.46
Commercial	0.025	0.311	16.417	6.198
Industrial	0.000	0.000	0.338	0.209
Fishpond	352.45	-	-	-

Source: MGB/GMMA Map

For every barangay, it is evident that residential areas currently occupied by informal settlers have higher exposures than other areas, therefore resulting to higher vulnerability and projected severity of consequence. Hence, the risks in these areas are the highest. Specific exposure, vulnerability, severity of consequence, and risks per barangay according to land use is illustrated in the succeeding tables.

5.4. RISK ASSESSMENT

In terms of risks, the City may generally face low to moderate risks when it comes to flooding, except for some critical areas. It can be observed that high risk areas were noted in all barangays, particularly the area occupied by the informal settlements. High risks were evaluated in these areas due to the high vulnerability of structures, including the make-up of light to salvageable materials, and non-hazard resistant designs. A total of 48.02 hectares of land area is occupied by informal settlements which are mostly located in coastal areas facing Manila Bay. Aside from this, high risks were also observed in Barangay Tanza which is earlier noted to be very highly susceptible to flooding, where around 366.23 hectares of fishponds, despite the absence of structures, is very exposed to the risks of possible overflowing that will eventually cause losses on the part of fishpond owners.

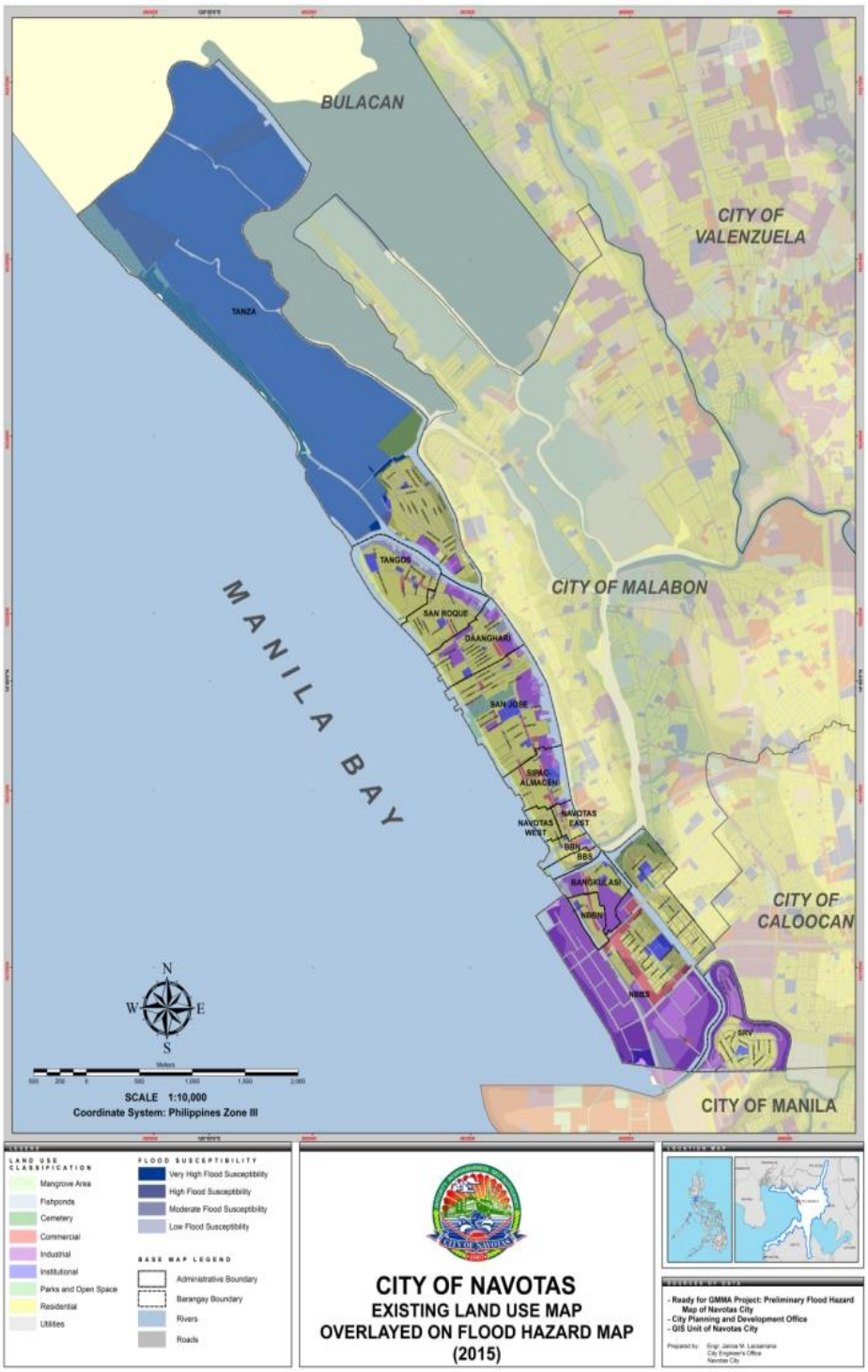
Meanwhile, moderate risks were assumed in other significant areas such as residential, commercial and institutional uses. Despite no exposures and vulnerability from flooding, around 5-10% of buildings may be severely damaged with compromised functionality when an approximated 1-2 meter flooding comes into the city and pumping stations are not functioning.

Finally, low risks from flooding are expected for most of the industrial areas, parks and open spaces, and utilities in Navotas. This can be attributed in the present infrastructural make-up of these structures which are now prepared for at least the average flood levels being experienced in the respective areas. Having the said architectural preparations, the non-exposure and non-vulnerability of

these areas has been complemented with the least possible severity of consequence for any magnitude of flooding.

Land area-wise, as per the MGB table, a total of 436.60 hectares are presumed to be highly prone from the effects of flooding which is concentrated in only four of the 14 barangays, namely Tanza (412.50 hectares), North Bay Boulevard South (17.98 hectares), San Rafael Village (4.61hectares), and Bangkulasi (1.51 hectares).

Map 5.3. Navotas City Existing Land Use (2015) Overlayed on Flood Hazard Map



Map 5.4. Navotas City Risk Map

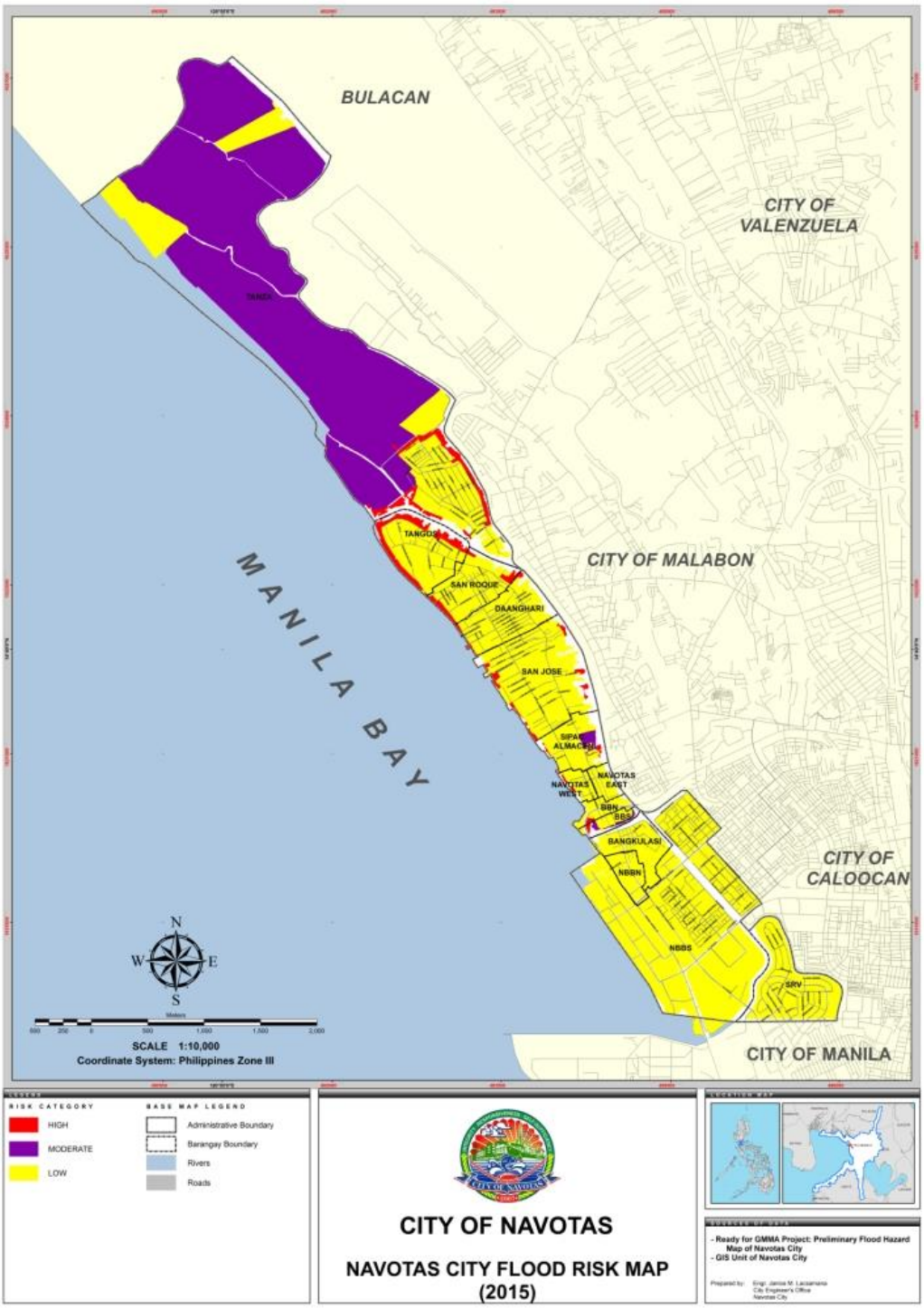


Table 5.9. Adaptive Capacity of the Three (3) Barangays Highly Susceptible to Flooding

Location (Barangay)	Susceptibility/ Risk Level	Adaptive Capacity				
		Access to financial Assistance (Insurance)	Access to Information	Capacity or Willingness		Government Investments
				Retrofit	Relocate	
Tanza	Very High	Low	High	Low	Low	High
NBBS	Very High	Low	High	Low	Low	High
Bangkulasi	Very High	Low	High	Low	Low	High

The table above shows the capacity of each barangay to adapt to hazards such as flooding. Considering that the very highly susceptible areas are the informal settlements along the coast and riverways, these three barangays were given utmost concern for having very high susceptibility to flooding. It shows that these affected families have limited access to financial assistance as they do not have the capacity for property insurance coverage. Considering their economic status, it is also difficult for these residents to retrofit their houses. However, their access to information is high because of the intensive information, education and communication (IEC) campaign by the local government, barangay officials and community leaders regarding the hazards and risks present in the city. For the City government, the adaptive capacity is high due to the continuous implementation of structural as well as non-structural preventive and mitigating projects to address these hazards.

Table 5.10. Structural and Non-structural Mitigating Measures

Location (Barangay)	Susceptibility / Risk Level	Mitigation Measures	
		Structural	Non-structural
Tanza NBBS Bangkulasi	Very High	• Construction of additional Bombastik pumping stations • Conduct of dredging and desilting of waterways • Construction and upgrading of drainage system • Construction of river walls • Construction of 3.5 - Kilometer coastal dike along Manila Bay • Development of resettlement sites for ISFs • Continued implementation of the comprehensive drainage master plan • Regular maintenance of flood control facilities • Presence of the CAMANAVA Flood Control Project	• MOAs or Resolutions, ordinances, etc. being implemented relative to the issue • Creation of Local inter-Agency Committee on Waterways • Strict enforcement of Environmental Code • Regular conduct of clean-up activities • Conduct of regular declogging of canals

Moreover, the city government thru its Local Disaster Risk Reduction and Management Office has implemented risk reduction and management related programs that are considered priority programs. These measures are needed to help in reducing and/or mitigating the occurrence and effects of flooding within the City.

Table 5.11. Additional Mitigating Measures Implemented

Location	Susceptibility / Risk Level	Mitigating Measures	
		Structural	Non-Structural
Tanza NBBS Bangkulasi	Very High	• Purchase of rescue equipment and vehicles such as:Amphibian, inflatable rubber boats, rescue vehicles, and other water vehicles.	• Provision of IEC Materials in all communities (high tide alert; Tinig ng Navotas; official city website: www.navotas.gov.ph; feedback mechanism: "TXT JRT") • Conduct of Community-Based Disaster Risk Reduction and Management Orientation • Conduct of various drills • Creation of the LDRRM Office • Continuous training of JRT (Joint Rescue Team) • Installation of early warning devices

5.5. Adaptive Capacity / Mitigating Measures

Contingent to the determination of the vulnerability of both the people and the structures, the City has launched a number of initiatives in order to enhance the adaptive capacity of its population.

In terms of institution, the Navotas City Disaster Risk Reduction and Management Council had been active in terms of performing its functions pursuant to Republic Act No. 10121 otherwise known as the Philippine Disaster Risk Reduction and Management Act of 2010. The Navotas City Disaster Risk Reduction and Management Office had already been institutionalized to take-charge of capacity-building measures both on the part of the local government and the population.

A Joint Rescue Team was also organized in order to harness the support of the private and non-government organizations in terms of emergency and disaster preparedness and response. A network of volunteers is in close coordination with the rescue team, particularly in time of urgent needs.

Furthermore, the city government has already identified the locations of safe evacuation centers during disasters and other emergencies. Signages pointing to the locations of these evacuation centers were already installed as the majority of these facilities are public schools.

Map 5.5. Location of Evacuation Centers Map


BULACAN
CITY OF VALENZUELA
TANZA
TANGOS
SAN ROQUE
DAANGHARI
SAN JOSE
SIPAC ALMACEN
NAVOTAS EAST
NAVOTAS WEST
BBN
BBS
BANGKULASI
NBBN
NBBS
SRV
CITY OF MALABON
MANILA BAY
CITY OF CALOOCAN
CITY OF MANILA
N
W
E
S
SCALE 1:10,000
Coordinate System: Philippines Zone III
MAP LEGEND
Evacuation Centers
Administrative Boundary
Barangay Boundary
Rivers
Roads
CITY OF NAVOTAS
LOCATION OF
EVACUATION CENTERS MAP
2015
- Bureau of Fire Protection - Navotas City Fire Station
- GIS Unit of Navotas City

As to information dissemination, the city utilizes its social networking sites (i.e. Facebook, Twitter, and Website) in order to facilitate wide information sharing as to pre-, during, and post-disaster activities. The TxtJRT mechanism also enables the residents to obtain and provide information regarding disasters and emergencies.

To address flooding, the City is continuously investing in the institution of mitigating measures like construction of additional pumping stations, river walls and coastal dikes in various strategic locations in the city, including those highly susceptible to flooding in order to minimize, if not completely eliminate, flood occurrence. At present, there are 44 "Bombastik" pumping stations around Navotas and the construction of a 3.5-kilometer coastal dike along Manila Bay has already started.

As part of the Oplan Likas Program of the national government and in coordination with the National Housing Authority, relocation of informal settler families (in-city and off-city), particularly in coastal areas and waterways are ongoing.

Even though the fishponds in Barangay Tanza are considered to have a moderate risk from flooding, the city government cannot institute structural mitigating measures for the reason that these fishponds are privately owned.

The table below elaborates the state of the adaptive capacity of the citizens in terms of insurance coverage, availability of alternative sites, capacity to relocate or retrofit, allocation of government resources for risk reduction, and capacity to conform to additional zoning regulations.

Table 5.12. State of Adaptive Capacity in Navotas City

Insurance Coverage	Available Alternative Sites	Capacity to relocate or retrofit	Government Resources for Programs and Projects related to Risk Reduction	Capacities of Property Owners to conform with Risk Mitigation related to Zoning Regulations
Informal settlements were identified as highly susceptible, these families do not have the capacity to avail a property insurance	1. NavotaAs Residences, Barangay San Roque (218 units) 2. NavotaAs Homes, Barangay Tanza (1,380 units) 3. Medium-rise Building at Tanglaw, Barangay NBBS (60 units) 4. Medium–rise Building at Gulayan, Barangay NBBS (120 units) 5. Other available NHA	None	1. Allocation of fund for risk reduction 2. Coordination with other NGAs for fund allocation	None

	resettlement sites for off-city relocation 6. Venterdeck, Barangay NBBS (proposed) 7. Sampaguita St., Barangay Tanza (on going expropriation proceedings)			

Table 5.13. Exposure Database

Hazard			EXPOSURE							
				AREA						
Flood Susc.	Flood Depth	Like Occur.	Barangay	Land Use	Specific Use	Total area Allocation in Hectares	Replacement Cost(PHP) per sqm.	Affected Area in Hectares (GIS Derived)	%Exposure	Affected Value (PHP)
B	C	D	E	F		G	H	I	J	K
									=I/G	(HxI)*10000
Very High	> 2 meters	5	Tanza	Agriculture (Fishpond) (68.80%)		338.51	-	338.51	100%	0
High	1-2 meters	4	**Total area : 492 has**					0.0007	0%	0
Very High	> 2 meters	5	**Pop. = 24,917**	Idle Lands (2.09%)		10.28	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Industrial (6.80%)		33.43	3,718.92	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Informal Settlements		7.09	-	2.7395	39%	0
High	1-2 meters	4						2.2672	32%	0
Very High	>2 meters	5		Institutional (0.15%)	Tanza Elementary,	0.73	1,941.07	0.1497	21%	2,905,774
High	1-2 meters	4						0.0678	9%	1,316,042
Very High	>2 meters	5		Residential (7.49%)		36.86	1,511.87	9.6845	26%	146,417,050
High	1-2 meters	4						4.9635	13%	75,041,667
Very High	>2 meters	5		Utilities (6.32%)	Sanitary Landfill	31.12	-	10.9562	35%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River(5.80%)		28.52	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads(1.11%)		5.46	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	Tangos	Commercial (2.71%)		0.84	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 31 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 32,941**	Industrial (0.77%)		0.24	3,718.92	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Informal Settlements		6.33	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (5.87%)		1.82	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Parks and Open Spaces (0.48%)		0.15	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (57.32%)		17.77	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (8.55%)		2.65	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (3.87%)		1.20	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	San Roque	Commercial (0.26%)		0.07	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 27 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 17,916**	Industrial (8.63%)		2.33	3,718.92	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Informal Settlements		2.44	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (2.41%)		0.65	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (65.15%)		17.59	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (7.44%)		2.01	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (7.07%)		1.91	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	Daanghari	Industrial (20.77%)		5.40	3,718.92	0	0%	0
High	1-2 meters	4	**Total area : 26 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 19,179**	Informal Settlements		1.93	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (2.46%)		0.64	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (54.85%)		14.26	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (7.5%)		1.95	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (7.0%)		1.82	-	0	0%	0
High	1-2 meters	4						0	0%	0

HAZARD			EXPOSURE								
				AREA							
Flood Susce.	Flood Depth	Like Occur.	Barangay	Land Use	Specific Use	Total area Allocation in Hectares	Replacement Cost (PHP) per sqm.	Affected Area in Hectares (GIS Derived)	%Exposure	Affected Value (PHP)
B	C	D	E	F		G	H	I	J	K
Very high	>2 meters	5	San Jose	Commercial		0.70	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 71 has**	(0.99%)				0	0%	0
Very high	>2 meters	5	**Pop. = 28,153**	Idle Lands		2.15	-	0	0%	0
High	1-2 meters	4		(3.03%)				0	0%	0
Very high	>2 meters	5		Industrial		8.47	3,718.92	0	0%	0
High	1-2 meters	4		(11.93%)				0	0%	0
Very high	>2 meters	5		Informal		4.02	-	0	0%	0
High	1-2 meters	4		Settlements				0	0%	0
Very high	>2 meters	5		Institutional		3.55	1,941.07	0	0%	0
High	1-2 meters	4		(5.0%)				0	0%	0
Very high	>2 meters	5		Parks and		3.66	-	0	0%	0
High	1-2 meters	4		Open Spaces				0	0%	0
Very high	>2 meters	5		Residential		36.85	1,511.87	0	0%	0
High	1-2 meters	4		(51.90%)				0	0%	0
Very high	>2 meters	5		Utilities		0.27	-	0	0%	0
High	1-2 meters	4		(0.38%) -				0	0%	0
Very high	>2 meters	5		River (11.93%)		8.47	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very high	>2 meters	5		Roads (4.03%)		2.86	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	Sipac-Almacen	Commercial		1.68	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 27 has**	(6.22%)				0	0%	0
Very High	>2 meters	5	**Pop. = 11,541**	Industrial		3.17	3,718.92	0	0%	0
High	1-2 meters	4		(11.74%)				0	0%	0
Very High	>2 meters	5		Informal		0.29	-	0	0%	0
High	1-2 meters	4		Settlements				0	0%	0
Very High	>2 meters	5		Institutional		2.06	1,941.07	0	0%	0
High	1-2 meters	4		(7.63%)				0	0%	0
Very High	>2 meters	5		Parks and Open		0.42	-	0	0%	0
High	1-2 meters	4		Spaces (1.56%)				0	0%	0
Very High	>2 meters	5		Residential		13.10	1,511.87	0	0%	0
High	1-2 meters	4		(48.52%)				0	0%	0
Very High	>2 meters	5		Utilities		0.07	-	0	0%	0
High	1-2 meters	4		(0.26%)				0	0%	0
Very High	>2 meters	5		River (19.0%)		5.13	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (4.0%)		1.08	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	Navotas East	Industrial		0.59	3,718.92	0	0%	0
High	1-2 meters	4	**Total area : 6 has**	(9.84%)				0	0%	0
Very High	>2 meters	5	**Pop. = 2,241**	Institutional		0.06	1,941.07	0	0%	0
High	1-2 meters	4		(1.0%)				0	0%	0
Very High	>2 meters	5		Parks and Open		0.03	-	0	0%	0
High	1-2 meters	4		Spaces (0.5%)				0	0%	0
Very High	>2 meters	5		Residential		3.29	1,511.87	0	0%	0
High	1-2 meters	4		(54.83%)				0	0%	0
Very High	>2 meters	5		Commercial		0.41	1,633.24	0	0%	0
High	1-2 meters	4		(6.83%)				0	0%	0
Very High	>2 meters	5		River (19.0%)		1.14	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (8.0%)		0.48	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	Navotas West	Informal		0.02	-	0	0%	0
High	1-2 meters	4	**Total area : 7 has**	Settlements (0.29%)				0	0%	0
Very High	>2 meters	5	**Pop. = 8,698**	Institutional		0.01	1,941.07	0	0%	0
High	1-2 meters	4		(0.14%)				0	0%	0
Very High	>2 meters	5		Residential		6.57	1,511.87	0	0%	0
High	1-2 meters	4		(93.86%)				0	0%	0
Very High	>2 meters	5		Roads (5.71%)		0.40	-	0	0%	0
High	1-2 meters	4						0	0%	0

HAZARD			EXPOSURE								
				AREA							
Flood Susc.	Flood Depth	Like Occur	Barangay	Land Use	Specific Use	Total area Allocation in Hectares	Replacement Cost (PHP) per sqm.	Affected Area in Hectares (GIS Derived)	%Exposure	Affected Value (PHP)
B	C	D	E	F		G	H	I	J	K
Very High	>2 meters	5	SRV	Industrial (42.10%)		16.42	3,718.92	0.2327	1%	8,653,915
High	1-2 meters	4	**Total area : 39 has**					6.1949	38%	230,383,065
Very High	>2 meters	5	**Pop. = 3,530**	Institutional (1.90%)		0.74	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Parks and Open Spaces (0.26%)		0.10	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (33.67%)		13.13	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (10.0%)		3.90	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (12.08%)		4.71	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	agumbayan Nort	Commercial (7.25%)		0.29	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 4 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 2,652**	Informal Settlements		0.11	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (7.25%)		0.29	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Parks and Open Spaces (7.75%)		0.31	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (44.5%)		1.78	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Utilities (9.75%)		0.39	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (2.25%)		0.09	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (18.5%)		0.74	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	agumbayan Sout	Commercial (3.0%)		0.15	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 5 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 4,524**	Informal Settlements		1.18	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (0.4%)		0.02	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Parks and Open Spaces (0.6%)		0.03	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (32.6%)		1.63	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (33.0%)		1.65	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (6.8%)		0.34	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5	Bangkulasi	Commercial (3.0%)		0.45	1,633.24	0	0%	0
High	1-2 meters	4	**Total area : 15 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 8,263**	Idle Lands (1.53%)		0.23	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Industrial (44.13%)		6.62	3,718.92	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Informal Settlements		0.04	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (2.2%)		0.33	1,941.07	0.0057	2%	110,641
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (27.53%)		4.13	1,511.87	0.4042	10%	6,110,979
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Utilities (3.4%)		0.51	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		River (10.67%)		1.60	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (7.27%)		1.09	-	0	0%	0
High	1-2 meters	4						0	0%	0

HAZARDS			EXPOSURE								
				AREA							
Flood Susc.	Flood Depth	Like Occur	Barangay	Land Use	Specific Use	Total area Allocation in Hectares	Replacement Cost(PHP) per sqm.	Affected Area in Hectares (GIS Derived)	%Exposure	Affected Value (PHP)
B	C	D	E	F		G	H	I	J	K
Very High	>2 meters	5	NBBN	Industrial (7.19%)		4.67	3,718.92	0	0%	0
High	1-2 meters	4	**Total area : 65 has**					0	0%	0
Very High	>2 meters	5	**Pop. = 16,201**	Informal Settlements		7.90	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Institutional (3.69%)		2.40	1,941.07	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Parks and Open Spaces (0.55%)		0.36	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Residential (45.14%)		29.34	1,511.87	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Commercial (8.11%)		5.27	1,633.24	0	0%	0
High	1-2 meters	4						0	0%	0
Very High	>2 meters	5		Roads (23.17%)		15.06	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very high	>2 meters	5	NBBS	Commercial (5.67%)		14.41	1,633.24	0.0567	0%	926,044
High	1-2 meters	4	**Total area : 254 has**					0.3335	2%	5,446,839
Very high	>2 meters	5	**Pop. = 68,375**	Idle Lands (0.59%)		1.50	-	0	0%	0
High	1-2 meters	4						0.1737	12%	0
Very high	>2 meters	5		Industrial (42.88%)		108.91	3,718.92	2.2943	2%	85,323,067
High	1-2 meters	4						17.3014	16%	643,424,360
Very high	>2 meters	5		Informal Settlements		8.31	-	0	0%	0
High	1-2 meters	4						0.0329	0%	0
Very high	>2 meters	5		Institutional (2.67%)		6.79	1,941.07	0	0%	0
High	1-2 meters	4						1.1172	16%	21,685,578
Very high	>2 meters	5		Parks and Open Spaces (0.43%)		1.08	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very high	>2 meters	5		Residential (22.86%)		58.06	1,511.87	3.0832	5%	46,613,976
High	1-2 meters	4						7.8716	14%	119,008,359
Very high	>2 meters	5		River (9.09%)		23.08	-	0	0%	0
High	1-2 meters	4						0	0%	0
Very high	>2 meters	5		Roads (12.54%)		31.86	-	0	0%	0
High	1-2 meters	4						0	0%	0
				Residential		9,754.00	1,511.87			
				Commercial		10,537.00	1,633.24			
				Industrial		23,993.00	3,718.92			
				Institutional		12,523.00	1,941.07			

Table 5.14. Vulnerability Database

EXPOSURE				VULNERABILITY				
	AREA							
Barangay	Land Use	Total area Allocation in Hectares	Affected Area in Hectares (GIS Derived)	Proportion of buildings with walls with light to salvegable materials	Proportion of Buildings in dilapidated/ condemned Condition	Structure not employing hazard resistant building design	No access/ area coverage to infrastructure related mitigation measures	Remarks/ Description (prevailing lot sizes, building height, if blighted areas, etc)
E	F	G	I	L	M	N	O	P
Tanza	Agriculture (Fishpond) (68.80%)	338.51	338.51	0%	0%	0%	0%	Fishponds
			0.0007					
Total area : 492 has	Idle Lands (2.09%)	10.28	0	0%	0%	0%	0%	No Structures
Pop. = 24,917			0					
	Industrial (6.80%)	33.43	0	0%	0%	0%	0%	Shipyards
			0					
	Informal Settlements	7.09	2.7395	95%	95%	100%	0%	
			2.2672					
	Institutional (0.15%)	0.73	0.1497	0%	0%	10%	0%	Old Structures
			0.0678					
	Residential (7.49%)	36.86	9.6845	0%	0%	10%	0%	Old Structures
			4.9635					
	Utilities (6.32%)	31.12	10.9562	0%	0%	0%	0%	No Structures
			0					
	River (5.80%)	28.52	0	0%	0%	0%	0%	No Structures
			0					
	Roads (1.11%)	5.46	0	0%	0%	0%	0%	No Structures
			0					
Tangos	Commercial (2.71%)	0.84	0	0%	0%	10%	0%	Old Structures
			0					
Total area : 31 has	Industrial (0.77%)	0.24	0	0%	0%	0%	0%	Shipyards
Pop. = 32,941			0					
	Informal Settlements	6.33	0	95%	95%	100%	0%	
			0					
	Institutional (5.87%)	1.82	0	0%	0%	10%	0%	Old Structures
			0					
	Parksand Open	0.15	0	0%	0%	0%	0%	No Buildings
			0					
	Residential (57.32%)	17.77	0	0%	0%	10%	0%	Old Structures
			0					
	River (8.55%)	2.65	0	0%	0%	0%	0%	No Structures
			0					
	Roads (3.87%)	1.20	0	0%	0%	0%	0%	No Structures
			0					
San Roque	Commercial (0.26%)	0.07	0	0%	0%	10%	0%	Old Structures
			0					
Total area : 27 has	Industrial (8.63%)	2.33	0	0%	0%	0%	0%	Shipyards
Pop. = 17,916			0					
	Informal Settlements	2.44	0	95%	95%	100%	0%	
			0					
	Institutional (2.41%)	0.65	0	0%	0%	10%	0%	Old Structures
			0					
	Residential (65.15%)	17.59	0	0%	0%	10%	0%	Old Structures
			0					
	River (7.44%)	2.01	0	0%	0%	0%	0%	No Structures
			0					
	Roads (7.07%)	1.91	0	0%	0%	0%	0%	No Structures
			0					
Daanghari	Industrial (20.77%)	5.40	0	0%	0%	0%	0%	Shipyards
			0					
Total area : 26 has	Informal Settlements	1.93	0	95%	95%	100%	0%	
Pop. = 19,179			0					
	Institutional (2.46%)	0.64	0	0%	0%	10%	0%	Old Structures
			0					
	Residential (54.85%)	14.26	0	0%	0%	10%	0%	Old Structures
			0					
	River (7.5%)	1.95	0	0%	0%	0%	0%	No Structures
			0					
	Roads (7.0%)	1.82	0	0%	0%	0%	0%	No Structures
			0					

EXPOSURE				VULNERABILITY				
	AREA							
Barangay	Land Use	Total area Allocation in Hectares	Affected Area in Hectares (GIS Derived)	Proportion of buildings with walls with light to salvegable materials	Proportion of Buildings in dilapidated/ condemned Condition	Structure not employing hazard resistant building design	No access/ area coverage to infrastructure related mitigation measures	Remarks/ Description (prevailing lot sizes, building height, if blighted areas, etc)
E	F	G	I	L	M	N	O	P
San Jose	Commercial (0.99%)	0.70	1,633.24	0%	0%	10%	0%	Old Structures
Total area : 71 has	Idle Lands (3.03%)	2.15	-	0%	0%	0%	0%	No Structures
Pop. = 28,153	Industrial (11.93%)	8.47	3,718.92	0%	0%	0%	0%	Shipyards
	Informal Settlements	4.02	-	95%	95%	100%	0%	
	Institutional (5.0%)	3.55	1,941.07	0%	0%	10%	0%	Old Structures
	Parks and Open	3.66	-	0%	0%	0%	0%	No Buildings
	Residential (51.90%)	36.85	1,511.87	0%	0%	10%	0%	Old Structures
	Utilities (0.38% -	0.27	-	0%	0%	0%	0%	Shipyards
	River (11.93%)	8.47	-	0%	0%	0%	0%	No Structures
	Roads (4.03%)	2.86	-	0%	0%	0%	0%	No Structures
Sipac-Almacen	Commercial (6.22%)	1.68	1,633.24	0%	0%	10%	0%	Old Structures
Total area : 27 has	Industrial (11.74%)	3.17	3,718.92	0%	0%	0%	0%	Shipyards
Pop. = 11,541	Informal Settlements	0.29	-	95%	95%	100%	0%	
	Institutional (7.63%)	2.06	1,941.07	0%	0%	10%	0%	Old Structures
	Parks and Open	0.42	-	0%	0%	0%	0%	No Buildings
	Residential (48.52%)	13.10	1,511.87	0%	0%	10%	0%	Old Structures
	Utilities (0.26%)	0.07	-	0%	0%	0%	0%	No Buildings
	River (19.0%)	5.13	-	0%	0%	0%	0%	No Structures
	Roads (4.0%)	1.08	-	0%	0%	0%	0%	No Structures
Navotas East	Industrial (9.84%)	0.59	3,718.92	0%	0%	0%	0%	Shipyard
Total area : 6 has	Institutional (1.0%)	0.06	1,941.07	0%	0%	10%	0%	Old Structures
Pop. = 2,241	Parks and Open	0.03	-	0%	0%	0%	0%	No Buildings
	Residential (54.83%)	3.29	1,511.87	0%	0%	10%	0%	Old Structures
	Commercial (6.83%)	0.41	1,633.24	0%	0%	10%	0%	Old Structures
	River (19.0%)	1.14	-	0%	0%	0%	0%	No Structures
	Roads (8.0%)	0.48	-	0%	0%	0%	0%	No Structures
Navotas West	Informal Settlements (0.29%)	0.02	-	95%	95%	100%	0%	
Total area : 7 has	Institutional (0.14%)	0.01	1,941.07	0%	0%	10%	0%	Old Structures
Pop. = 8,698	Residential (93.86%)	6.57	1,511.87	0%	0%	10%	0%	Old Structures
	Roads (5.71%)	0.40	-	0%	0%	0%	0%	No Structures

EXPOSURE				VULNERABILITY				
	AREA							
Barangay	Land Use	Total area Allocation in Hectares	Affected Area in Hectares (GIS Derived)	Proportion of buildings with walls with light to salvegable materials	Proportion of Buildings in dilapidated/ condemned Condition	Structure not employing hazard resistant building design	No access/ area coverage to infrastructure related mitigation measures	Remarks/ Description (prevailing lot sizes, building height, if blighted areas, etc)
E	F	G	I	L	M	N	O	P
SRV	Industrial (42.10%)	16.42	3,718.92	0%	0%	10%	0%	Old Structures
Total area : 39 has	Institutional (1.90%)	0.74	1,941.07	0%	0%	10%	0%	Old Structures
Pop. = 3,530	Parksand Open	0.10	-	0%	0%	0%	0%	No Buildings
	Residential (33.67%)	13.13	1,511.87	0%	0%	10%	0%	Old Structures
	River (10.0%)	3.90	-	0%	0%	0%	0%	No Structures
	Roads (12.08%)	4.71	-	0%	0%	0%	0%	No Structures
Bagumbayan North	Commercial (7.25%)	0.29	1,633.24	0%	0%	10%	0%	Old Structures
Total area : 4 has	Informal Settlements	0.11	-	95%	95%	100%	0%	
Pop. = 2,652	Institutional (7.25%)	0.29	1,941.07	0%	0%	10%	0%	Old Structures
	Parksand Open	0.31	-	0%	0%	0%	0%	No Buildings
	Residential (44.5%)	1.78	1,511.87	0%	0%	10%	0%	Old Structures
	Utilities (9.75%)	0.39	-	0%	0%	0%	0%	No Structures
	River (2.25%)	0.09	-	0%	0%	0%	0%	No Structures
	Roads (18.5%)	0.74	-	0%	0%	0%	0%	No Structures
Bagumbayan South	Commercial (3.0%)	0.15	1,633.24	0%	0%	10%	0%	Old Structures
Total area : 5 has	Informal Settlements	1.18	-	95%	95%	100%	0%	
Pop. = 4,524	Institutional (0.4%)	0.02	1,941.07	0%	0%	10%	0%	Old Structures
	Parksand Open	0.03	-	0%	0%	0%	0%	No Buildings
	Residential (32.6%)	1.63	1,511.87	0%	0%	10%	0%	Old Structures
	River (33.0%)	1.65	-	0%	0%	0%	0%	No Structures
	Roads (6.8%)	0.34	-	0%	0%	0%	0%	No Structures
Bangkulasi	Commercial (3.0%)	0.45	1,633.24	0%	0%	10%	0%	Old Structures
Total area : 15 has	Idle Lands (1.53%)	0.23	-	0%	0%	0%	0%	NoStructures
Pop. = 8,263	Industrial (44.13%)	6.62	3,718.92	0%	0%	10%	0%	Container Yard,
	Informal Settlements	0.04	-	95%	95%	100%	0%	
	Institutional (2.2%)	0.33	1,941.07	0%	0%	10%	0%	Old Structures
	Residential (27.53%)	4.13	1,511.87	0%	0%	10%	0%	Old Structures
	Utilities (3.4%)	0.51	-	0%	0%	0%	0%	DPWH Pumping
	River (10.67%)	1.60	-	0%	0%	0%	0%	No Structures
	Roads (7.27%)	1.09	-	0%	0%	0%	0%	No Structures

EXPOSURE				VULNERABILITY				
Barangay	AREA: Land Use	AREA: Total area Allocation in Hectares	AREA: Affected Area in Hectares (GIS Derived)	Proportion of buildings with walls with light to salvegable materials	Proportion of Buildings in dilapidated/ condemned Condition	Structure not employing hazard resistant building design	No access/area coverage to infrastructure related mitigation measures	Remarks/ Description (prevailing lot sizes, building height, if blighted areas, etc)
E	F	G	I	L	M	N	O	P
NBBN **Total area : 65 has Pop. = 16,201**	Industrial (7.19%)	4.67	3,718.92	0%	0%	10%	0%	Manufacturing; Old Structures
	Informal Settlements	7.90	-	95%	95%	100%	0%	
	Institutional (3.69%)	2.40	1,941.07	0%	0%	10%	0%	Old Structures
	Parks and Open	0.36	-	0%	0%	0%	0%	No Buildings
	Residential (45.14%)	29.34	1,511.87	0%	0%	10%	0%	Old Structures
	Commercial (8.11%)	5.27	1,633.24	0%	0%	10%	0%	Old Structures
	Roads (23.17%)	15.06	-	0%	0%	0%	0%	No Structures
NBBS **Total area : 254 has Pop. = 68,375**	Commercial (5.67%)	14.41	1,633.24	0%	0%	10%	0%	Old Structures
	Idle Lands (0.59%)	1.50	-	0%	0%	0%	0%	No Structures
	Industrial (42.88%)	108.91	3,718.92	0%	0%	10%	0%	Fishport, Manufactur
	Informal Settlements	8.31	-	95%	95%	100%	0%	
	Institutional (2.67%)	6.79	1,941.07	0%	0%	10%	0%	Old Structures
	Parks and Open	1.08	-	0%	0%	0%	0%	No Buildings
	Residential (22.86%)	58.06	1,511.87	0%	0%	10%	0%	Old Structures
	River (9.09%)	23.08	-	0%	0%	0%	0%	No Structures
	Roads (12.54%)	31.86	-	0%	0%	0%	0%	No Structures

Vulnerability	
Very High	More than 50% of exposed elements
High	30-50% of the exposed elements
Moderate	>15-30% of the exposed elements
Low	>5-15% of the exposed elements
Very Low	2-5% of the exposed the elements
Residual	Less than 2% of the exposed elements

Table 5.15. Severity of Consequence and Risk Database

EXPOSURE				SEVERITY OF CONSEQUENCE				RISK	
Barangay	AREA: Land Use	AREA: Total area Allocation in Hectares	AREA: Affected Area in Hectares (GIS Derived)	SevConsq_FGD	SevConsq_LGU	Sev_Consq_AVE	CATEGORY	Estimated Risks	Risk Category
E	F	G	I	Q	R	S	T	U	V
						=(Q+R)/2		=SxD	
Tanza	Agriculture (Fishpond) (68.80%)	338.51	338.51	2	2	2	Low	10.00	Moderate
Total area : 492 has			0.0007						
Pop. = 24,917	Idle Lands (2.09%)	10.28	0	0	0	0	n/a	0.00	Low
			0						
	Industrial (6.80%)	33.43	0	1	1	1	Low	5.00	Low
			0						
	Informal Settlements (1.44%)	7.09	2.7395	4	4	4	Very High	20.00	High
			2.2672						
	Institutional (0.15%)	0.73	0.1497	2	2	2	Low	10.00	Moderate
			0.0678						
	Residential (7.49%)	36.86	9.6845	1	1	1	Low	5.00	low
			4.9635						
	Utilities (6.32%)	31.12	10.9562	0	0	0	n/a	0.00	low
			0						
	River (5.80%)	28.52	0	0	0	0	n/a	0.00	Low
			0						
	Roads (1.11%)	5.46	0	0	0	0	n/a	0.00	Low
			0						
Tangos	Commercial (2.71%)	0.84	0	1	1	1	Low	5.00	low
Total area : 31 has			0						
Pop. = 32,941	Industrial (0.77%)	0.24	0	1	1	1	Low	5.00	low
			0						
	Informal Settlements	6.33	0	4	4	4	Very High	20.00	high
			0						
	Institutional (5.87%)	1.82	0	1	1	1	Low	5.00	low
			0						
	Parksand Open	0.15	0	0	0	0	n/a	0.00	low
			0						
	Residential (57.32%)	17.77	0	1	1	1	Low	5.00	low
			0						
	River (8.55%)	2.65	0	0	0	0	n/a	0.00	Low
			0						
	Roads (3.87%)	1.20	0	0	0	0	n/a	0.00	Low
			0						
San Roque	Commercial (0.26%)	0.07	0	1	1	1	Low	5.00	low
Total area : 27 has			0						
Pop. = 17,916	Industrial (8.63%)	2.33	0	1	1	1	Low	5.00	low
			0						
	Informal Settlements (9.04%)	2.44	0	4	4	4	Very High	20.00	high
			0						
	Institutional (2.41%)	0.65	0	1	1	1	Low	5.00	low
			0						
	Residential (65.15%)	17.59	0	1	1	1	Low	5.00	low
			0						
	River (7.44%)	2.01	0	0	0	0	n/a	0.00	Low
			0						
	Roads (7.07%)	1.91	0	0	0	0	n/a	0.00	Low
			0						
Daanghari	Industrial (20.77%)	5.40	0	1	1	1	Low	5.00	low
Total area : 26 has			0						
Pop. = 19,179	Informal Settlements (7.43%)	1.93	0	4	4	4	Very High	20.00	high
			0						
	Institutional (2.46%)	0.64	0	1	1	1	Low	5.00	low
			0						
	Residential (54.85%)	14.26	0	1	1	1	Low	5.00	low
			0						
	River (7.5%)	1.95	0	0	0	0	n/a	0.00	Low
			0						
	Roads (7.0%)	1.82	0	0	0	0	n/a	0.00	Low
			0						

EXPOSURE				SEVERITY OF CONSEQUENCE				RISK	
Barangay	AREA								
	Land Use	Total area Allocation in Hectares	Affected Area in Hectares (GIS Derived)	SevConsq_FGD	SevConsq_LGU	Sev_Consq_AVE	CATEGORY	Estimated Risks	Risk Category
E	F	G	I	Q	R	S	T	U	V
						=(Q+R)/2		=SxD	
San Jose	Commercial (0.99%)	0.70	1,633.24	1	1	1	Low	5.00	low
Total area : 71 has									
Pop. = 28,153	Idle Lands (3.03%)	2.15	-	0	0	0	n/a	0.00	low
	Industrial (11.93%)	8.47	3,718.92	1	1	1	Low	5.00	low
	Informal Settlements (5.66%)	4.02	-	4	4	4	very high	20.00	high
	Institutional (5.0%)	3.55	1,941.07	1	1	1	Low	5.00	low
	Parks and Open Spaces	3.66	-	0	0	0	n/a	0.00	low
	Residential (51.90%)	36.85	1,511.87	1	1	1	Low	5.00	low
	Utilities (0.38%) - Industrial	0.27	-	1	1	1	Low	5.00	low
	River (11.93%)	8.47	-	0	0	0	n/a	5.00	Low
	Roads (4.03%)	2.86	-	0	0	0	n/a	0.00	Low
Sipac-Almacen	Commercial (6.22%)	1.68	1,633.24	1	1	1	Low	5.00	low
Total area : 27 has									
Pop. = 11,541	Industrial (11.74%)	3.17	3,718.92	1	1	1	Low	5.00	low
	Informal Settlements (1.07%)	0.29	-	4	4	4	very high	20.00	high
	Institutional (7.63%)	2.06	1,941.07	2	2	2	Low	10.00	moderate
	Parks and Open Spaces	0.42	-	0	0	0	n/a	0.00	low
	Residential (48.52%)	13.10	1,511.87	1	1	1	Low	5.00	low
	Utilities (0.26%)	0.07	-	0	0	0	n/a	0.00	low
	River (19.0%)	5.13	-	0	0	0	n/a	0.00	Low
	Roads (4.0%)	1.08	-	0	0	0	n/a	0.00	Low
Navotas East	Industrial (9.84%)	0.59	3,718.92	0	0	0	n/a	0.00	low
Total area : 6 has									
Pop. = 2,241	Institutional (1.0%)	0.06	1,941.07	1	1	1	Low	5.00	low
	Parks and Open Spaces	0.03	-	0	0	0	n/a	0.00	low
	Residential (54.83%)	3.29	1,511.87	1	1	1	Low	5.00	low
	Commercial (6.83%)	0.41	1,633.24	1	1	1	Low	5.00	low
	River (19.0%)	1.14	-	0	0	0	n/a	0.00	Low
	Roads (8.0%)	0.48	-	0	0	0	n/a	0.00	Low
Navotas West	Informal Settlements (0.29%)	0.02	-	4	4	4	very high	20.00	high
Total area : 7 has									
Pop. = 8,698	Institutional (0.14%)	0.01	1,941.07	1	1	1	Low	5.00	low
	Residential (93.86%)	6.57	1,511.87	1	1	1	Low	5.00	low
	Roads (5.71%)	0.40	-	0	0	0	n/a	0.00	Low

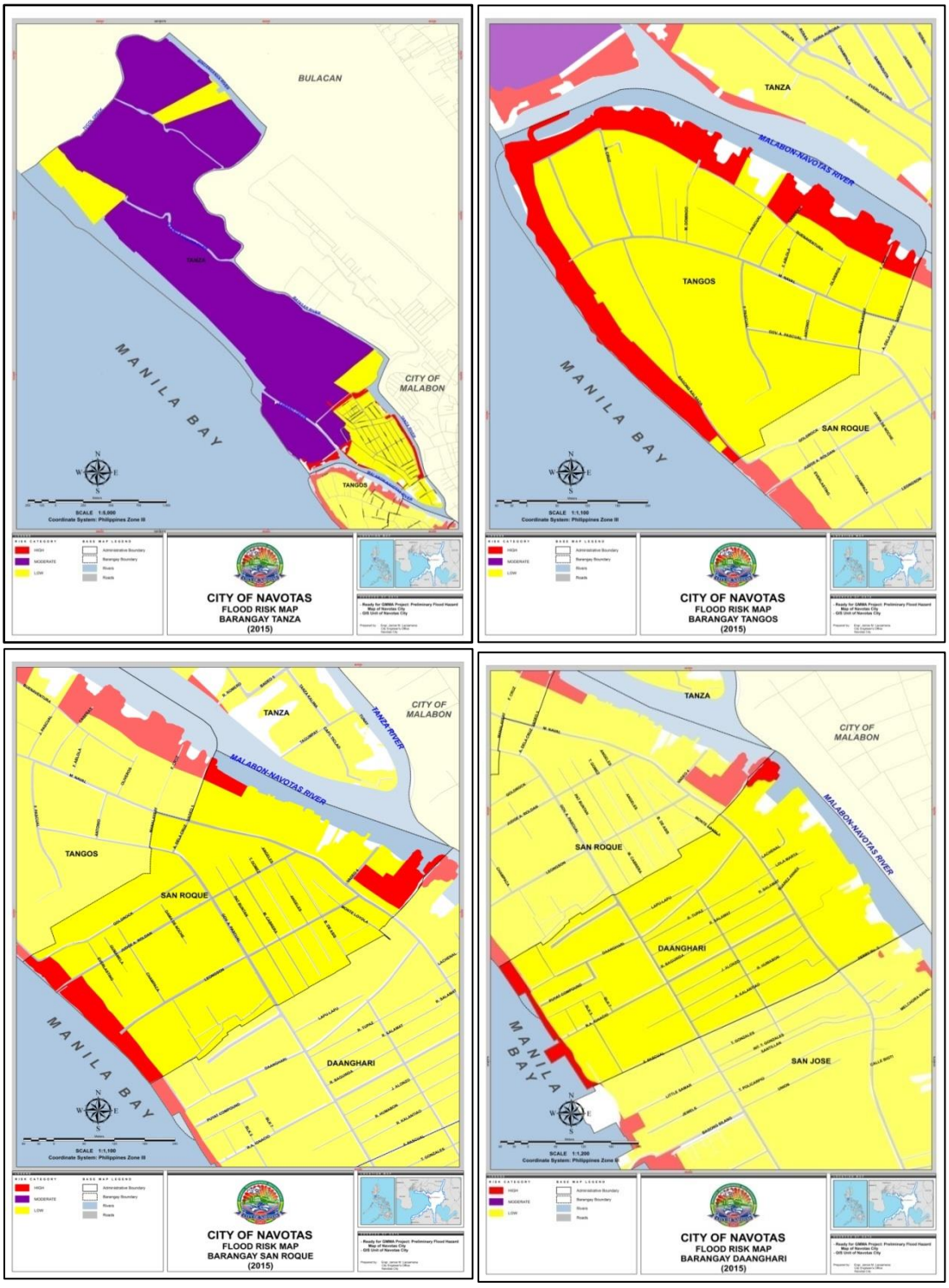
EXPOSURE				SEVERITY OF CONSEQUENCE				RISK	
Barangay	AREA								
	Land Use	Total area Allocation in Hectares	Affected Area in Hectares (GIS Derived)	SevConsq_FGD	SevConsq_LGU	Sev_Consq_AVE	CATEGORY	Estimated Risks	Risk Category
E	F	G	I	P	Q	R	S	T	U
Navotas East	Industrial (24.56%)	1.4734	0	0	0	0	n/a	0.00	low
			0						
Total area : 6 has	Institutional (1.67%)	0.1002	0	0	0	0	n/a	0.00	low
			0						
Pop. = 2,241	Residential (60.72%)	3.643	0	2	2	2	low	10.00	moderate
			0						
	Commercial (13.05%)	0.7834	0	2	2	2	low	10.00	moderate
			0						
Navotas West	Informal Settlements (0.23%)	0.0161	0	4	4	4	very high	20.00	high
			0						
Total area : 7 has	Institutional (0.13%)	0.0091	0	0	0	0	n/a	0.00	low
			0						
Pop. = 8,698	Residential (98.28%)	6.8793	0	2	2	2	low	10.00	moderate
			0						
	Commercial (1.36%)	0.0955	0	2	2	2	low	10.00	moderate
			0						
SRV	Industrial (54.01%)	21.0639	0.2327	2	2	2	low	10.00	moderate
			6.1949						
Total area : 39 has	Institutional (2.27%)	0.8853	0	2	2	2	low	10.00	moderate
			0						
Pop. = 3,530	Parks and Open Spaces (0.30%)	0.117	0	0	0	0	n/a	0.00	low
			0						
	Residential (43.42%)	16.9338	0	2	2	2	low	10.00	moderate
			0						
Bagumbayan North	Commercial (3.24%)	0.1296	0	2	2	2	low	10.00	moderate
			0						
Total area : 4 has	Idle Lands (20.72%)	0.8288	0	0	0	0	n/a	0.00	low
			0						
Pop. = 2,652	Institutional (11.86%)	0.4744	0	0	0	0	n/a	0.00	low
			0						
	Parks and Open Spaces (0.74%)	0.0296	0	1	1	1	low	5.00	moderate
			0						
	Residential (47.16%)	1.8864	0	2	2	2	low	10.00	moderate
			0						
	Utilities (16.28%)	0.6512	0	0	0	0	n/a	0.00	low
			0						

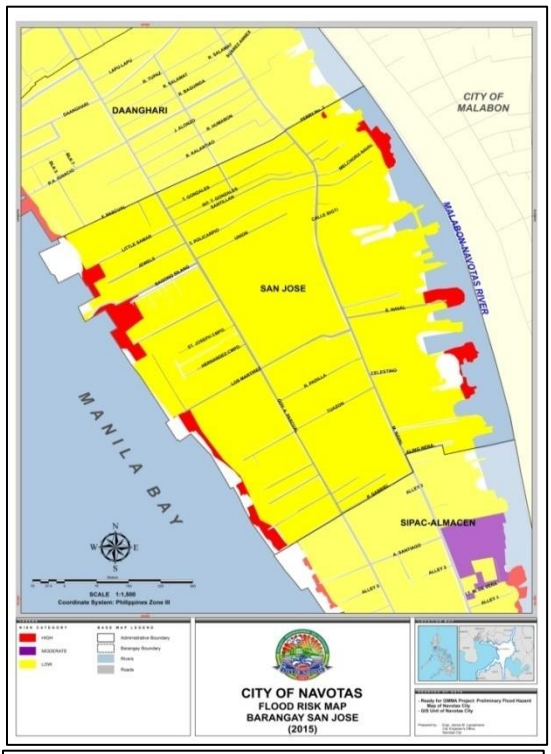
EXPOSURE				SEVERITY OF CONSEQUENCE				RISK	
Barangay	AREA: Land Use	AREA: Total area Allocation in Hectares	AREA: Affected Area in Hectares (GIS Derived)	SevConsq_FGD	SevConsq_LGU	Sev_Consq_AVE	CATEGORY	Estimated Risks	Risk Category
E	F	G	I	Q	R	S	T	U	V
						=(Q+R)/2		=S x D	
NBBN	Industrial (7.19%)	4.67	3,718.92	1	1	1	low	5.00	low
Total area : 65 has									
Pop. = 16,201	Informal Settlements	7.90	-	1	1	1	low	5.00	low
	Institutional (3.69%)	2.40	1,941.07	1	1	1	low	5.00	low
	Parks and Open	0.36	-	0	0	0	n/a	0.00	low
	Residential (45.14%)	29.34	1,511.87	1	1	1	low	5.00	low
	Commercial (8.11%)	5.27	1,633.24	1	1	1	low	5.00	low
	Roads (23.17%)	15.06	-	0	0	0	n/a	0.00	Low
NBBS	Commercial (5.67%)	14.41	1,633.24	1	1	1	low	5.00	low
Total area : 254 has									
Pop. = 68,375	Idle Lands (0.59%)	1.50	-	0	0	0	n/a	0.00	low
	Industrial (42.88%)	108.91	3,718.92	1	1	1	low	5.00	low
	Informal Settlements	8.31	-	1	1	1	low	5.00	low
	Institutional (2.67%)	6.79	1,941.07	1	1	1	low	5.00	low
	Parks and Open	1.08	-	0	0	0	n/a	0.00	low
	Residential (22.86%)	58.06	1,511.87	1	1	1	low	5.00	low
	River (9.09%)	23.08	-	0	0	0	n/a	0.00	Low
	Roads (12.54%)	31.86	-	0	0	0	n/a	0.00	Low

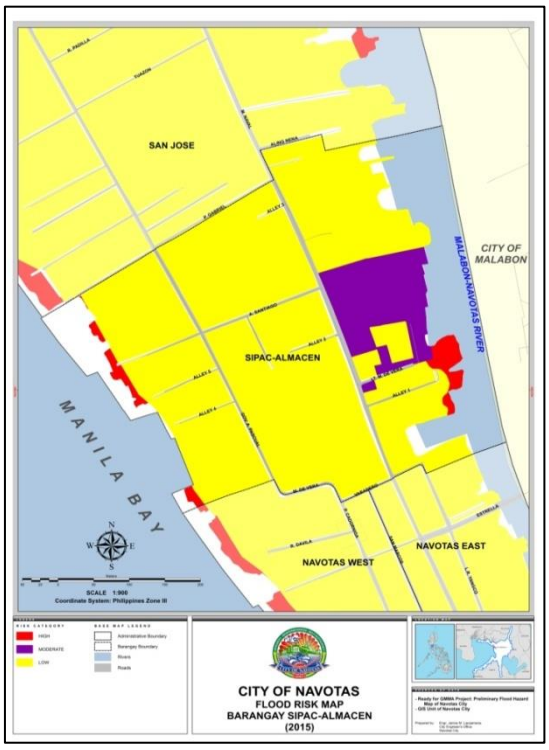
4	Very High Severity of Consequence	12-24	High Risk
3-<4	High Severity of Consequence	5-<12	Moderate Risk
		<5	Low Risk
0-<2	Low Severity of Consequence		

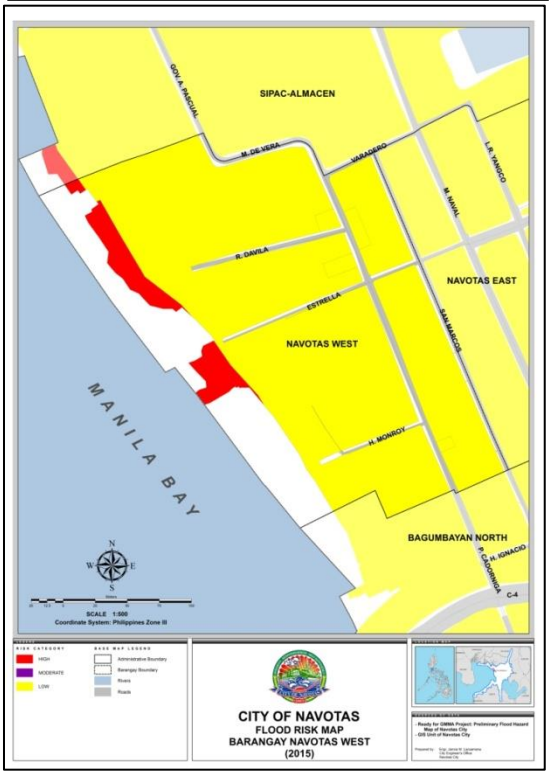
It can be concluded that in general, low risk is projected in most of the barangays and land uses except for some exceptions like the fishponds and institutional areas in Barangays Tanza and Sipac-Almacen, and informal settlements in most of the barangays.

Map 5.6. Risk Maps of the Fourteen (14) Barangays




DAANGHARI
CITY OF MALABON
SAN JOSE
MALABON-NAVOTAS RIVER
MANILA BAY
SIPAC-ALMACEN
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY SAN JOSE
(2015)


SAN JOSE
CITY OF MALABON
MALABON-NAVOTAS RIVER
SIPAC-ALMACEN
MANILA BAY
NAVOTAS WEST
NAVOTAS EAST
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY SIPAC-ALMACEN
(2015)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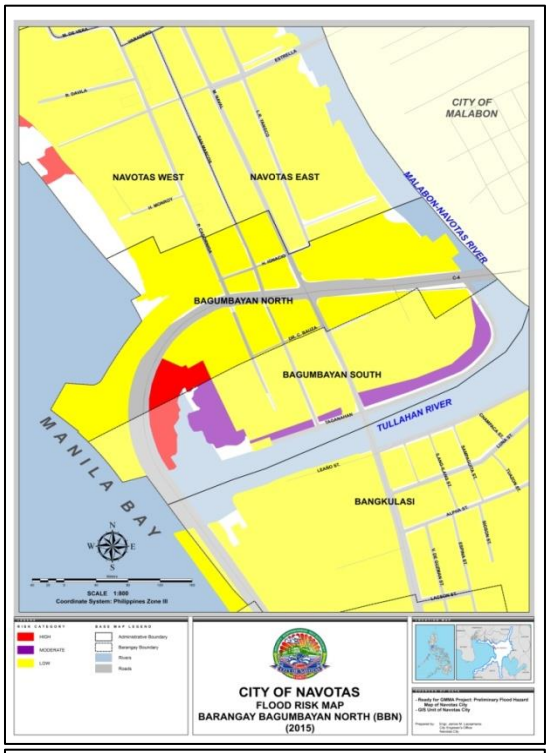
GOV A. PASCUAL
M. DE VERA
VAMACERO
LA. VIANCO
M. NAVAL
R. DAVILA
NAVOTAS EAST
ESTRELLA
NAVOTAS WEST
SAN MARCOS
H. MONROY
MANILA BAY
BAGUMBAYAN NORTH
H. IGNACIO
C-4
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY NAVOTAS WEST
(2015)


SIPAC-ALMACEN
VAMACERO
CITY OF MALABON
ESTRELLA
MALABON-NAVOTAS RIVER
LA. VIANCO
M. NAVAL
SAN MARCOS
NAVOTAS EAST
NAVOTAS WEST
H. MONROY
BAGUMBAYAN NORTH
H. IGNACIO
C-4
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY NAVOTAS EAST
(2015)


CITY OF MALABON
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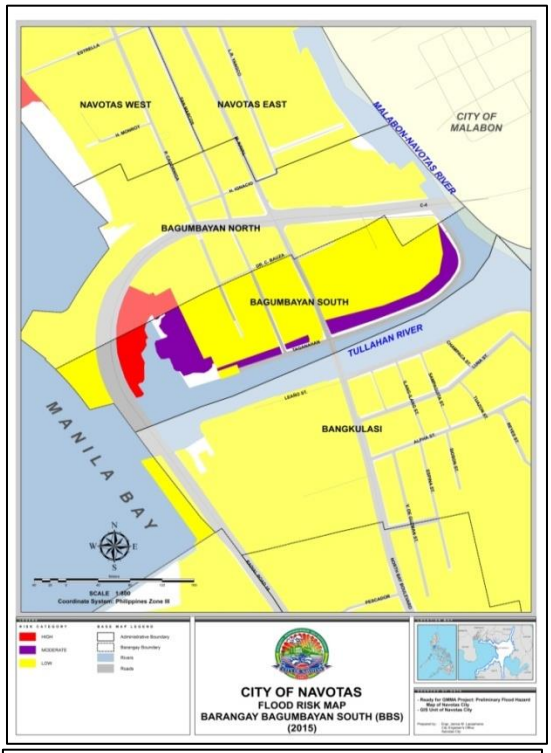
NAVOTAS EAST
MALABON-NAVOTAS RIVER
BAGUMBAYAN NORTH
BAGUMBAYAN SOUTH
TULLAHAN RIVER
MANILA BAY
BANGKULASI
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY BAGUMBAYAN NORTH (BBN)
(2015)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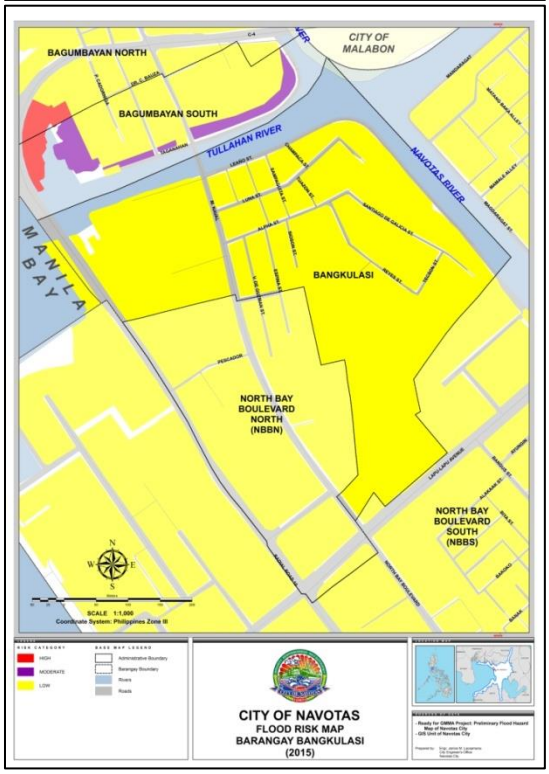
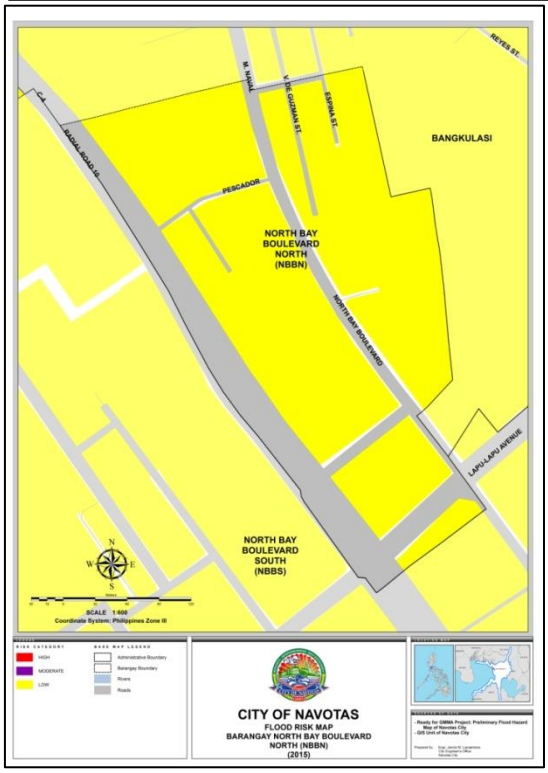
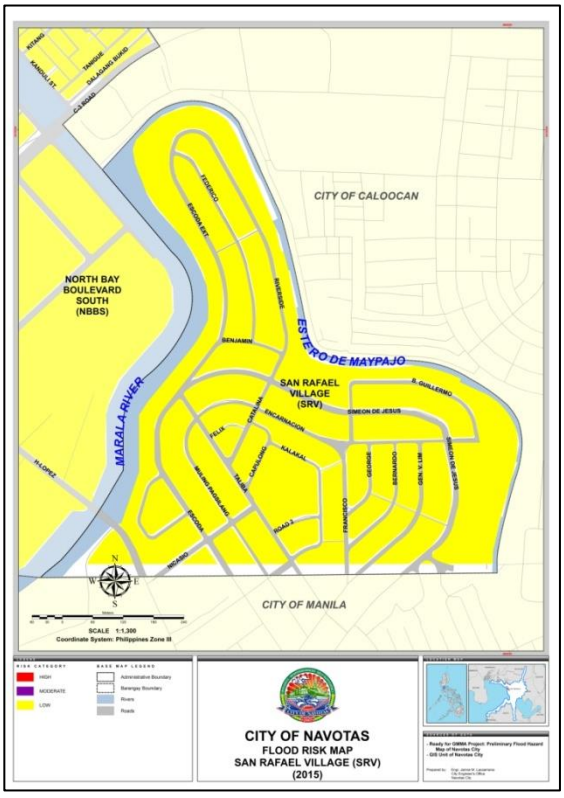
NAVOTAS EAST
CITY OF MALABON
MALABON-NAVOTAS RIVER
BAGUMBAYAN NORTH
BAGUMBAYAN SOUTH
TULLAHAN RIVER
MANILA BAY
BANGKULASI
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY BAGUMBAYAN SOUTH (BBS)
(2015)


BAGUMBAYAN NORTH
CITY OF MALABON
BAGUMBAYAN SOUTH
TULLAHAN RIVER
NAVOTAS RIVER
MANILA BAY
BANGKULASI
NORTH BAY BOULEVARD NORTH (NBBN)
NORTH BAY BOULEVARD SOUTH (NBBS)
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY BANGKULASI
(2015)


REYES ST.
BANGKULASI
PESCADOR
NORTH BAY BOULEVARD NORTH (NBBN)
NORTH BAY BOULEVARD SOUTH (NBBS)
LAPU-LAPU AVENUE
CITY OF NAVOTAS
FLOOD RISK MAP
BARANGAY NORTH BAY BOULEVARD NORTH (NBBN)
(2015)



As to critical facilities, all the schools at Barangay Tanza are identified to be at moderate risk. This is because the said schools are located at low lying areas and are adjacent to the fishponds. Mitigating measures are being employed in the area to avoid the adverse effects of floods such as an automatic suspension of classes upon declaration of storm signals 1 and 2 during the onslaught of a typhoon and the continuous operation of pumping stations.

Likewise, there are also critical facilities identified to be at moderate risk to flooding, these are located in Barangay Sipac – Almacen, like the Bagumbayan Elementary School, Navotas National High School, and other government offices situated near the riverways. The same measures as discussed in the previous paragraph are being employed in these areas.

Map 5.7. Navotas City Critical Facilities Overlayed on Flood Hazard Map

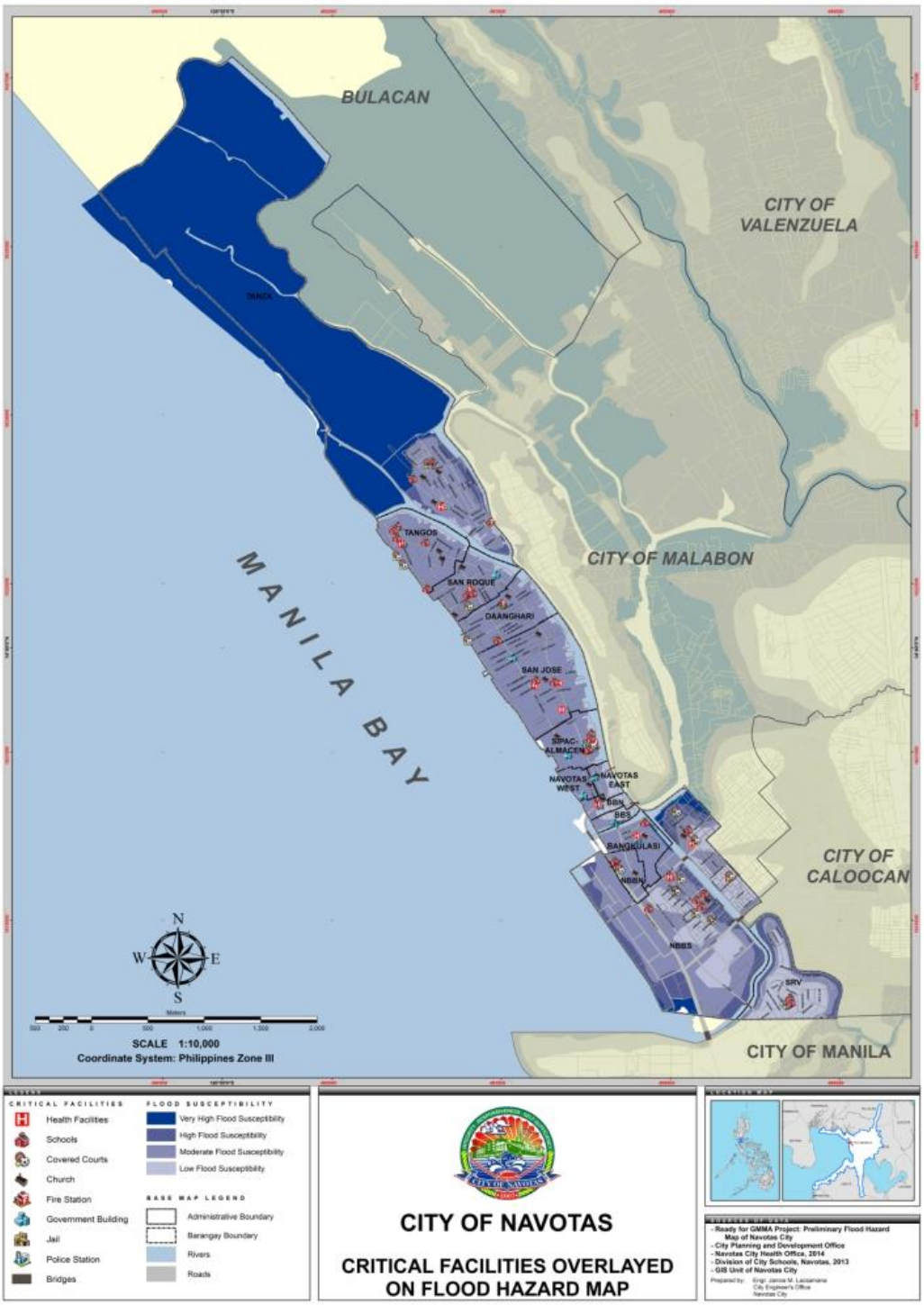


Table 5.16. Inventory of Tools and Equipment for Disaster

Quantity	Unit	Description
2	Pcs	Trauma Kits
10	Pcs	Rescue Knives
1	Unit	Portable inflatable emergency and disaster lighting
1	Pc	Rescue can (life buoy can)
5	Pcs	Water rescue helmet
10	Pcs	Type 3 responder's life vest
1	Unit	Fiber glass rescue boat
2	Units	Amphibian
1	Unit	Rubber rescue boat
50	Yards	Utility rope
1	Roll	Water rescue rope
10	Pcs	Harness
21	Pcs	Heavy duty flash lights
1	Roll	Nylon rope, 12 mm
1	Roll	Nylon rope, 14 mm
410	Pcs	First Aid kit with accessories
140	Pcs	Flashlights
1,560	Pcs	Headlamp
1	Pc	Megaphone
11	Units	generator set
2	Pcs	life ring
6	Units	base radio
132	Units	handheld radio

Source: Local Disaster Risk Reduction and Management Office

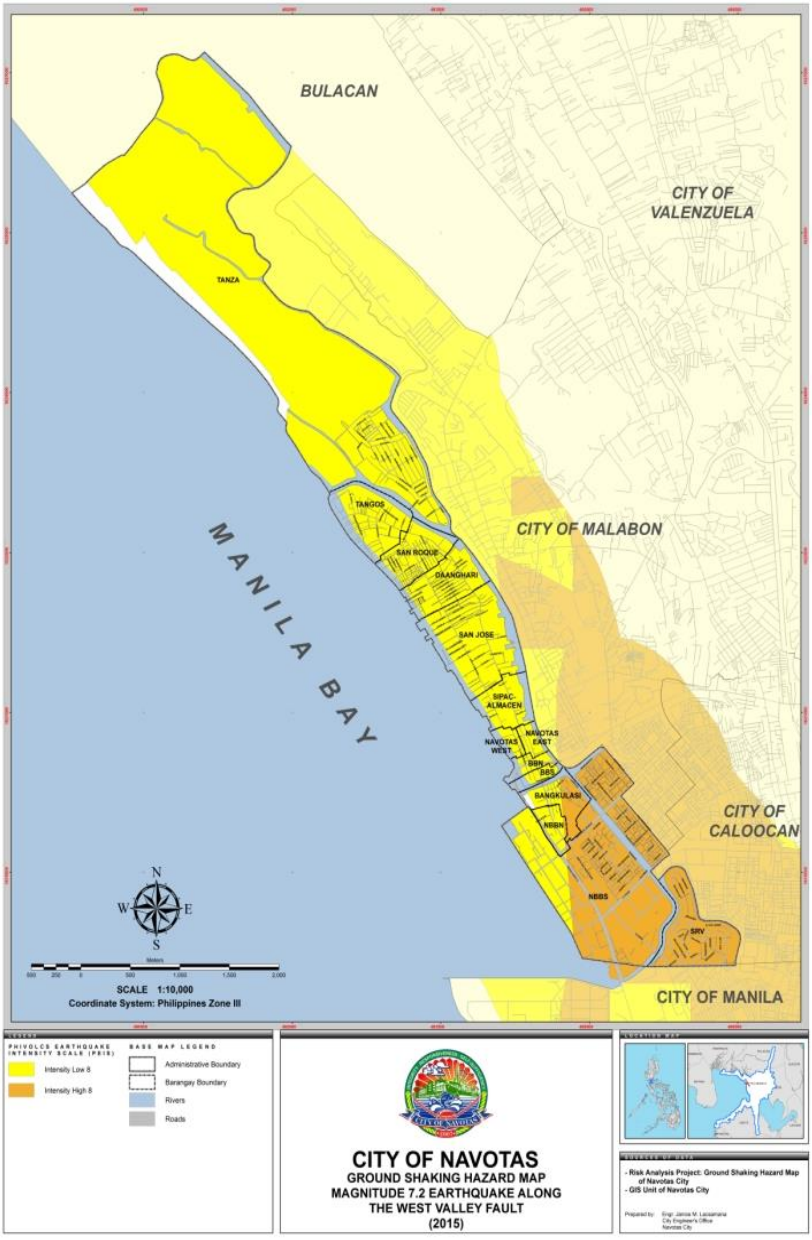
5.6. Ground Shaking

According to the Metro Manila Earthquake Impact Reduction Study (2004), there are three earthquake scenarios which may cause damages to Navotas; the magnitude 7.2 West Valley Fault (WVF) Earthquake, the magnitude 7.9 Manila Trench Earthquake and a model of the 1863 Manila Bay Earthquake. Out of the three, the WVF Earthquake is considered as the worst-case based on the potential number of casualties and damaged structures it will accrue. Fortunately, Navotas is not susceptible to Ground Rupture due to the fact that there are no fault lines located within the city. However, it is still not safe from other hazards caused by earthquakes such as Ground Shaking, Liquefaction, and Tsunami.

Ground shaking is the primary cause of casualties and damages to man-made structures when earthquakes occur. It is the effect of ground motion and movement of the earth's surface caused by seismic activities. The effect of ground shaking is measured using the PHIVOLCS Earthquake Intensity Scale (PEIS). Based on the 7.2 magnitude WVF earthquake scenario, Navotas would generally experience a Low VIII to High VIII Intensity level, which is described as Very Destructive according to the PEIS. The southern part of Navotas, specifically North Bay Boulevard South and San Rafael Village would experience slightly higher intensity level (high

VIII) compared to the rest of Navotas but both are still considered as an Intensity VIII event. During an event of this level, people may find it difficult to stand even outdoors, many well-built buildings are considerably damaged, concrete dikes and foundation of bridges are destroyed by ground settling or toppling, utility posts, towers and monuments may tilt or topple, and water and sewer pipes may be bent, twisted or broken.

Map 5.8. Ground Shaking Hazard Map
(Magnitude 7.2 Earthquake along the West Valley Fault) Risk Assessment

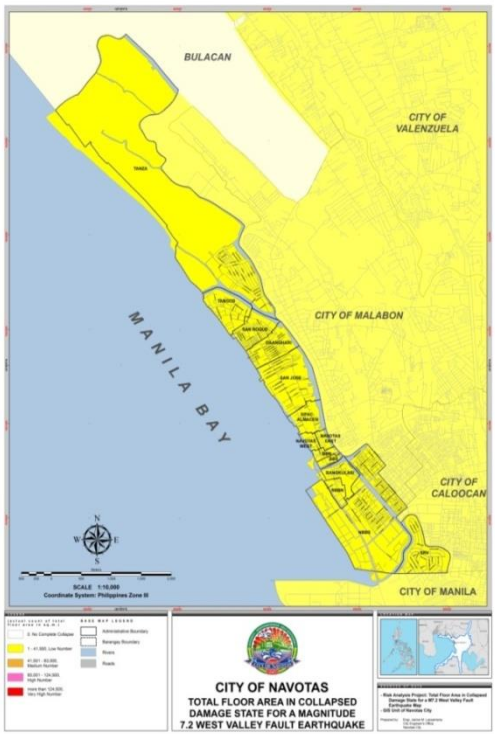


PHIVOLCS, under the GMMA-Risk Analysis Project (RAP), assessed the level of risk of Navotas during a 7.2 magnitude earthquake scenario. They conducted a procedure similar to the MMEIRS (2004) but with a more detailed information on the exposed units up to a land use-based level. Other than the land use type, the developed Exposure Database contains information such as the average building height, average number of levels, the building typologies, floor areas and the year it was constructed. From the exposure database, risks were calculated using vulnerability curves to determine the percentage of damage that an exposed unit would experience. Generated results shown in table 5.17 indicate the risks per barangay based on casualties, economic losses, and floor area damaged (structures).

Table 5.17. Risk Values for Ground Shaking

BARANGAY	Risk Values			
	Floor Area Damaged (Square Meters)		LOSSES (Millions PHP)	FATALITIES (No of Person)
	COMPLETE DAMAGE (NO COLLAPSE)	COMPLETE DAMAGE (WITH COLLAPSE)		
BAGUMBAYAN NORTH	8436	972	160	12
BAGUMBAYAN SOUTH	17874	1713	200	13
BANGCULASI	66742	7440	1532	40
DAANGHARI	154663	18492	2230	148
NAVOTAS EAST	12877	1777	247	13
NAVOTAS WEST	30978	3258	415	22
NORTH BAY BLVD. NORTH	65319	7686	1587	26
NORTH BAY BLVD. SOUTH	426500	55819	9263	259
SAN JOSE (POB.)	129415	14915	2094	90
SAN RAFAEL VILLAGE	174084	23354	4031	98
SAN ROQUE	98010	11271	1410	83
SIPAC-ALMACEN	59635	6908	1179	34
TANGOS	129496	11459	1282	115
TANZA	155336	16539	1669	137

Map 5.9. Risk Maps for Ground Shaking



Based on the results of RAP, Navotas have a low risk in terms of damaged structures, casualties and economic losses as compared to the rest of the cities in Metro Manila. The highest value of risk to damaged structures and casualties, as computed by RAP, is located in barangay North Bay Boulevard South. Other barangays that have more than a hundred casualties include Daanghari, Tangos, and Tanza. For damaged and collapsed structures, barangays San Rafael Village, Daanghari, Tanza, and San Jose were identified as risk areas.

- North Bay Boulevard South, which is affected by a slightly higher intensity level than the rest of Navotas, has the highest risk in terms of casualties, damage structures and losses. Land use is predominantly industrial with 82.93 hectares or 32.65% of the total barangay area, and residential with 74.1 hectares or 29.17% for formal settlers and 10.6 hectares or 4.17% for informal settlers. The industrial nature of the barangay is centered on fishing and related industries as well as storage and warehousing of container vans.
- Barangays Daanghari, Tanza, and Tangos are projected to have more than a hundred fatalities during the said scenario. One reason is that these barangays are occupied by a large number of informal settlers. Their housing structures are considered as vulnerable to ground shaking because of the use of low quality materials and haphazard process of construction. In addition, most of the structures do not follow the National Building Code. San Jose, San Rafael and San Roque are also projected to amass about 80-100 fatalities. These areas, on the other hand, have lesser areas with informal settlements, but are predominantly covered by residential areas.
- Barangays San Rafael, Daanghari, Tanza and San Jose would experience high risk to damaged structures. These areas are predominantly residential land areas.

Mitigating Measures

It was said that no buildings can be 100% safe from ground shaking; thus, the strict implementation of the building code will ensure that the structures and buildings in the city will be resistant to an optimal extent to these strong forces. In addition, the city has limited open spaces for evacuation, so identification of areas for development into evacuation sites will be initiated. Furthermore, evacuation plans are currently being implemented by the LRRDM Office.

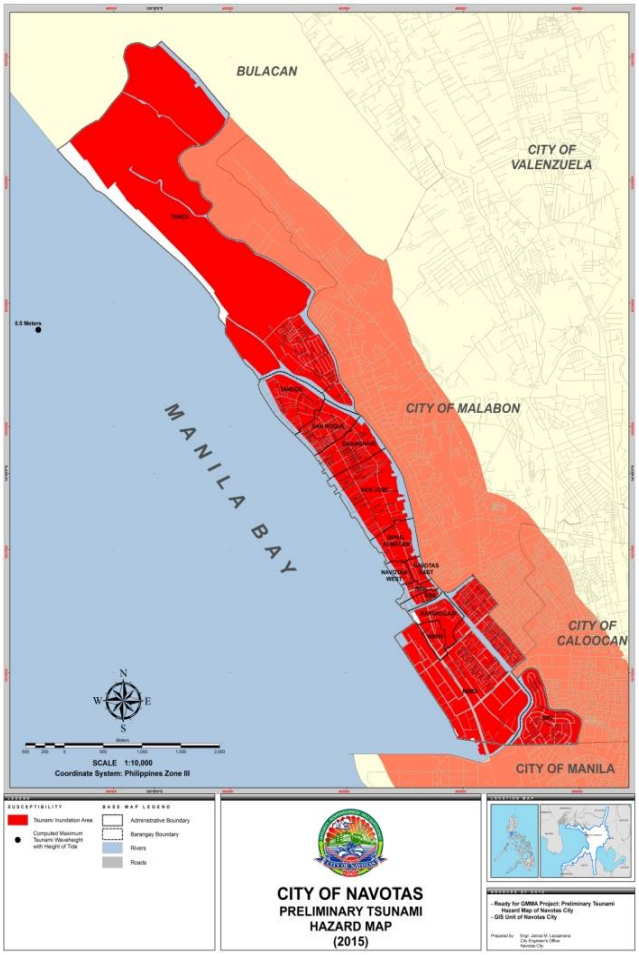
Most of the identified vulnerable stakeholders are living adjacent to the industrial areas where there is numerous storage facilities for containers. Consequently, the towering heights of these containers are prone to the effects of ground shaking. To ensure the safety of the constituents, height regulation for the stacking of container will be implemented.

5.7. Other Hazards

5.7.1. Tsunami

Tsunami is a Japanese word with the English translation, "harbor wave." In the past, tsunamis were sometimes referred to as "tidal waves" by the general public and as “seismic sea waves” by the scientific community. Tsunamis is commonly caused by seismic activities of the earth's crust but can also be caused by marine landslides and volcanic eruptions. The PHIVOLCS Tsunami Susceptibility Map was based on a generated earthquake scenario from the fault lines located westof Manila Bay. It is estimated that the inundation of the Tsunami will be about 5.5 meters. It should also be noted that there were no historical incidence of tsunami in the city.

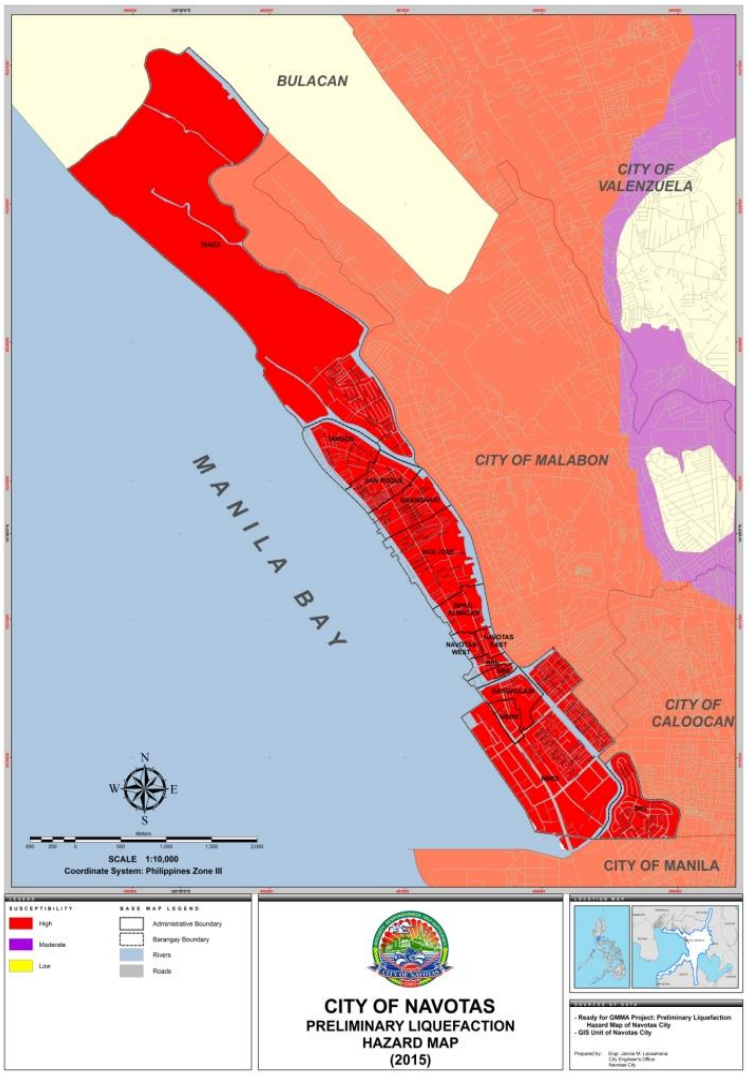
Map 5.10. Preliminary Tsunami Hazard Map



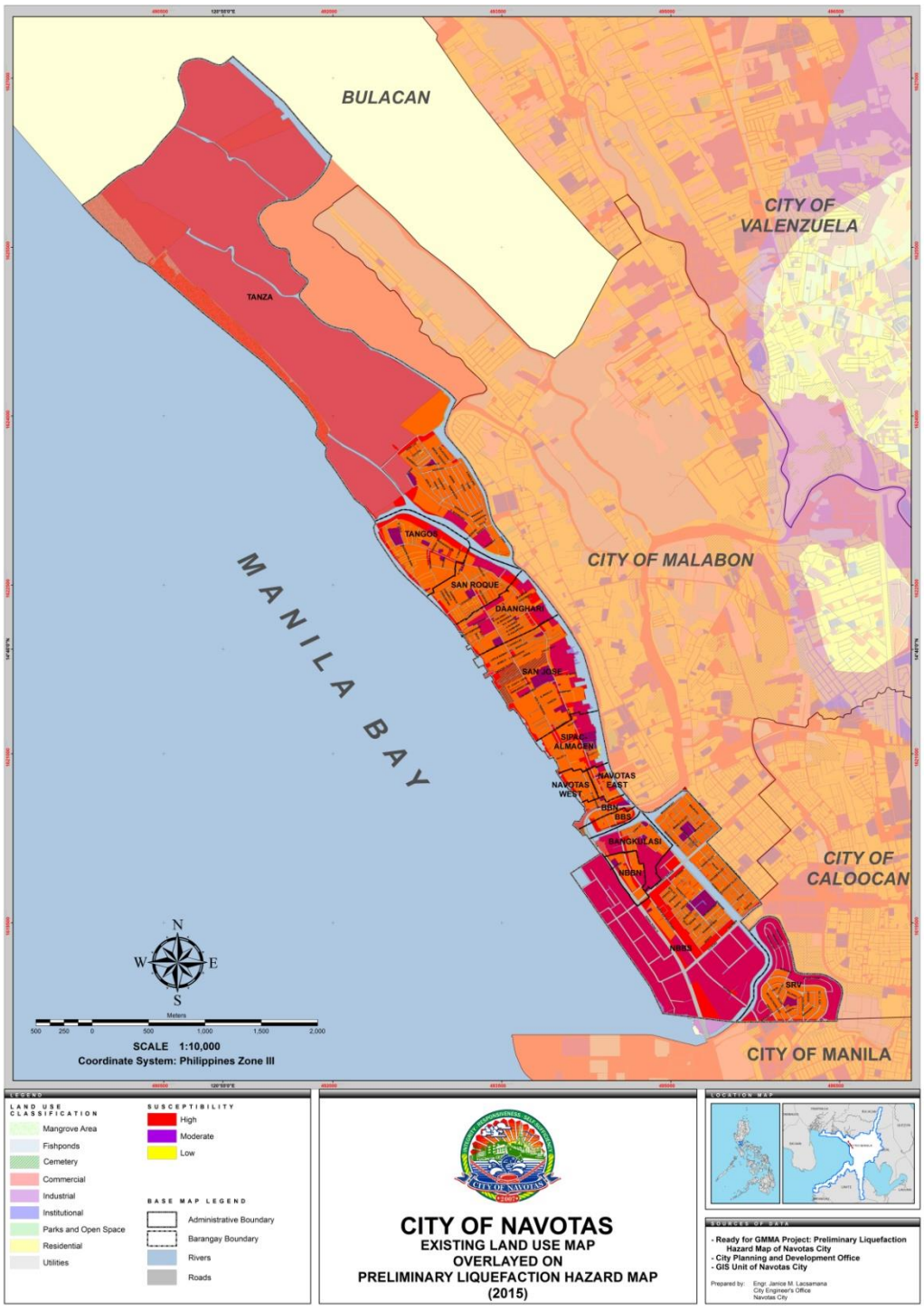
5.7.2. Liquefaction

Liquefaction is the process by which wet sediment starts to behave like a liquid. It occurs because of the increased pore pressure and reduced effective stress between solid particles generated by the presence of liquid. It is often caused by severe shaking, especially those associated with earthquakes. The PHIVOLCS liquefaction susceptibility map was based on the geology, earthquake source zone, historical accounts of liquefaction, geomorphology and hydrology of the area, and preliminary microtremor survey data utilized to validate the type of underlying materials.Using the susceptibility map generated by PHIVOLCS, the entire city is considered to be highly susceptible to liquefaction.

Map 5.11. Preliminary Liquefaction Hazard Map



Map 5.12. Liquefaction Overlay Map

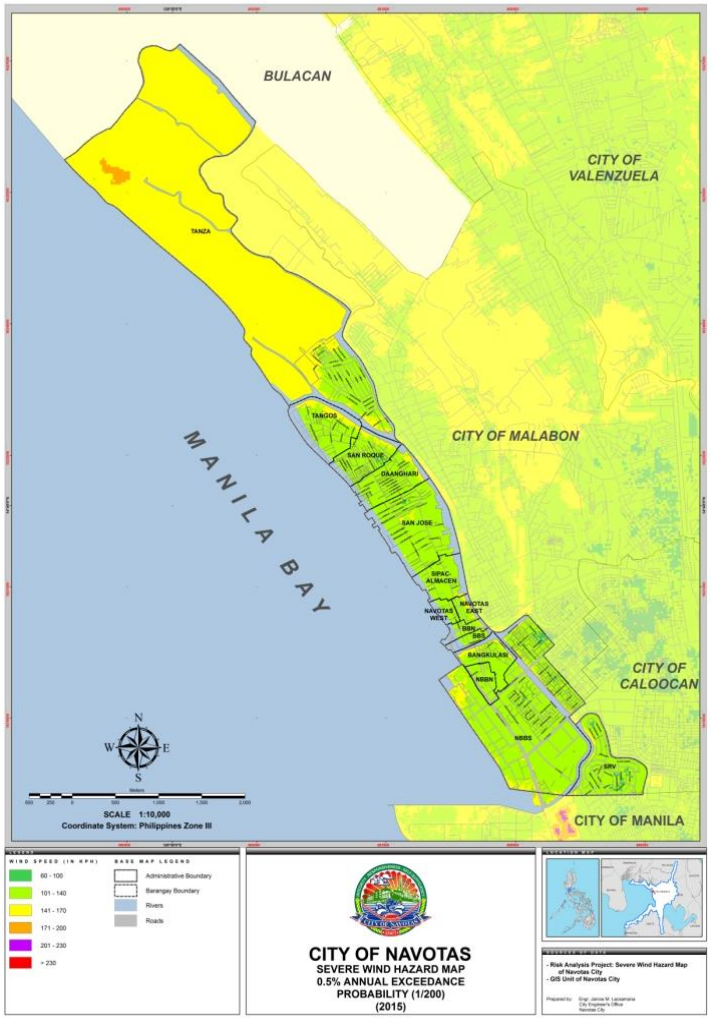


5.7.3. Severe Wind

Severe winds are hydro-meteorological hazards that cause destruction to properties usually during tropical typhoons. Areas vulnerable to severe winds are less densely built areas with large open spaces and populated areas that are beside tall and vulnerable structures like buildings, communication towers, power lines, and billboards. There are no recorded events which caused significant damages to properties and casualties that are directly related to severe winds. However, during events of strong typhoons, individual cases have been reported.

A severe wind risk assessment for the city of Navotas was produced under the GMMA-RAP. Based on the assessment, most barangays would only experience minimal wind speeds.

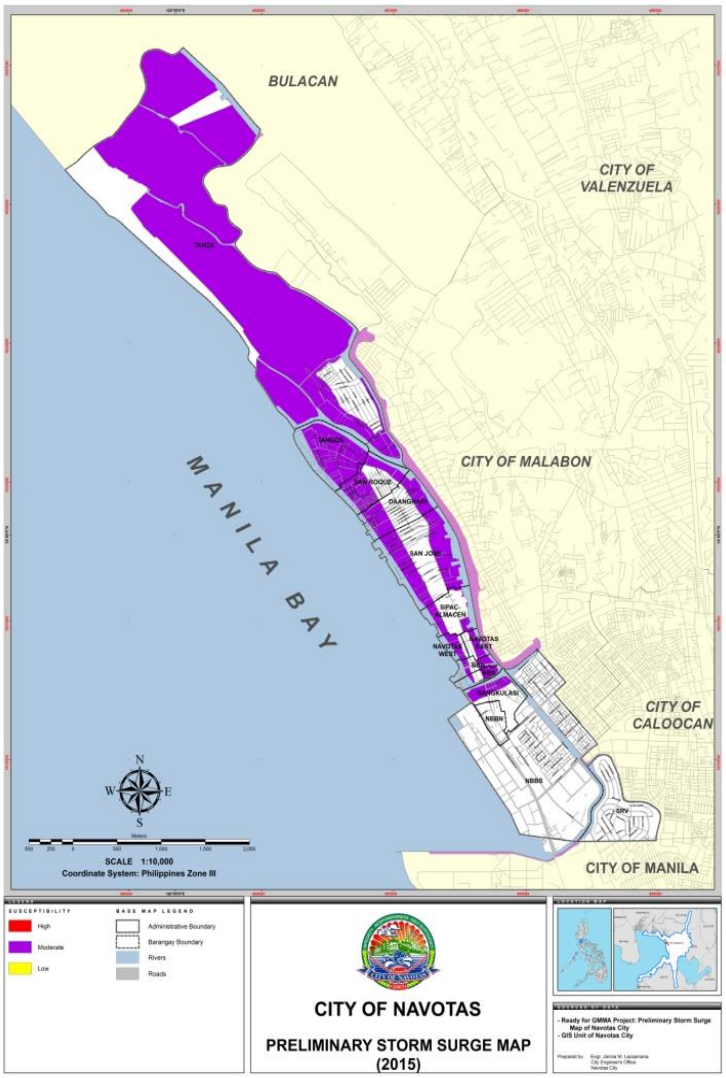
Map 5.13. Severe Wind Hazard Map 0.5% Annual Exceedance Probability (1/200)



5.7.4. Storm Surge

Storm Surge is a rise of ocean water usually associated with tropical typhoons. These are caused primarily by strong winds pushing the water surface. Given the fact that sea levels are rising and extreme weather events are becoming prevalent due to climate change, storm surges are hazards that may adversely affect the city due to part of it is identified as an area that is experiencing ground subsidence. Navotas is also easily inundated by high tides.According to the Storm Surge Map by PAGASA, almost all barangays except the southern barangays (North Bay Boulevard North, North Bay Boulevard South and San Rafael Village) are susceptible to storm surges. Areas along the coast of Manila Bay and rivers are the most susceptible, as well as the northern fishpond areas of barangay Tanza.

Map 5.14. Preliminary Storm Surge Map



Mitigating Measures

The results of the RAP showed that the effects of these four hazards should not be underestimated, thus the implementation of the following mitigating measures will effectively lessen the adverse effects of these hazards.

Table 5.18. Mitigating Measures for Other Identified Hazards

Hazard	Mitigating Measures
Tsunami	• Development of Green Linear Parks along the coastal area and riverbanks • Construction of the 3.5 Kilometer Coastal Dike • 20 meter easement along the coast
Liquefaction	• Strict observance of the Building Code
Severe Winds	• Incorporation of wind resistant designs for new structures in Wind Damage Prone Areas. • Strict implementation of CLUP and Zoning Ordinance and design standards implied within. • Development of Green Linear Parks along Open areas (such as Marine Ponds, Open Fields, Riverbanks) to act as wind brakes to adjacent residential areas.
Storm Surge	• Development of Green Linear Parks along the coastal area and riverbanks • Construction of the 3.5 Kilometer Coastal Dike • 20 meter easement along the coast, which is considered as No Build Zone • Mangrove Planting along the shoreline

5.8. DRR Conclusion

Navotas City has used land-use planning as a tool to mainstream disaster risk reduction and climate change adaptation into urban development processes. In return, it can provide a system with which interventions to partner local actors for risk mapping and public resilience building can be undertaken.

With this in mind, the LGU performed an assessment of the natural hazards that may befall on the city. Based on experiences and historical data, several hazards were identified that may affect the exposed elements of the community. These hazards include those of geological and hydro-meteorological origin.

The assessment showed that the majority of the city has low to moderate risk of flooding, including most of the residential, commercial, and institutional areas. However, it should be noted that some areas still have a high risk of flooding, which include informal settlement areas in all barangays and the fishponds in Brgy. Tanza. On the

other hand, low risk of flooding is expected for most of the industrial areas, parks and open spaces, and utilities in Navotas.

Based on the historical data obtained, Typhoon Pedring was by far one of the worst cases of natural calamities that hit the city where around 3,000 families were affected and displaced from their homes in 2011. Since most of these families were considered as informal settlers and resides in the identified critical areas, the city government prohibited them to return and decided to relocate them to existing housing projects of the city.

Even before the Typhoon Pedring hit the city, Navotas has existing mitigating measures and structures to address the flooding in the city. But the adverse events that happened during the onslaught of Typhoon Pedring proved that further improvements of these measures should be undertaken.

The city administration initiated the construction of additional “Bombastik” pumping stations in the recognized critical areas. In addition the following projects and activities were also started: (1) conduct dredging and desilting of waterways; (2) construction and upgrading of drainage system; (3) development of resettlement sites for ISFs; (4) continuous implementation of the comprehensive drainage master plan; and (5) regular maintenance of flood control facilities like the CAMANAVA flood control facility. In the intervening time, the LGU is currently constructing a 3.5 kilometer coastal dike along Manila Bay and river walls which can greatly reduce flooding in the city.

The mitigating measures instituted were proven to be helpful during the onslaught of Typhoon Gener and the southwest monsoon rain (Habagat) a year after Typhoon Pedring hit the city. At the height of Typhoon Gener, 700 families were reported to be affected, all of which were part of the pre-emptive evacuation of the city government. Habagat on the other hand affected only 180 families along the coastal areas. There are no reported damages to houses during these calamities.

Other hazards may also affect the city like storm surges, tsunami, liquefaction, and severe winds. The result of the assessment showed that the city is highly susceptible to tsunami and liquefaction. Furthermore, the coastal barangays were revealed to be prone to the effects of storm surges. On the other hand, severe winds can only felt by the city during typhoons.

On top of all the institutional initiatives, disaster awareness of the communities has been improved through training and information campaign. The LGU thru the Public Information Office (PIO) and the Local Disaster and Risk Reduction Management Council (LDRRMC) is constantly providing its citizens with information like the heights of the tides for the whole month, weather updates, and upcoming typhoons. They also conducted Community-based Disaster Risk Reduction and Management Orientation and drills. Furthermore, the “TXTJRT”, a feedback mechanism which enables the residents to obtain and provide disaster related information was also launched. The knowledge imparted to the communities can result to better community involvement. As all efforts in development start with the people, their awareness and participation can lead to a great and strong community.

The city government is placing greater value in the prevention and preparation for the humanitarian and financial impacts of a disaster before it strikes rather than the post-event relief. More work anticipates the city before it recognizes its safe development goals. But what is important is that Navotas City has proven that it can stand the impacts of natural calamities like typhoons and flooding due to its effective mitigating measures and remarkable adaptive capacity.