

Chapter 2. Earthquake Damage Scenario

CHAPTER 2. EARTHQUAKE DAMAGE SCENARIO

2.1 Earthquake Scenario Setting and Ground Motion

2.1.1 Fault in the Philippines

The Philippines is located in latitude 5° to 19°45' N. and longitude 116° to 128° E. Metropolitan Manila is located in the center of Luzon Island, between Manila Bay, which extends to the South China Sea, and Laguna de Bay. Many earthquake generators are distributed all over the country as shown in Figure 2.1.1.



Figure 2.1.1 Geological Faults in the Philippines

Source : PHIVOLCS

2.1.2 Earthquake Generators

The Eurasian Plate (or South China Plate) subducts eastward beneath Luzon Island along the Manila Trench, and the Philippine Sea Plate subducts westward along the East Luzon Trench simultaneously as shown in Figure 2.1.2. Because of this complex tectonic setting, Luzon Island shows high seismic activity. The Philippine Islands are sandwiched between two opposite subduction zones. A long, inland Philippine Fault Zone (PFZ) lies parallel to the subduction trenches. The PFZ is assumed to release the shear stress caused by the oblique subduction of the ocean plates. Many faults are identified around Metropolitan Manila; the West Valley Fault (WVF) and the East Valley Fault (EVF), which run north to south along the west and east edge of the Marikina Valley, are thought to pose the greatest threat to Metropolitan Manila due to their proximity.

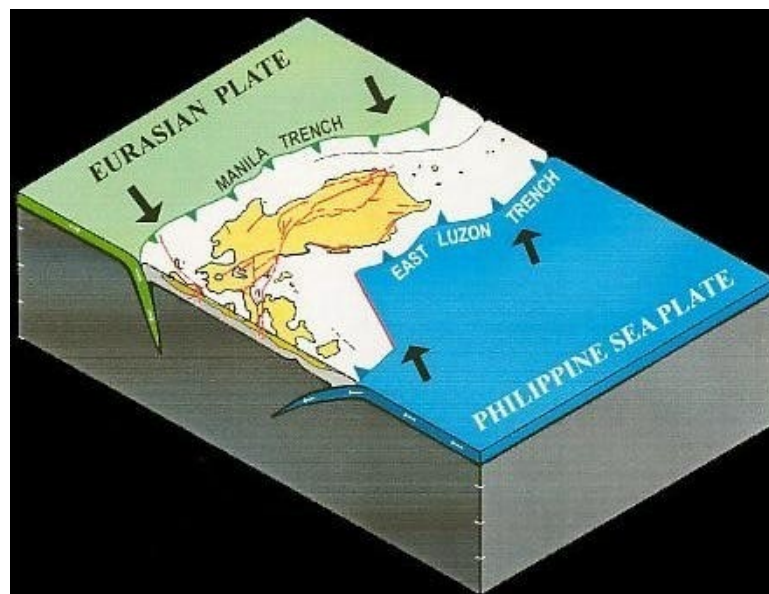


Figure 2.1.2 Subducting Plates under Luzon Island

Source: PHIVOLCS

The faults and trenches around Metropolitan Manila are shown in Figure 2.1.3. The fault traces based on geological survey (bold lines) are used for the analysis of inland fault and the fault traces based on seismic activities (thin lines) are used for the analysis of offshore fault.

Results of several trenching excavation surveys at WVF and EVF indicate that at least two or perhaps four large surface-rupturing events have occurred since AD 600. Therefore, the recurrence interval of the earthquakes generated is less than 500 years. Bautista (2000) has suggested that the 1658 and 1771 earthquakes could be candidate events for the EVF. However, no event along the WVF is known. If no earthquake had occurred at the WVF after the 16th century, then the earthquake occurrence along the WVF becomes a serious threat.

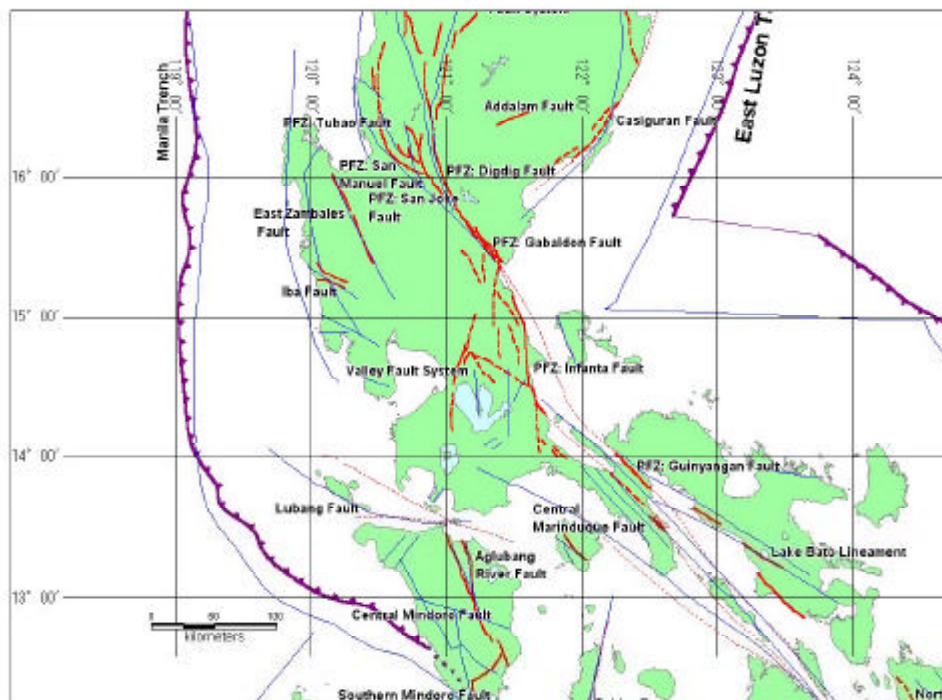


Figure 2.1.3 Distribution of Faults and Trenches around Metropolitan Manila

Source: PHIVOLCS

2.1.3 Earthquake Condition

The earthquakes that occurred before the start of instrumental seismic observation are called historical earthquakes.

The distribution of collected historical earthquakes is shown in Figure 2.1.4 and the instrumentally recorded earthquakes after 20th century is shown in Figure 2.1.5. M.L.P. Bautista (2000) has selected 36 historical and recent earthquakes that caused some damage to Metropolitan Manila. These 36 events are listed in Table 2.1.1 and the years of their occurrence are shown in Figure 2.1.4 and Figure 2.1.5. The events, those with year of occurrence underlined in Table 2.1.1, are the 10 most damaging earthquakes to Metropolitan Manila. In the five events in 1658, 1771, 1863, 1880 and 1937, shaded by dark gray in Table 2.1.1, Metropolitan Manila is supposed to have experienced over 100 gal PGA on average ground condition. As for the source fault of these earthquakes, M.L.P. Bautista (2000) has supposed EVF as the source fault of 1658 and 1771 event, Infanta Segment of PFZ as the source fault of 1880 event and Laguna-Banahaw Fault that runs north to south along the east coast of Laguna Lake as the source fault of 1937 event. In these 36 hazardous earthquakes, only the 1677 event and the 1863 event have the description of tsunami around Metropolitan Manila. Those faults are listed as the source faults of the scenario earthquakes.

Table 2.1.1 Destructive Earthquakes that Affected Metropolitan Manila and Estimated PGA

Year	Month	Day	Ms	Distance(km)	PGA(gal)
1589					
1599	6	21		4.1	
1601	1	1			
1603					
1635					
1645	11	30	7.9	116.3	81.0
1658	8	19	5.7	12.5	202.6
1664	7	19			
1665	7	19			
1674					
1677	12	7	7.3	163.8	27.9
1728	11	28		18.9	
1767	11	13		41.1	
1770	12			41.1	
1771	2	1	5.0	14.1	113.2
1796	11	5	6.9	179.2	16.5
1824	10	26	7.4	103.2	69.8
1828	11	9	6.6	190.3	11.1
1830	1	18	6.3	94.2	34.3

Year	Month	Day	Ms	Distance(km)	PGA(gal)
1833	11	7			
1852	9	16	7.6	108.7	74.0
1862	3	4	6.1	113.0	21.2
1863	6	3	6.5	13.1	298.3
1869	10	1	6.6	70.9	66.8
1880	7	18	7.6	67.8	139.8
1892	3	16	6.6	214.2	8.2
1937	8	20	7.5	52.2	174.7
1942	4	8	7.5	118.9	59.6
1968	8	2	7.3	224.6	13.2
1970	4	7	7.3	152.2	32.5
1970	4	12	7.0	123.8	38.0
1972	4	26	7.2	153.8	29.4
1973	3	17	7.3	232.5	12.1
1974	2	19	6.1	139.0	14.3
1977	3	19	7.0	282.2	5.3
1990	7	16	7.8	124.6	67.8
1994	11	14	7.1	119.1	44.1
1999	12	12	6.8	203.2	11.2

Source: PHIVOLCS and Study Team

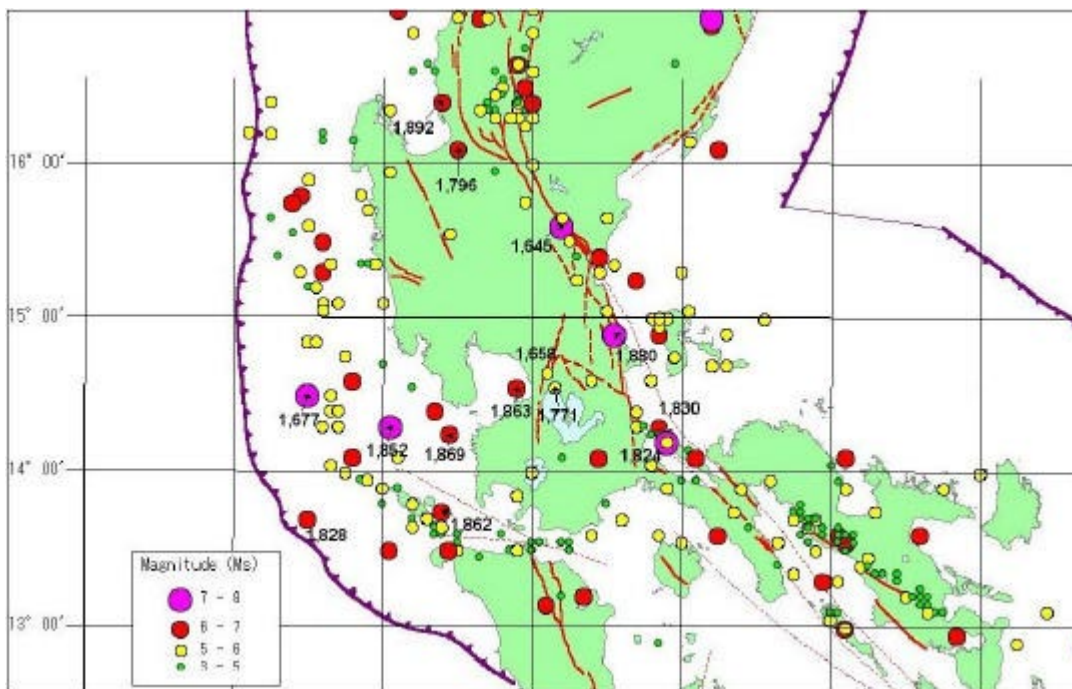


Figure 2.1.4 Distribution of Historical Earthquakes from 1608 to 1895

Source: M. L. P. Bautista and Oike K. (2000)

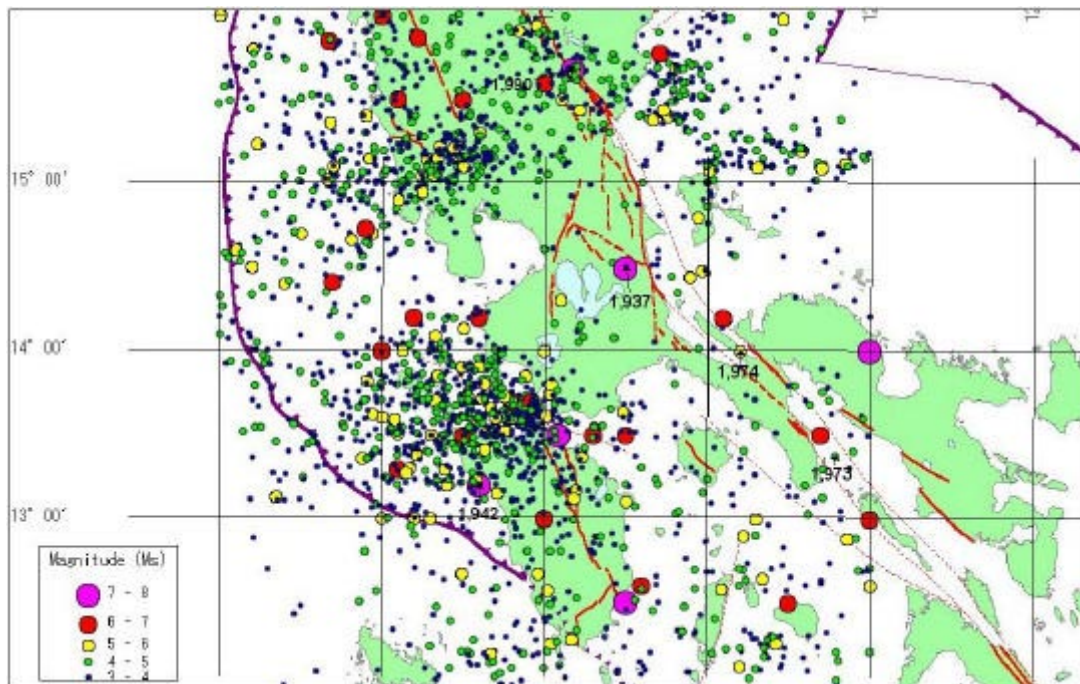


Figure 2.1.5 **Distribution of Instrumentally Recorded Earthquakes from 1907 to 2002**

Source: PHIVOLCS

2.1.4 Scenario Earthquakes

A total of 18 scenario earthquakes were set. Three types of fault length were used for the West Valley Fault (WVF) considering the low continuity in the north and south. Tsunami was evaluated for the movement of Manila Trench and re-occurrence of 1863 earthquake. The source faults of scenario earthquakes are shown in Figure 2.1.6. The black solid line and shaded area show the fault of scenario earthquakes. The precise fault parameters are shown in Table 2.1.2. The empirical formula by Wells and Coppersmith (1994) was used to calculate the earthquake magnitude and fault width from fault length.

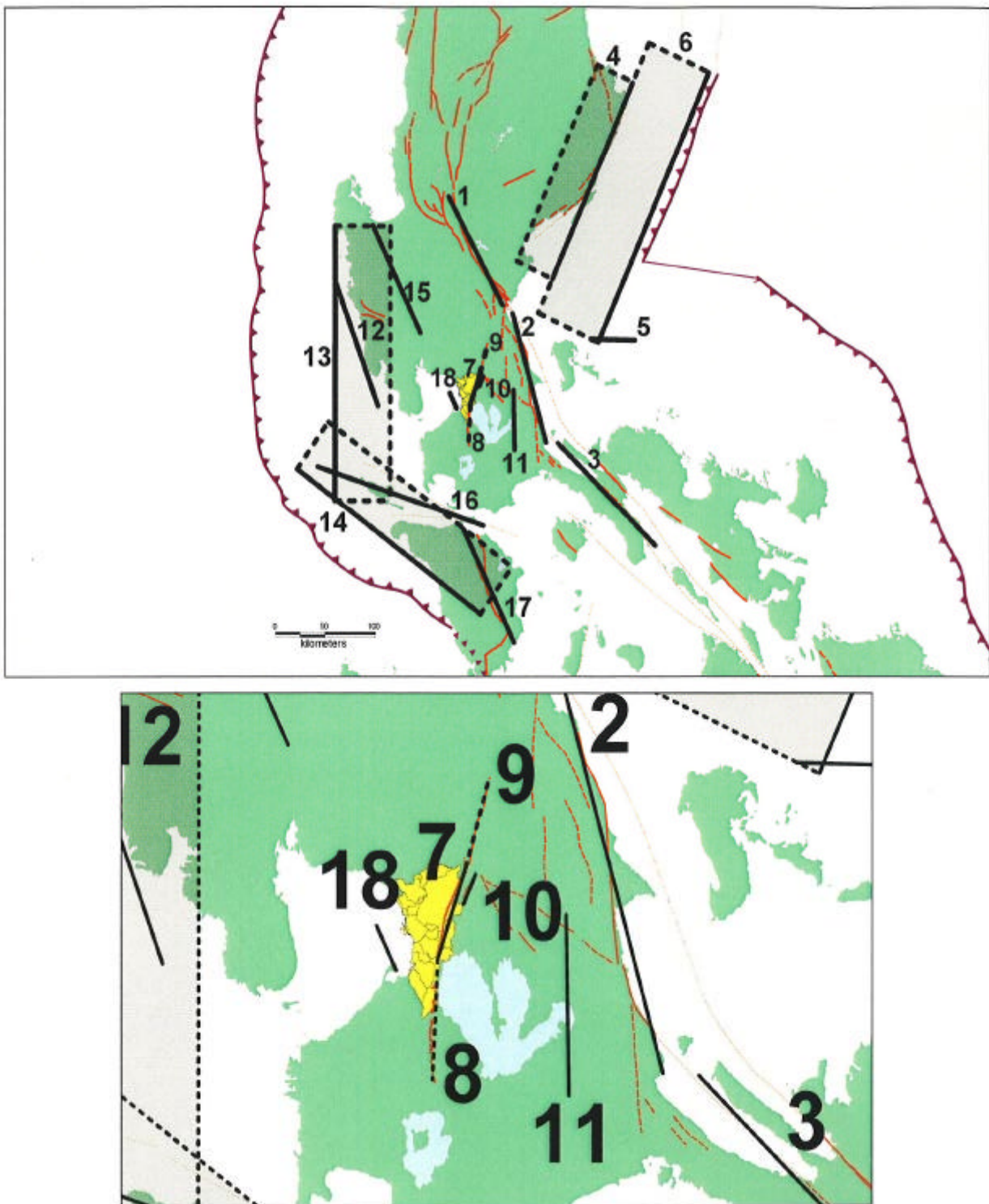


Figure 2.1.6 Scenario Earthquake Fault Models for Hazard Estimation

Source : PHIVOLCS and Study Team

Table 2.1.2 Fault Model Parameters of Scenario Earthquakes for Hazard Estimation

No.	Fault Name	Tectonics	Style	Magnitude	Fault Length (km)	Fault Width (km)	Dip Angle	Depth (km)	Past Earthquakes along the Fault	
									Y.M.D	Ms
1	PFZ: Digdig Segment	Crustal	SS	7.9	115	26	90	2	1645.11.30 1990.07.16	7.9 7.8
2	PFZ: Infanta Segment	Crustal	SS	7.6	125	27	90	2	1880.07.18	7.6
3	PFZ Ragay Gulf Segment	Crustal	SS	7.6	137	28	90	2	1824.10.26 1973.03.17	7.4 7.3
4	Casinguran Fault	Subduction	R	7.8	200	58	45	35	1968.08.01 1970.04.07	7.3 7.3
5	E-W Transform Fault	Crustal	SS	7.0	44	17	90	0	1970.04.12	7.0
6	East Luzon Trough	Subduction	R	8.0	275	71	25	0		
7	West Valley Fault	Crustal	SS	6.8	30	15	90	2	1658.08.19	5.7
8				7.2	67	21				
9				7.4	96	24				
10	East Valley Fault	Crustal	SS	6.3	10	9	90	2	1771.02.01	5.0
11	Laguna-Banahaw Fault	Crustal	SS	7.5	56	19	90	2	1937.08.20	7.5
12	West Boundary Fault	Crustal	R	7.5	120	42	90	0		
13	Manila Trench (16-14N)	Subduction	R	7.9	255	68	40	40	1677.12.07	7.3
14	Manila Trench (14-12.5N)	Subduction	R	7.9	227	63	35	35	1972.04.25	7.2
15	East Zambales Fault	Crustal	SS	7.4	110	26	90	2		
16	Lubang Fault	Crustal	SS	7.7	175	31	90	0	1942.04.08	7.5
17	Central Mindoro Fault	Crustal	SS	7.5	116	26	90	2		
18	1863 Earthquake	Crustal	SS	6.5	15	11	90	2	1863.06.03	6.5

SS : Strike Slip, R : Reverse Fault

2.1.5 Earthquake Ground Motion

The distribution of ground motion, seismic intensity, liquefaction potential, and slope stability were calculated for these 18 scenario earthquakes. Three modes, model 08 (West Valley Fault), Model 13 (Manila Trench), Model 18 (1863 Manila Bay), are selected for detailed mag analysis because these scenario earthquakes show typical and severe damages to Metropolitan Manila.

The distributions of the seismic intensity in PHIVOLCS Earthquake Intensity Scale (PEIS) for the three models are shown in Figure 2.1.7. Table 2.1.3 shows definition of the PEIS. Corresponding Modified Mercalli Intensity (MMI) and Japan Metrological Agency Intensity (JMAI) are included in the table.

Table 2.1.3 PHIVOLCS Earthquake Intensity Scale (PEIS)

Intensity Scale	Description	MMI	JMAI
I	Scarcely Perceptible - Perceptible to people under favorable circumstances. Delicately balanced objects are disturbed slightly. Still Water in containers oscillates slowly.	I	0
II	Slightly Felt - Felt by few individuals at rest indoors. Hanging objects swing slightly. Still Water in containers oscillates noticeably.	II	1
III	Weak - Felt by many people indoors especially in upper floors of buildings. Vibration is felt like one passing of a light truck. Dizziness and nausea are experienced by some people. Hanging objects swing moderately. Still water in containers oscillates moderately.	III	2
IV	Moderately Strong - Felt generally by people indoors and by some people outdoors. Light sleepers are awakened. Vibration is felt like a passing of heavy truck. Hanging objects swing considerably. Dinner, plates, glasses, windows and doors rattle. Floors and walls of wood framed buildings creak. Standing motor cars may rock slightly. Liquids in containers are slightly disturbed. Water in containers oscillate strongly. Rumbling sound may sometimes be heard.	IV	2-3
V	Strong - Generally felt by most people indoors and outdoors. Many sleeping people are awakened. Some are frightened, some run outdoors. Strong shaking and rocking felt throughout building. Hanging objects swing violently. Dining utensils clatter and clink; some are broken. Small, light and unstable objects may fall or overturn. Liquids spill from filled open containers. Standing vehicles rock noticeably. Shaking of leaves and twigs of trees are noticeable.	V	3
VI	Very Strong - Many people are frightened; many run outdoors. Some people lose their balance. motorists feel like driving in flat tires. Heavy objects or furniture move or may be shifted. Small church bells may ring. Wall plaster may crack. Very old or poorly built houses and man-made structures are slightly damaged though well-built structures are not affected. Limited rockfalls and rolling boulders occur in hilly to mountainous areas and escarpments. Trees are noticeably shaken.	VI	4
VII	Destructive - Most people are frightened and run outdoors. People find it difficult to stand in upper floors. Heavy objects and furniture overturn or topple. Big church bells may ring. Old or poorly built structures suffer considerably damage. Some well-built structures are slightly damaged. Some cracks may appear on dikes, fishponds, road surface, or concrete hollow block walls. Limited liquefaction, lateral spreading and landslides are observed. Trees are shaken strongly. (Liquefaction is a process by which loose saturated sand lose strength during an earthquake and behave like liquid).	VII	4
VIII	Very Destructive - People panicky. People 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. Railway tracks are bent or broken. Tombstones may be displaced, twisted or overturned. Utility posts, towers and monuments may tilt or topple. Water and sewer pipes may be bent, twisted or broken. Liquefaction and lateral spreading cause man-made structure to sink, tilt or topple. Numerous landslides and rockfalls occur in mountainous and hilly areas. Boulders are thrown out from their positions particularly near the epicenter. Fissures and faults rupture may be observed. Trees are violently shaken. Water splash or stop over dikes or banks of rivers.	VIII, IX	5-6
IX	Devastating - People are forcibly thrown to ground. Many cry and shake with fear. Most buildings are totally damaged. Bridges and elevated concrete structures are toppled or destroyed. Numerous utility posts, towers and monument are tilted, toppled or broken. Water sewer pipes are bent, twisted or broken. Landslides and liquefaction with lateral spreadings and sandboils are widespread. The ground is distorted into undulations. Trees are shaken very violently with some toppled or broken. Boulders are commonly thrown out. River water splashes violently on slopes over dikes and banks.	X, XI	7
X	Completely Devastating - Practically all man-made structures are destroyed. Massive landslides and liquefaction, large-scale subsidence and uplifting of land forms and many ground fissures are observed. Changes in river courses and destructive seiches in large lakes occur. Many trees are toppled, broken and uprooted.	XII	7

Source: PHIVOLCS web site, <http://www.phivolcs.dost.gov.ph/Earthquake/Scale/peis.html>

MMI: Modified Mercalli Intensity

JMAI: Japan Metrological Agency Intensity

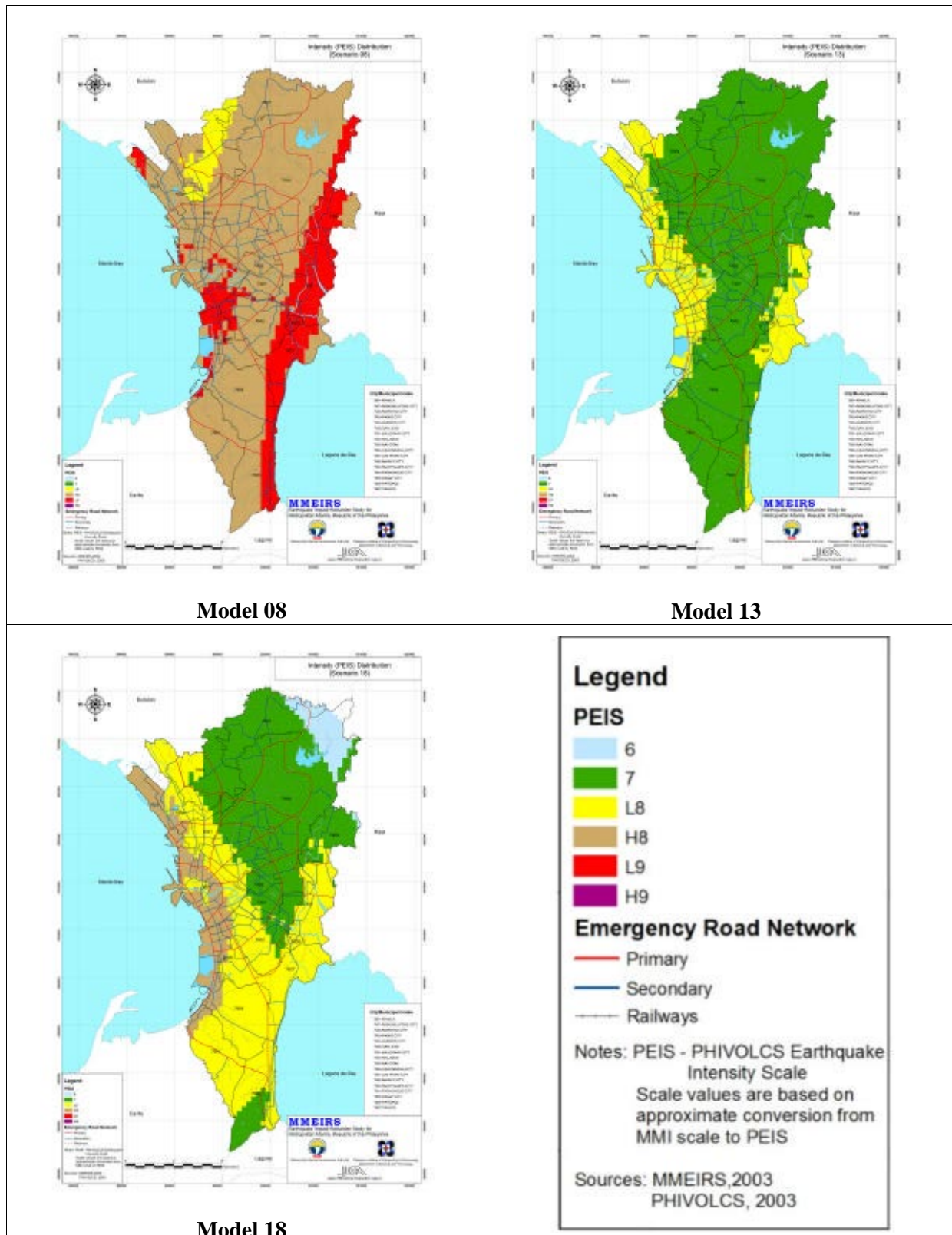


Figure 2.1.7 Distribution of Seismic Intensity in PHIVOLCS Earthquake Intensity Scale

2.2 Earthquake Damage and Urban Vulnerability

2.2.1 Summary of Earthquake Damage

Summary of earthquake damage for Model08, 13, 18 are shown in Table 2.2.1.

Table 2.2.1 Summary of Earthquake Damage

Scenario Earthquake		Model		Model 08	Model 13	Model 18	
		Magnitude		7.2	7.9	6.5	
		Fault Mechanism		Inland Fault	Subduction	Unknown	
Residential Building 1,325,896		Damage		Heavily	168,300 (12.7%)	1,900 (0.1%)	14,200 (1.1%)
				Partly	339,800 (25.6%)	6,600 (0.5%)	52,700 (4.0%)
Population 9,932,560		Casualty		Dead	33,500 (0.3%)	100 (0.0%)	3,100 (0.0%)
				Injured	113,600 (1.1%)	300 (0.0%)	9,500 (0.1%)
Fire		Outbreak		500	-	-	
		Burnt area and building		Wind Speed 3m/s	798 ha 42,100 buildings	-	-
				Wind Speed 8m/s	1,710 ha 97,800 buildings		
		Casualty		Wind Speed 3m/s	7,900 (0.1%)		
				Wind Speed 8m/s	18,300 (0.2%)	-	-
Bridge 213 (with detail inventory and stability analysis 189) Flyover 80 (with detail inventory and stability analysis 38)		Large possibility of falling-off		Bridge	7	0	0
				Flyover	0	0	0
		Moderate possibility of falling-off		Bridge	2	0	2
				Flyover	0	0	0
Water Supply Distribution Pipes Total 4,615km		Break of pipes or joints		4000 points	0 points	200 points	
Electric Power Transmission and Distribution Line Total 4,862km		Cut of cables		30 km	0 km	4 km	
PLDT Telephone Aerial Cable 9,445 km Underground Cable 3,906 km		Cut of cables		95 km	0 km	11 km	
Public Purpose Buildings (Hospital 177, School 1412, Fire Fighting 124, Police 43, MMDCC Organizations and 17 LGU City and Municipal Halls 53)		Heavily Damaged		8 - 10 %	0 - 0.2 %	0 - 1 %	
		Partly Damaged		20 - 25 %	0 - 0.3 %	2 - 3 %	
Mid-rise and High-rise Buildings		10-30 stories building 981		Heavily Damaged	11 %	0.3 %	2.3 %
				Partly Damaged	27 %	2.8%	9.2 %
		30-60 stories building 119		Heavily Damaged	2 %	0 %	0%
				Partly Damaged	12 %	0.1%	0.5%

Source: Study Team

2.2.2 Earthquake Damage Scenario During One Week from Occurrence of Earthquake

Earthquake damage scenario for Model 08 is shown in Table 2.2.2.

Basic Condition

Scenario earthquake: Model 08 (West Valley Fault, Magnitude 7.2)

Occurrence of earthquake: 7PM, wind speed 8m/sec.

Damage amount and situation are presented Section 2.1 and 2.2. These are translated into a script for better understanding. Lynn Paladio-Melosantos of PHIVOLCS, based upon damage data, developed the script. Script contents were discussed with the Study Team before being finalized.

Table 2.2.2 Earthquake Damage Scenario

Basic Condition		-Scenario earthquake: Model 08 (West Valley Fault, Magnitude 7.2) -Occurrence of earthquake: 7PM, wind speed 8m/sec.			
Items	0-1 hour	1-24 hours	1-3 days	3-7 days	7 days after
Buildings	<ul style="list-style-type: none"> 170,000 heavily damaged or collapsed (13% of total buildings) 340,000 moderately damaged (26% of total buildings) 10,000 Liquefaction affected building alongside of Manila Bay Damage ratio of concrete-made buildings is 9%, wooden-made buildings is 16% Damage ratio in squatter building is 27%. These figures include damaged caused by aftershocks 8 – 10% heavily damaged or collapsed 20-25% moderately damaged 	<ul style="list-style-type: none"> Residents begin to evacuate to slightly damaged public buildings Official function severely limited 	<ul style="list-style-type: none"> Public buildings are occupied with refugees Staffs can not reach to the Buildings Official function severely limited 	<ul style="list-style-type: none"> Public buildings are occupied with refugees Staffs can not reach to the Buildings Official function severely limited 	<ul style="list-style-type: none"> Debris removal
Hospital, school, fire fighting, police, government	<ul style="list-style-type: none"> 8 – 10% heavily damaged or collapsed 20-25% moderately damaged 	<ul style="list-style-type: none"> Residents begin to evacuate to slightly damaged public buildings Official function severely limited 	<ul style="list-style-type: none"> Public buildings are occupied with refugees Staffs can not reach to the Buildings Official function severely limited 	<ul style="list-style-type: none"> Public buildings are occupied with refugees Staffs can not reach to the Buildings Official function severely limited 	<ul style="list-style-type: none"> Temporary repairs initiated Debris removal
Mid-rise and High-rise	<ul style="list-style-type: none"> 11 % heavily damaged or collapsed, 27% moderately damaged for total of 1000 10-30 stories building 2% heavily damaged or collapsed, 12% moderately damaged for total of 100 30-50 stories building 	<ul style="list-style-type: none"> Many people are trapped in elevators by electric power failure Damage expands by aftershocks 	<ul style="list-style-type: none"> No power and water supply in not severely damaged buildings Habitation impossible in high-rise residences 	<ul style="list-style-type: none"> Public buildings are occupied with refugees Staffs can not reach to the Buildings Official function severely limited 	<ul style="list-style-type: none"> Temporary repairs initiated Debris removal
Dead	<ul style="list-style-type: none"> 34,000 dead, 90% of dead from pressure of collapsed building This figure includes trapped persons who are not rescued from collapsed buildings and die. Number of dead is small in squatter area 	<ul style="list-style-type: none"> 20,000 trapped in damaged building burnt to death Burnt to death in squatter area occurs Building Collapse by aftershocks make further dead people 	<ul style="list-style-type: none"> Persons trapped in the collapsed building are all dead. Some dead bodies are dug out Absolute limitation of burial Death of heavily injured persons as to limitation of appropriate medical treatment 	<ul style="list-style-type: none"> Persons trapped in the collapsed building are all dead. Some dead bodies are dug out Absolute limitation of burial Death of heavily injured persons as to limitation of appropriate medical treatment 	<ul style="list-style-type: none"> More dead bodies are dug out
Injured	<ul style="list-style-type: none"> 110,000 people with non-life-threatening injuries Trauma, fracture of a bone, visceral cleft caused by collapsed building and falling furniture Non structural elements fall from mid-rise and high-rise buildings 	<ul style="list-style-type: none"> Non structural elements fall from mid-rise and high-rise buildings 	<ul style="list-style-type: none"> Many crush syndromes occur to the rescued from collapsed building 	<ul style="list-style-type: none"> Many crush syndromes occur to the rescued from collapsed building 	<ul style="list-style-type: none"> Limitation of clean water Patients increasing by contamination, unsanitary living conditions, especially in infants Wounds become infected

Items	0-1 hour	1-24 hours	1-3 days	3-7days	7days after
Fire	Outbreak of Fire	<ul style="list-style-type: none"> Total 500 fire outbreak by electricity short circuit 70 in Manila, 60 Quezon, 50 in Pasig Fire from Factories, Hospitals, Residential Kitchens Petroleum leakage from storage tank LPG leakage from storage tank 	<ul style="list-style-type: none"> Explosion of LPG and petroleum and tanks by spreading of fire around Magnification of fire spreading 	<ul style="list-style-type: none"> New fire outbreaks occur by short circuit of resuming of power supply 	
	Spread of Fire	<ul style="list-style-type: none"> Not occurred yet 	<ul style="list-style-type: none"> Fire hydrants incapable Fire engine unreachable to the fire areas because of congested or debris-blocked roads Fire fighting system incapable 100,000 (7%) residential building in 1,700 hecter area burned out Heavy smoke causes respiratory illnesses 	<ul style="list-style-type: none"> Fire almost extinguished 	
Lifelines	Water Supply	<ul style="list-style-type: none"> Failure of water supply caused by damage to water supply pipe at 4,000 points 	<ul style="list-style-type: none"> Failure of water supply over the whole city 	<ul style="list-style-type: none"> Damages to Angat reservoir and water purification plant causes stopping of water supply for long term 	
	Electricity Supply	<ul style="list-style-type: none"> Electric transmission facilities, electric transformer substation on the fault is damaged Total 30km snapping of cables Many snapping of cables caused by building collapse 	<ul style="list-style-type: none"> Partially recovering in area of building damage is not severe 	<ul style="list-style-type: none"> Damages to transformer substation is not recovered Power failure continues over the whole city 	
	Telephone	<ul style="list-style-type: none"> Total 100km snapping of cables Many snapping of cables caused by building collapse Cellular phone broken off as results of damages to base transceiver station Telephone and cellular phone service is congested and out of use 	<ul style="list-style-type: none"> Telephone services suspended over the whole city Suspended area expands by spread of fire 	<ul style="list-style-type: none"> Partially recovering applying emergency backup generators Limitation of available fuel for the generator Limited time of telephone 	
Transportation	Airports	<ul style="list-style-type: none"> Runway slightly damaged Some loss of function in airport facilities 	<ul style="list-style-type: none"> Closure of runway Only helicopter available Poor visibility by fire haze 	<ul style="list-style-type: none"> Runway reopening Incapable Instrumental landing system by electricity problem Only daytime visual flight 	
	Ports and Harbors	<ul style="list-style-type: none"> Wharfs in Northport, Southport and Container terminal are damaged and tilted by liquefaction Damages to cargo-handling machine 	<ul style="list-style-type: none"> General shipping impossible to come alongside the pier Incapable loading and unloading 		
Central Government	Roads and Bridges	<ul style="list-style-type: none"> Total of 9 bridges damaged One in Pasig River, One in Marikina River, One in Manggahan Floodway 	<ul style="list-style-type: none"> Fire occurs from vehicles left on roads 	<ul style="list-style-type: none"> Almost all roads are occupied with vehicles Almost all roads are disabled Many people having difficulty in returning to their residence 	
		<ul style="list-style-type: none"> Residential buildings around the Maracanang Palace, the Upper House are severely damaged Liquefaction around The Lower House area MMDA building severely damaged 	<ul style="list-style-type: none"> Danger to fire spreading to the Maracanang Palace 	<ul style="list-style-type: none"> Public buildings are occupied with refugees Staffs can not reach to the Buildings Official function stopped 	

1) Day 1

Evening. August 26, 2003 is a typical Tuesday, the traffic, the crowd, the sunset at 6:14 as announced by PAGASA. Except that today you are not coming home from work, but from the WORKSHOP at Shangrila Hotel. You are almost home, looking forward to a simple *tinolang manok* that you know is stewing in your kitchen.

You get off from the bus and navigate your village road. As you are walking the last few meters to your gate, you feel a sudden jolt. It sort of pushes you forward. At first you don't know what it is. But the ground continues shaking, up and down, sideways, getting stronger every second. You fall to the ground, unable to keep standing. You hear a booming sound. You hear screams from people inside their homes. You hear breaking glasses. Telephone and power poles sway violently. Then the power goes off. In front of you, the village road is heaving, as if you are riding waves. The strong ground shaking goes on for 50 seconds. It is the longest 50 seconds of your life.

The ground shaking has stopped but you remain on the ground, still feeling dizzy. You try to get up, your knees shake under you. People start pouring out of their homes. Panic and confusion are everywhere. Occasional cries and wails add to the confusion. Around you are toppled poles and fences, collapsed houses, cracked roads, broken water pipes.

You go home as quickly as you can. You recognize your family amongst the crowd on the village street. They are all home, shaken but unhurt. You let out a sigh of relief and say a prayer of thanks. But your family refuses to enter your home. A barangay leader gives instructions to you and your neighbors to move to the basketball court to keep away from objects that may fall or topple.

You move your family as instructed. You try to make a call to other relatives but your mobile phone has no signal. Still you dialed a number. It didn't work. You finally walked back to check your home. But home is something you barely recognize. Everything seems to be piled up on the floor – appliances, shelves, books, lighting fixtures, family portraits, clothes, your prized Jollibee collectibles, even the *tinola* dinner.

Among the pile of mess on the floor, you pick up the old battery-operated transistor radio that your mother-in-law refuses to part with. You turn it on. At first you only get static. You play with the dials and catch this piece of news: PHIVOLCS issued a bulletin that says a devastating earthquake, with magnitude 7.2 generated by the nearby West Valley Fault, hit Metropolitan Manila. The ground shaking was felt at PEIS VIII in Metropolitan Manila. Weak to strong aftershocks are expected.

You rummage for blankets and go back to the basketball court. You try to think happy thoughts knowing this would be a very long night. You stay tuned in to the radio. News trickles in.

-
- There is a major power outage in Metropolitan Manila as well as in the neighboring provinces in Luzon.
 - Telephone lines, including cellular networks, are down.
 - Many residential houses are heavily damaged and collapsed
 - Some school buildings collapsed.
 - A few hospitals are heavily damaged, ICU patients need to be transferred, and other patients need to be evacuated.
 - Fires broke out in several residential clusters, chemical plants, and few other factories and hospitals.
 - Hundreds, if not thousands, are estimated trapped dead or injured from collapsed or burning houses, buildings and factories.
 - Abandoned cars, some damaged by falling objects, littered the streets of Metropolitan Manila.

Within the next few hours after the earthquake, the National Disaster Coordinating Council convened. Not all the member agencies have representatives immediately available.

2) Day 2-3

You are one of the more fortunate. No one is injured in your household. But your house is damaged and you are not sure if it will survive the next strong aftershock. Also, food and drinking water are becoming scarce. The barangay leaders and community members work together to provide for everyone.

Overnight you felt several moderate to weak after shocks. There is still no electricity, telephone communication, and water. Haze from burning buildings darkens the horizon. Fires still spread unabated.

News reports give more dismal picture of the extent of damage brought by the earthquake:

The President declares a state of calamity. She mobilizes the Armed Forces of the Philippines for rescue, clearing of debris, and construction of temporary shelters. She suspends schools and offices.

Philippine flags fly at half-mast.

PHIVOLCS confirms movement of the West Valley Fault after it conducted an aerial survey over Metropolitan Manila.

Volunteer rescue groups from Olongapo and Baguio City coordinate with the NDCC.

Back-up power generators are available only in critical public and private offices.

There are more reports of collapsed houses, now numbering in the thousands, mid- to high-rise buildings, and major bridges

Many roads are impassable.

The LRT and MRT railways remain standing but not operational.

Reports of casualties continue to rise to several thousands.

Several thousand families have lost their homes and begin to occupy open spaces.

People rescued from collapsed buildings show crush syndromes and given medical attention on site in temporary medical shelters. They cannot be transferred immediately to hospitals because ambulances cannot get through the roads littered with debris and cars.

The police contain random acts of looting.

3) Day 4-7

You continue to occupy the basketball court. There is still no power, communication and water supply.

In the tent clusters that sprouted in parks and other open spaces, the lack of clean water supply makes the outbreak of infectious diseases a threat.

In hospitals, injured patients are lined up even along corridors. Again, the lack of clean water is a major problem.

Many people, especially children, suffer from shock, traumatized by the strong ground shaking, the sight of destruction, or being temporarily trapped.

Bodies exhumed from rubbles are lined up along the streets. The air has the distinct smell of decay.

International volunteer rescue teams coordinate with the NDCC. Rescue will continue in the next few days.

Clearing of debris will continue for several weeks to months. Bodies will continue to be recovered among building debris.

Relief goods are distributed in evacuation centers. Some evacuation centers receive more relief goods than others.

Neighboring Asian countries pledge and extend technical, medical and other forms of support.

The Government appeals to those with capabilities to join forces in responding to the disaster.

Recovery and rehabilitation will take years and years.

2.3 Regional Urban Vulnerability

2.3.1 Approach

Understanding the urban earthquake vulnerability correctly together with urban structure is important in order to come up with appropriate measures for reducing level of vulnerability. In relation to this, regional vulnerability evaluation aims to achieve the following:

- 1) An index for planning an earthquake prepared city
- 2) A reference for selecting the regions for establishing projects on earthquake measures, and
- 3) A tool of understanding the urban earthquake vulnerability for the community members, to raise awareness

Among the earthquake scenario prepared for this study, Model 08, the West Valley Fault model, will cause the most damages Metropolitan Manila. Once the urban structure is being prepared for the impact of the Model 08 earthquake, it will also be prepared for less destructive earthquake scenarios. Therefore, Model 08 was applied for consideration.

Three indices, building collapse, flammability, and evacuation difficulty, were used for determining the existing vulnerabilities for earthquakes in the region. Lastly, an evaluation on the comprehensive regional vulnerability is also added to understand the foremost vulnerable areas within Metropolitan Manila. Simplified flow of this analysis is shown in Figure 2.3.1.

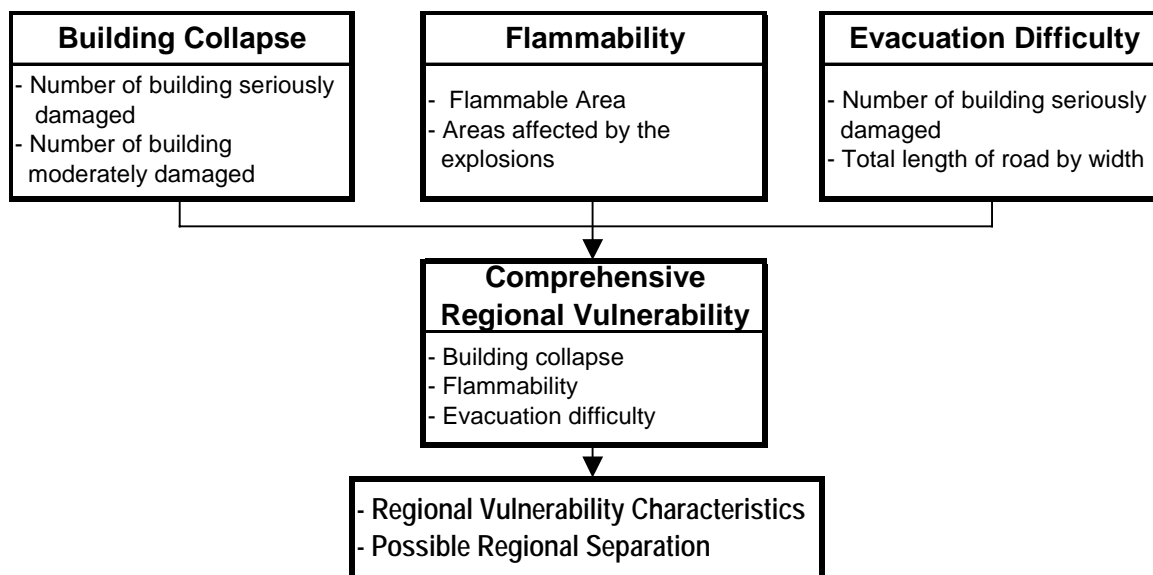


Figure 2.3.1 Flow of the Regional Vulnerability Evaluation

2.3.2 Comprehensive Regional Vulnerability and its Characteristics

Comprehensive regional vulnerability evaluation was done to show the areas with high vulnerability for all three kinds of vulnerabilities - building collapse, flammability, and, evacuation difficulty.

The comprehensive evaluation gives an idea which areas of Metropolitan Manila have the highest vulnerability during earthquake occurrences. This is important for administrative and planning purposes, and for the awareness of community members of their living environment. Areas with high vulnerability are priority areas for consideration in plans to reduce the earthquake impacts.

The characteristics of the comprehensive regional vulnerability are also expressed by integrating the result of three vulnerabilities. The figure of regional vulnerability characteristics (Figure 2.3.2 and Figure 2.3.3) are the simplified expression of the region, for people to understand easily the characteristics of the vulnerabilities facing the area.

The three indices were accumulated and re-classified by equal intervals to indicate the degree of vulnerability. For the creation of regional vulnerability characteristics, areas with high vulnerability, for (ranks 4 and 5), for all indices on building collapse, flammability, evacuation difficulty, and comprehensive regional vulnerability were taken into account.

Comprehensive Regional Vulnerability

Figure 2.3.2 shows the comprehensive regional vulnerability. Warmer colored area shows higher vulnerable rank. This figure indicates that there are 9 areas to pay most attention to among the Metropolitan Manila as for the comprehensive regional vulnerability. Those areas are summarized in Table 2.3.1.

Table 2.3.1 Area of High Vulnerability

1) Navotas Bay Area	6) Western Marikina City Area
2) Manila North Port Area	7) Eastern Pasig City Area
3) South Eastern Manila City Area	8) Muntinlupa Laguna Bay Area
4) Central Manila Bay Area	9) Mandaluyong - Makati City Border Area
5) North Eastern Quezon City Area	

Regional Vulnerability Characteristics

Figure 2.3.3 shows the regional vulnerability characteristics. Metropolitan Manila has vulnerability characteristics as described in Table 2.3.2.

Table 2.3.2 High Vulnerable Area by Type

Type of Vulnerability	Area	
Flammability and Evacuation Difficulty	1) Navotas Bay Area 2) Manila North Port Area	3) South Eastern Manila City Area 4) Central Manila Bay Area
Building Collapse and Evacuation Difficulty	1) North Eastern Quezon City Area 2) Western Marikina City Area 3) Eastern Pasig City Area	4) Muntinlupa Laguna Bay Area 5) Mandaluyong Makati City Border Area
Flammability	1) Valenzuela-Kalookan South-Quezon west intersection	
Evacuation Difficulty	1) Metropolitan Manila Fringes - Northern Fringe	- Taguig Fringe - Las Pinas Fringe

2.3.3 Possible Regional Separation

The proposed emergency road network was overlain onto the comprehensive regional vulnerability map to determine the possible separation of areas in Metropolitan Manila because of earthquake impact. Results are shown in Figure 2.3.4. Obviously, roads crossing or passing through the high vulnerable areas are with a high probability of becoming impassable. Overall, by analyzing passable and impassible roads, it can be deduced that Metropolitan Manila will possibly be separated into four regions by the earthquake impact. Reasons for regional separation are summarized below.

MM West

Western part of Metropolitan Manila will be isolated from other part of Metropolitan Manila by fire and building collapse

MM North, and MM South

Northern and Southern part of Metropolitan Manila will be separated by the building collapse and the geographical condition. The area between Mandaluyong and Makati has a high possibility of building collapse; Moreover, Pasig River is running east-west which is naturally disadvantageous in terms of separation.

MM East

All road networks running east-west, which are on the fault will be broken due to the movement. Other roads running north-south near in fault areas will be difficult to use, due to the high number of building collapse.

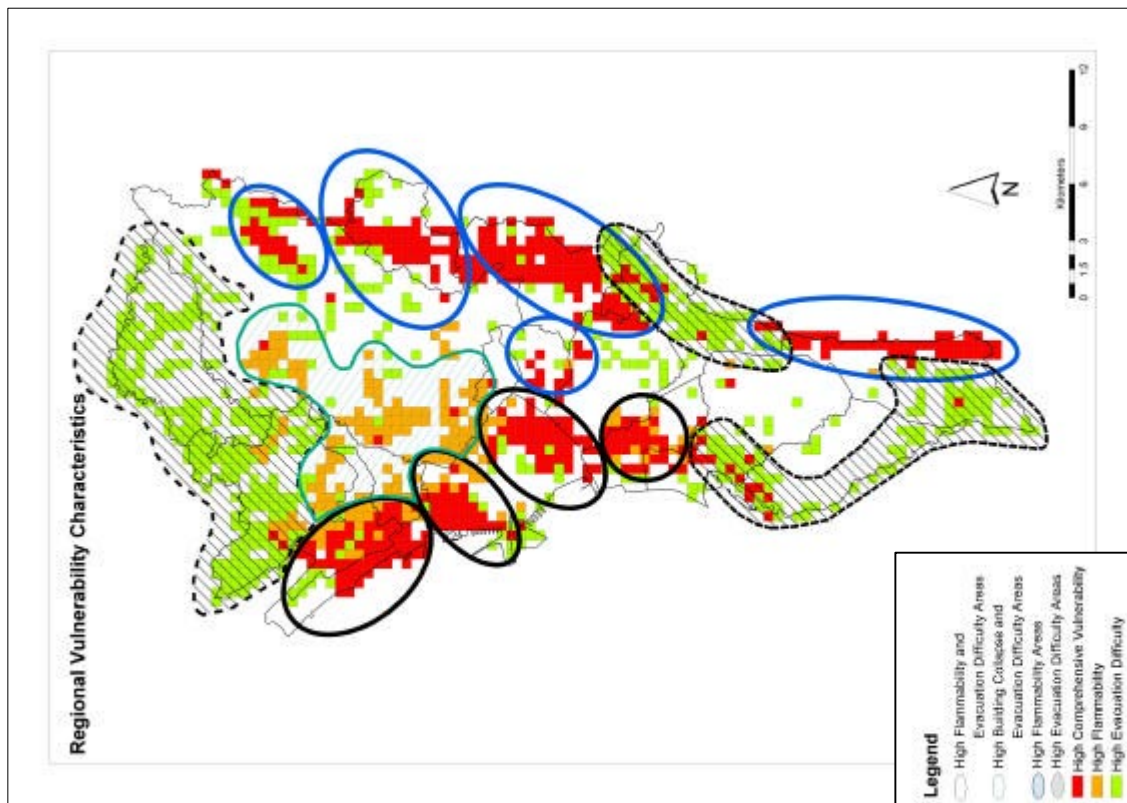


Figure 2.3.3 Regional Vulnerability Characteristics

Source: JICA Study Team

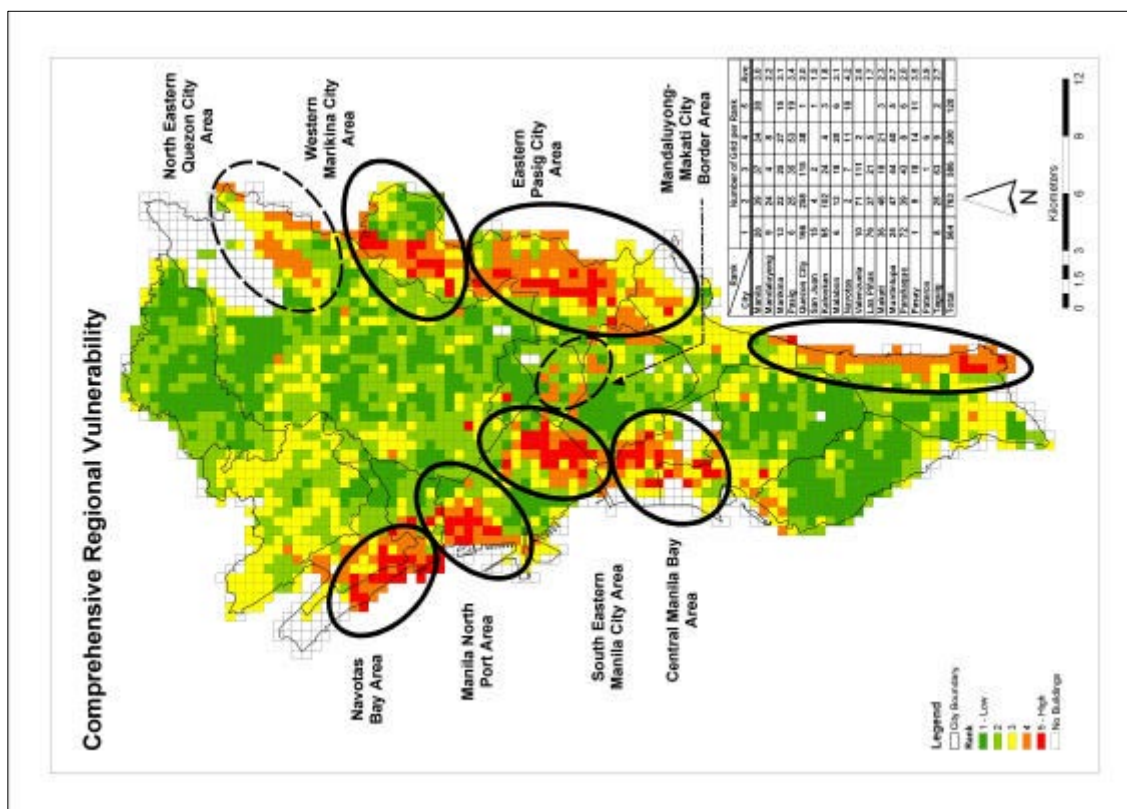


Figure 2.3.2 Comprehensive Regional Vulnerability

Source: JICA Study Team

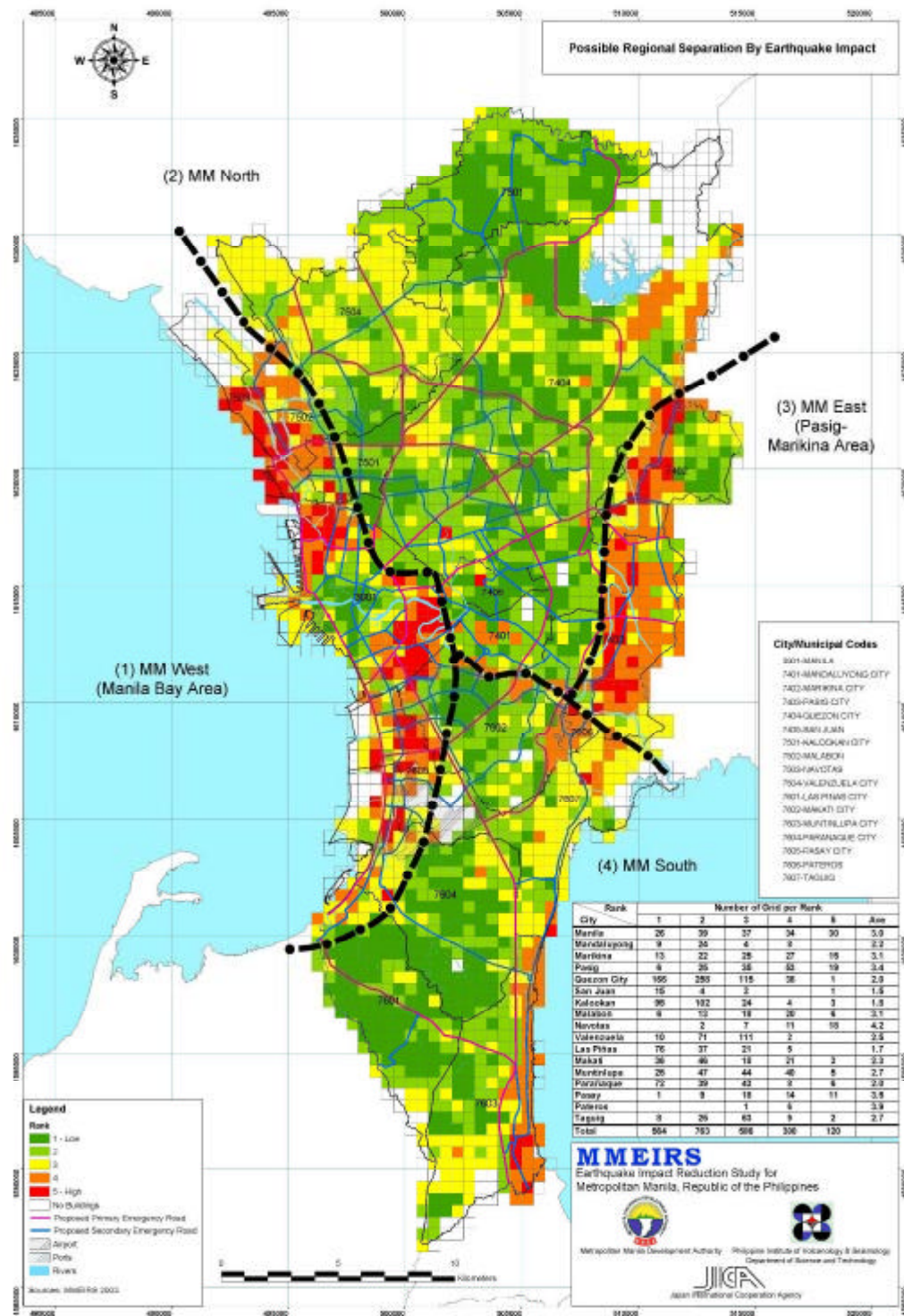


Figure 2.3.4 Possible Regional Separation by Earthquake Impact

Source: JICA Study Team

2.4 Facts and Damage Estimation by LGUs

1) Social Condition (Population & Land Use Condition) of LGU

City/ Municipality	Population		Population Growth 95-00	Total Land Area (GIS)	Residential				Commercial Area		Industrial Area		Open Area (Parks, Open Spaces)		Subdivision			
	1995	2000			Residential		Informally Occupied Area		Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)
					Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)										
Manila	1,654,761	1,581,082	-0.91	4,128	1,526	37.0	89	2.2	574	0.04	353	8.5	247	6.0	224	5.4		
Mandaluyong	286,870	278,474	-0.59	1,107	468	42.3	18	1.6	150	0.05	196	17.7	125	11.3	245	22.2		
Marikina	357,231	391,170	1.83	2,265	1,466	64.7	0.5	0.0	63	0.02	214	9.4	177	7.8	916	40.5		
Pasig	471,075	505,058	1.40	3,188	1,477	46.3	13	0.4	317	0.06	631	19.8	403	12.6	581	18.2		
Quezon	1,989,419	2,173,831	1.79	16,533	7,864	47.6	1,211	7.3	1,027	0.05	852	5.2	666	4.0	4,792	29.0		
San Juan	124,187	117,680	-1.07	588	426	72.4	6	1.0	63	0.05	24	4.2	11	1.8	140	23.8		
Valenzuela	437,165	485,433	2.12	4,452	3,547	79.7	54	1.2	216	0.04	409	9.2	696	15.6	1,496	33.6		
Kalookan	1,023,159	1,177,604	2.85	5,312	746	14.0	44	0.8	45	0.00	260	4.9	116	2.2	161	3.0		
Malabon	347,484	338,855	-0.50	1,596	278	17.4	38	2.4	4	0.00	140	8.8	2	0.2	34	2.1		
Navotas	229,039	230,403	0.12	1,095	1,572	143.5	28	2.5	86	0.04	1,061	96.9	1,008	92.1	378	34.6		
Las Pinas	413,086	472,780	2.74	3,227	2,040	63.2	-	0.0	252	0.05	190	5.9	667	20.7	1,576	48.8		
Makati	484,176	444,867	-1.68	3,196	1,633	51.1	6	0.2	579	0.13	66	2.1	189	5.9	784	24.5		
Muntinlupa	399,846	379,310	-1.05	3,813	1,917	50.3	12	0.3	377	0.10	303	7.9	926	24.3	1,255	32.9		
Paranaque	391,296	449,811	2.83	4,561	2,796	61.3	12	0.3	315	0.07	327	7.2	593	13.0	1,524	33.4		
Pasay	408,610	354,908	-2.78	1,778	569	32.0	10	0.6	154	0.04	26	1.5	353	19.9	11	0.6		
Pateros	55,286	57,407	0.76	195	153	78.5	-	0.0	6	0.01	1	0.4	4	1.8	4	2.0		
Taguig	381,350	467,375	4.15	2,752	1,163	42.3	18	0.6	13	0.00	342	12.4	158	5.8	181	6.6		
Total	9,454,040	9,906,048	0.94	59,786	29,642	49.6	1,559	2.6	4,241	0.04	5,396	9.0	6,341	10.6	14,301	23.9		

Source: JICA Study Team

Note: 1) Population 1995, 2000 Philippine Year Book; Population 2000 is based on the data provided by NSO, 2) Land area is calculated based on the GIS, 3) Subdivision map was provided by ALMEC 1996, 4) Land use area is calculated by the 2003 Landuse Map

2) Building Distribution of LGU

City / Municipality	Total Building Numbers	Classification of Buildings				Construction Year				
		CB	CW	W	S	Earlier than 1960	1961-1970	1971-1980	1981-1990	1991-2000
Manila	168,528	45,830	66,741	32,428	23,529	32,651	20,061	25,156	33,269	32,507
Mandaluyong	32,942	9,778	13,195	5,102	4,868	2,959	3,471	5,175	7,627	9,809
Marikina	53,422	30,298	13,473	6,552	3,100	2,632	4,249	8,562	15,065	18,314
Pasig	72,143	32,487	19,194	14,648	5,814	3,147	4,700	10,290	18,756	27,283
Quezon	302,818	141,287	88,738	35,797	36,995	15,709	18,636	41,915	82,085	109,616
San Juan	11,793	4,480	3,930	2,145	1,238	2,672	1,652	1,642	1,659	1,931
Valenzuela	62,778	33,781	15,148	8,357	5,492	7,702	8,356	14,865	51,013	71,864
Kalookan	168,480	87,830	44,065	18,295	18,290	4,162	4,713	8,260	13,960	15,119
Malabon	51,694	16,160	14,884	13,268	7,382	2,726	2,317	6,326	9,995	11,293
Navotas	35,124	9,145	10,037	9,244	6,698	2,290	3,703	8,920	16,880	23,176
Las Pinas	73,919	40,028	13,194	13,149	7,549	1,072	2,852	11,451	23,351	29,925
Makati	50,381	23,862	15,169	6,529	4,821	5,764	6,070	7,235	11,813	12,406
Muntinlupa	55,522	25,152	13,749	8,983	7,638	1,506	2,485	8,290	18,522	19,979
Paranaque	72,230	34,099	17,253	14,037	6,842	2,935	3,522	9,242	21,432	28,051
Pasay	39,968	13,225	14,895	6,931	4,917	4,693	4,567	7,114	9,894	8,089
Pateros	8,726	3,650	2,540	1,641	895	912	1,124	1,756	2,071	2,242
Taguig	65,428	34,859	14,548	9,797	6,224	1,485	2,193	7,855	19,439	29,508
Total	1,325,896	585,952	380,751	206,904	152,292	95,017	94,671	184,054	356,831	451,112

Source: JICA Study Team

Note: 1) CB: Concrete/Brick/Stone, 2) CW: Half concrete/brick/stone/and half wood, 3) W: Wood, 4)S: Galvanized iron, Makeshift/Salvaged

3) Road Distribution by LGU

City/ Municipality	Road length (km)				Road ratio (%)		
	0-6m	6-12m	12m+	Total	Narrow (0-6m)	Moderate (6-12m)	Wide (12m+)
Manila	44	579	26	650	6.8	89.1	4.1
Mandaluyong	1	432	29	462	0.1	93.5	6.4
Marikina	1	439	73	513	0.2	85.5	14.3
Pasig	12	151	7	170	6.8	89.0	4.2
Quezon	2	124	18	145	1.4	86.0	12.6
San Juan	36	569	142	747	4.8	76.2	19.0
Valenzuela	3	336	11	351	0.9	95.8	3.3
Kalookan	8	341	47	396	2.0	86.0	12.0
Malabon	14	72	6	92	15.3	78.3	6.4
Navotas	2	540	52	594	0.4	90.9	8.7
Las Pinas	2	149	44	196	1.1	76.3	22.6
Makati	2	365	32	400	0.6	91.4	8.0
Muntinlupa	1	17	2	19	5.1	86.7	8.2
Paranaque	59	1,654	190	1,903	3.1	86.9	10.0
Pasay	0	93	9	103	0.0	91.0	9.0
Pateros	1	249	10	260	0.4	95.6	4.0
Taguig	31	287	15	333	9.2	86.4	4.4
Total	219	6,398	715	7,331	3.0	87.3	9.7

Source: JICA Study Team

4) Land Damage Area of LGU (Earthquake Scenario Model 08)

City/ Municipality	Land Areas		Damage Affected Areas									
	Published Area (sq. km.)	GIS Calculated Area (sq.km.)	Rate of Area by MMI (%)			Rate of Area by PGA (gal)			Rate of Area by Liquefaction Potential (%)			
						300 - 600	600 - 1000	1000 - 1600	Low	Relatively Low	Relatively High	High
			8+	9+	10+							
Manila	38.3	41.3	16.2	83.8	0.0	51.2	48.8	-	37.9	2.4	29.1	28.6
Mandaluyong	26.0	11.1	0.0	100.0	0.0	78.8	20.5	0.7	18.6	0.0	0.8	4.6
Marikina	38.9	22.6	0.0	53.8	46.2	6.9	43.1	50.0	46.8	0.0	0.1	13.0
Pasig	13.0	31.9	0.0	44.9	55.1	20.7	53.9	25.4	33.7	0.0	17.8	30.3
Quezon	166.2	165.3	33.3	65.5	1.2	82.5	13.2	4.3	4.1	0.0	0.3	2.0
San Juan	10.4	5.9	0.0	100.0	0.0	100.0	-	-	0.0	0.0	0.0	11.6
Valenzuela	47.0	44.5	81.2	18.8	0.0	86.5	13.5	-	15.7	0.0	13.5	10.7
Kalookan	55.8	53.1	86.7	13.3	0.0	98.4	1.6	-	14.2	0.0	1.9	0.0
Malabon	23.4	16.0	42.9	57.1	0.0	62.5	37.5	-	45.4	3.1	21.1	7.3
Navotas	2.6	10.9	2.5	97.6	0.0	47.3	52.7	-	72.2	0.0	27.8	0.0
Las Pinas	41.5	32.3	34.0	66.0	0.0	92.9	7.1	-	1.5	2.1	3.2	0.9
Makati	29.9	32.0	0.0	98.4	1.6	48.8	50.3	0.9	18.5	0.9	1.8	4.6
Muntinlupa	46.7	38.1	0.0	85.9	14.1	38.1	54.3	7.6	26.8	0.2	1.6	0.0
Paranaque	38.3	45.6	0.0	100.0	0.0	60.8	39.2	0.0	0.6	0.0	16.9	8.5
Pasay	13.9	17.8	0.0	100.0	0.0	44.1	55.9	-	16.6	0.0	46.7	6.2
Pateros	10.4	2.0	0.0	100.0	0.0	98.8	1.2	-	0.0	0.0	37.9	60.9
Taguig	33.7	27.5	0.0	97.7	2.3	61.0	37.6	1.5	1.8	0.0	25.8	37.4
Total	636.0	597.8	-	-	-	-	-	-	-	-	-	-

Source: JICA Study Team

5) Building Damage and Casualty (Earthquake Scenario Model 08)

City/ Municipality	Population	Total Building Number	Building Damage				Casualty			
			Number (x 1,000)		Ratio		Number (x 1,000)		Ratio	
			Heavily	Partly	Heavily	Partly	Dead	Injured	Dead	Injured
Manila	1,581,082	168,528	24.6	50.1	14.6%	29.8%	6.0	19.8	0.4%	1.3%
Mandaluyong	278,474	32,942	4.3	9.6	12.9%	29.2%	1.0	3.4	0.4%	1.2%
Marikina	391,170	53,422	15.0	18.8	28.1%	35.1%	2.6	8.7	0.7%	2.2%
Pasig	505,058	72,143	22.8	25.6	31.5%	35.5%	3.4	11.8	0.7%	2.3%
Quezon	2,173,831	302,818	25.8	69.6	8.5%	23.0%	5.5	18.7	0.3%	0.9%
San Juan	117,680	11,793	1.2	3.1	9.8%	26.4%	0.4	1.1	0.3%	1.0%
Valenzuela	485,433	62,778	2.1	7.3	3.3%	11.6%	0.5	1.4	0.1%	0.3%
Kalookan	1,177,604	168,480	6.5	23.4	3.9%	13.9%	1.5	4.9	0.1%	0.4%
Malabon	338,855	51,694	4.3	11.7	8.2%	22.7%	0.8	2.8	0.2%	0.8%
Navotas	230,403	35,124	5.1	10.9	14.6%	31.0%	0.8	3.2	0.4%	1.4%
Las Pinas	472,780	73,919	5.9	16.7	8.0%	22.6%	1.2	4.0	0.3%	0.8%
Makati	471,379	50,381	8.9	16.4	17.7%	32.5%	2.3	7.5	0.5%	1.6%
Muntinlupa	379,310	55,522	13.3	19.0	24.0%	34.1%	2.0	7.5	0.5%	2.0%
Paranaque	449,811	72,230	9.0	20.9	12.4%	28.9%	1.7	5.6	0.4%	1.2%
Pasay	354,908	39,968	6.8	12.8	17.0%	32.1%	1.6	5.3	0.4%	1.5%
Pateros	57,407	8,726	1.6	2.9	18.8%	33.0%	0.3	0.9	0.5%	1.5%
Taguig	467,375	65,428	11.2	21.0	17.1%	32.2%	2.1	7.0	0.4%	1.5%
Total	9,932,560	1,325,896	168.3	339.8	-	-	33.5	113.6	-	-

Source: JICA Study Team

6) Fire Damage and Casualty (Earthquake Scenario Model 08)

City/ Municipality	Maximum Possible Burnout Area (ha)		Maximum Possible Burnout Building				Maximum Possible Fire Casualty Damage			
			Number (x 1,000)		Ratio		Number (x 1,000)		Ratio	
	Wind speed		Wind speed		Wind speed		Wind speed		Wind speed	
	3m/sec	8m/sec	3m/sec	8m/sec	3m/sec	8m/sec	3m/sec	8m/sec	3m/sec	8m/sec
Manila	216	450	13.7	31.0	8.1%	18.4%	3.0	6.8	0.2%	0.4%
Mandaluyong	33	70	1.7	4.0	5.1%	12.2%	0.3	0.7	0.1%	0.2%
Marikina	4	9	0.1	0.4	0.3%	0.8%	0.0	0.1	0.0%	0.0%
Pasig	35	74	2.2	5.0	3.1%	6.9%	0.7	1.6	0.1%	0.3%
Quezon	115	259	4.9	12.3	1.6%	4.1%	0.6	1.4	0.0%	0.1%
San Juan	21	43	0.5	1.3	4.6%	10.8%	0.1	0.2	0.1%	0.2%
Valenzuela	8	22	0.2	0.7	0.3%	1.1%	0.0	0.0	0.0%	0.0%
Kalookan	56	120	3.5	8.2	2.1%	4.8%	0.3	0.6	0.0%	0.1%
Malabon	54	114	3.2	7.3	6.1%	14.1%	0.3	0.7	0.1%	0.2%
Navotas	48	97	3.9	8.6	11.2%	24.4%	0.6	1.4	0.3%	0.6%
Las Pinas	18	38	0.8	1.7	1.0%	2.3%	0.1	0.2	0.0%	0.0%
Makati	53	116	2.0	4.9	4.0%	9.7%	0.7	1.6	0.1%	0.3%
Muntinlupa	35	78	0.8	2.0	1.4%	3.6%	0.2	0.6	0.1%	0.2%
Paranaque	39	82	1.5	3.5	2.1%	4.8%	0.2	0.6	0.1%	0.1%
Pasay	50	103	2.5	5.8	6.4%	14.4%	0.7	1.5	0.2%	0.4%
Pateros	3	7	0.2	0.5	1.8%	5.4%	0.0	0.1	0.1%	0.2%
Taguig	12	28	0.3	0.8	0.5%	1.3%	0.1	0.2	0.0%	0.0%
Total	798	1,710	42.1	97.8	-	-	7.9	18.3	-	-

Source: JICA Study Team

Chapter 3 Master Plan

CHAPTER 3. MASTER PLAN

3.1 Vision and Goals

3.1.1 The Vision -A Safer Metropolitan Manila from Earthquake Impact-

Since 1900, more than 30 earthquakes have caused some damage to Metropolitan Manila. Many faults have been identified around and within Metropolitan Manila, but the Valley Fault System that runs north to south along the west and east edges of the Marikina Valley is thought to pose the greatest threat to Metropolitan Manila due to its close proximity.

Of all the natural disasters that Metropolitan Manila has experienced throughout its history (such as tropical cyclones, droughts and floods, tsunamis, volcanic eruptions, and earthquakes), earthquakes pose the greatest threat to the life, property, and the economy. Since Metropolitan Manila is the leading city in the Philippines, and the center of governmental, financial, commercial, and social activities, the impact of a large earthquake in Metropolitan Manila will greatly affect the nation.

The damage estimation of a potential rupture of the West Valley Fault, is that 40% of the total number of residential buildings within Metropolitan Manila will be heavily or partly damaged, and the earthquake will cause approximately 34,000 deaths and 1,144,000 injuries. Moreover, fire spreading as a secondary effect of the earthquake will cause an additional 18,000 deaths.

The Metropolitan Manila area, together with neighboring provinces, is expected to grow continuously and reach 25 million inhabitants in the expanded urbanized area of 1,500 km² by 2015. This growing urbanization is creating unacceptable levels of an earthquake disaster in terms of both human and property losses. Therefore, the Metropolitan Manila Earthquake Impact Reduction Study was undertaken to develop a plan and strategies for “*A Safer Metropolitan Manila from Earthquake Impact*”.

3.1.2 The Goals

To achieve this vision, the Earthquake Impact Reduction Study for Metropolitan Manila presents six basic goals:

1) Develop National System Resistant to Earthquake Impact

Metropolitan Manila is the only mega urban center in the Philippines that includes the national functional backbone consisting of economic, financial, and information activities. Metropolitan Manila generates about 35% of the total GDP of the Philippines. Also, it is the seat of the Philippine national government including administrative, legislative, and judiciary functions, and international activities. With the rupture of the West Valley Fault, national functions will be paralyzed, and in the worst case, the earthquake will lead to chaos and disruption of the national

economy. Therefore, Metropolitan Manila needs to develop national systems resistant to earthquake impact through improvement and updating of existing systems. Especially targeted are the following: items for updating of regulations for earthquake disaster prevention, promotion of research and development for disaster prevention technology, capacity building for disaster response staff from national to community level, installation of modern equipment for disaster management agencies. Improvement and enhancement of these existing systems are to be implemented based on detailed plans.

2) Improve Metropolitan Manila's Urban Structure Resistant to Earthquakes

Recent earthquake damage in the urbanized areas in the world illustrate the extreme vulnerability of urban structures including buildings and infrastructure (such as roads, railways, port facilities), and lifelines (including electricity, telecommunication and water supply). Based on the damage estimation by West Valley Fault system rupture, it is estimated that 40% of the total residential buildings in Metropolitan Manila will be affected. Since building collapse causes the greatest number of deaths and injuries, the reinforcement and strengthening of buildings are a priority measure to reduce loss of life. Research and technology development on building structures and materials should also be promoted including improvement of building codes, development of design standard for low cost housing and cost-effective construction. Furthermore, building collapse is the major cause of fire breakouts, so building collapse in the highly fire-prone areas needs to be reduced. Existing urban structures in the severe damage estimation area should be improved through re-development of land use. Buildings should be constructed with higher resistive structures and fireproof materials. Location of open spaces and road widening should be involved for urban re-development. The results of the damage estimation of infrastructure and lifelines also show the possible impact to society. For example, malfunction of the port caused by the liquefaction or the collapse of bridges over the Marikina and Pasig rivers will greatly affect the transportation of people, goods and services to and from and within the Metropolitan area. The urban structure of Metropolitan Manila including transportation infrastructures and lifelines needs to be made resistant to earthquakes in order to reduce loss of life and associated impacts.

3) Enhance Effective Risk Management System

A great number of casualties and injuries are anticipated in the scenario of the West Valley Fault System rupture, but the actual number of losses will vary depending on the level of preparedness and effectiveness of the risk management and emergency response systems. Therefore, to reduce overall losses, an effective risk management system is necessary. Necessary actions include preventing secondary effects and damages, strengthening disaster management practices and response capacity, and ensuring access to critical information. Robust legal and institutional arrangements, including systems for inter-institutional coordination and clearly defined and

practiced roles of national, regional, city and municipal, and barangay level governmental and non-governmental entities, are essential to effective management of earthquake risk.

4) Enhance Community Disaster Management Capacity

In case of large disasters such as a major earthquake, most of the community members will not be reachable by public assistance immediately. Therefore, to protect community members from large earthquake impacts, it is important to maximize the preparedness and disaster response capacity of the community beforehand, through enhancement of social capital. Social capital in the Metropolitan Manila communities can be developed while recognizing community autonomy, local leadership, and community dynamics. This enhancement will be promoted through self-reliant and mutual-help risk management including disaster awareness through education and enlightenment.

5) Formulate Reconstruction Systems

To facilitate recovery and maximize the effectiveness of the reconstruction process of the damaged Metropolitan Manila, the preparation of recovery and reconstruction policies, strategies and procedures and their acceptance by the relevant agencies are indispensable. At present, the preparation of the risk management system is not fully developed for effective recovery and reconstruction. Nonexistence of a reconstruction structure and system will generate additional losses to the society and exacerbate inappropriate and vulnerable urban development. Both rehabilitation and reconstruction require careful planning and development to prevent further deterioration of urban structures and environmental degradation.

6) Promote Research and Technology Development on Earthquakes

For the promotion of earthquake impact reduction measures, analysis of present conditions and future projections related to earthquakes will play an important role. Especially, scientific research on large earthquake fault rupture mechanisms, return periods, and distribution of the active faults are important. The existing research and technology development system in the Philippines can be enhanced on earthquake science, earthquake engineering, geosciences under comprehensive those coordination. Especially mechanism of earthquake occurrence, estimation of earthquake motion, estimation of earthquake damages, comprehensive disaster condition estimation including secondary disaster are to be studied in depth.

3.2 The Plan

3.2.1 Overall Structure of the Plan

The Master Plan for Earthquake Impact Reduction sets forth basic policy and direction in pursuit of the vision of a safer Metropolitan Manila. The plan is a road map to achieve the vision. It contains 34 frameworks, each addressing specific goals and objectives. Each framework is not

only a stand-alone avenue to pursue improved levels of risk reduction but also a cross street interconnected with the other frameworks. The goals, objectives, and frameworks address Metropolitan Manila's most imminent earthquake disaster management issues. Existing earthquake disaster management systems in the Philippines is not enough to cope with expected earthquakes damages

The frameworks are presented in Chapter 5 of the main report. Each framework describes the following:

- Understanding / Concern
- Basic policy / Basic concept of framework
- List of action plans

The Basic policy / Basic concept of framework includes several strategies that are encapsulated in various action plans designed to lead to accomplishment of the framework's goal and objectives. The high priority of these action plans, or "Priority Action Plans," are then presented in Chapter 6 in a format that includes the aim and outline of the project and the implementing agency responsible for undertaking the action.

3.2.2 Plan Structure

Following table shows the structure of the Disaster Management Plan for Metropolitan Manila. As described above, to attain the vision of "A Safer Metropolitan Manila from Earthquake Impact", six goals have addressed. These goals have ten objectives, and then the objectives are broken down into thirty-four (34) frameworks in total. The frame works represent main policies and strategies to achieve goals and objectives. The framework contains 105 action plans. The action plans are prepared to put practice of the policies and strategies represented in the frameworks.

In this section, overview of the 34 frameworks are described. For the detailed description, the *Frameworks* are described in Chapter 5, and the *Action Plans* in Chapter 6 in the main report.

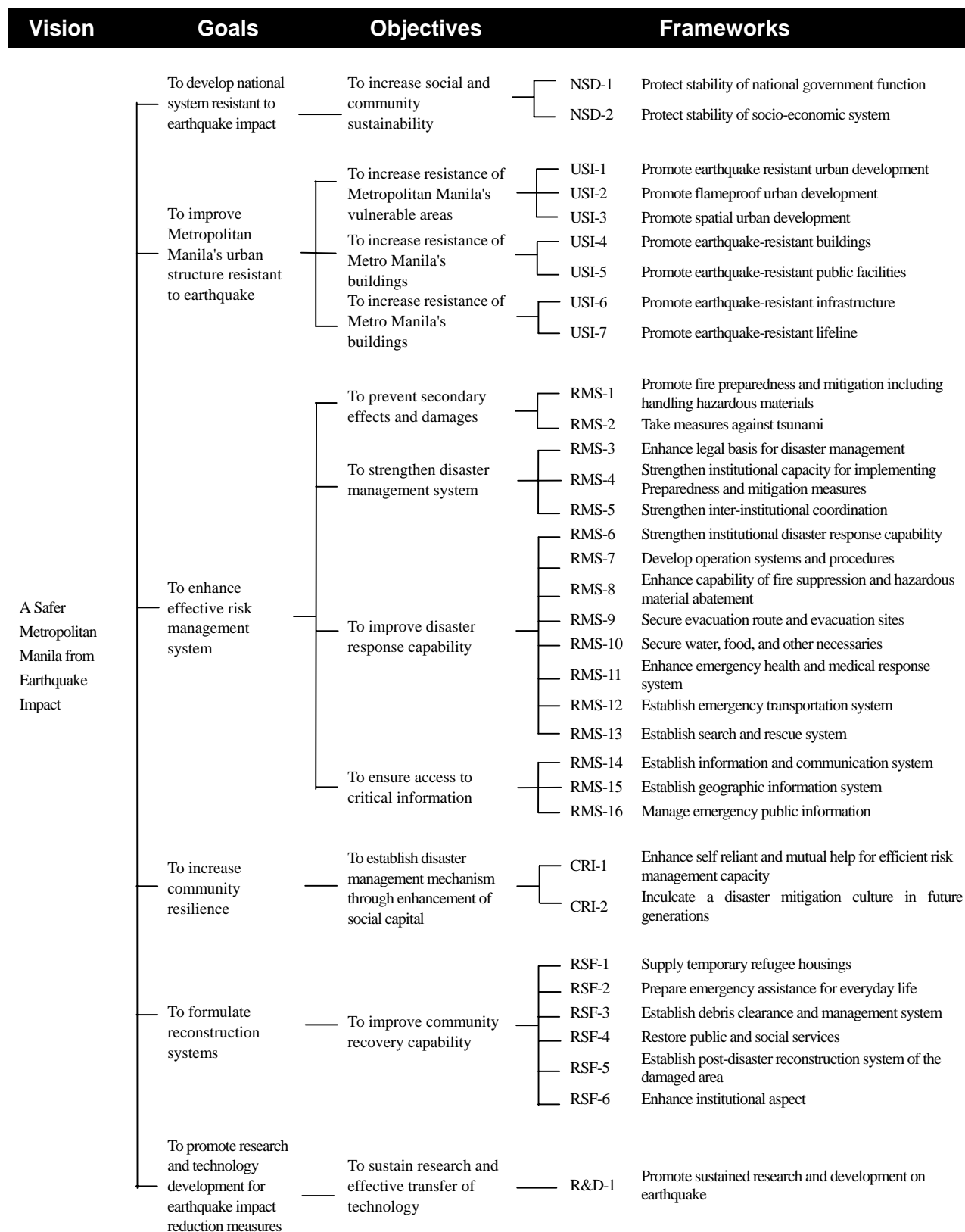
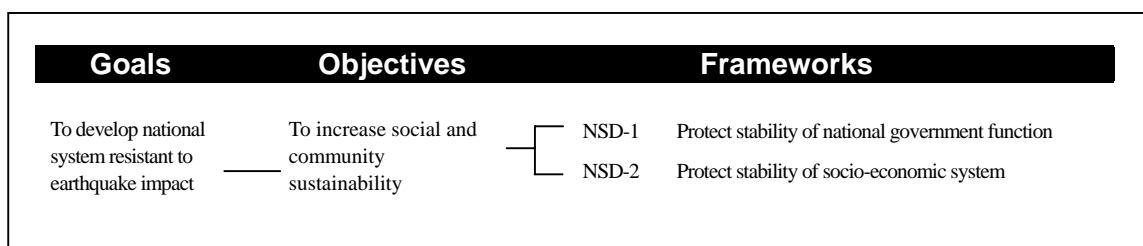


Figure 3.2.1 Structure of the Disaster Management Plan for Metropolitan Manila

3.3 Frameworks for the Earthquake Impact Mitigation

3.3.1 Development of National System Resistant to Earthquake Impact



Framework NSD-1: Protect Stability of National Government Function

■ **Understandings / Concerns:**

The Malacanang Palace and Congress, the Upper House (Senate) and the Lower House (House of Representatives), are standing on rather vulnerable area due to ground condition and earthquake motion. Consequently, for the purpose of maintaining the central function of the nation during emergency situations, it is definitely important to conduct seismic examination and retrofitting of related public buildings, to ensure temporary sites to accommodate government functions, and to ensure the access to the emergency road network.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Maintain the national function even in emergencies
- 2) Ensure telecommunication function and access to transportation network
- 3) Ensure the emergency service staff
- 4) Ensure the safety of the Malacañang Palace

■ **Action Plans:**

- Enhance security capability of National Government function with the Office of the President
- Promote urban reform around the important national facilities

Framework NSD-2: Protect Stability of Socio-Economic System

■ **Understandings / Concerns:**

47% of the houses in Metro Manila are estimated to be damaged or burnt, and about 3 million people will become refugee or homeless. The damage to infrastructure and lifelines will have a huge negative influence on the stability of socio-economic situation and on the function of the capital of the nation, which will spread all through the country.

■ **Basic Policy /Basic Concept of Framework:**

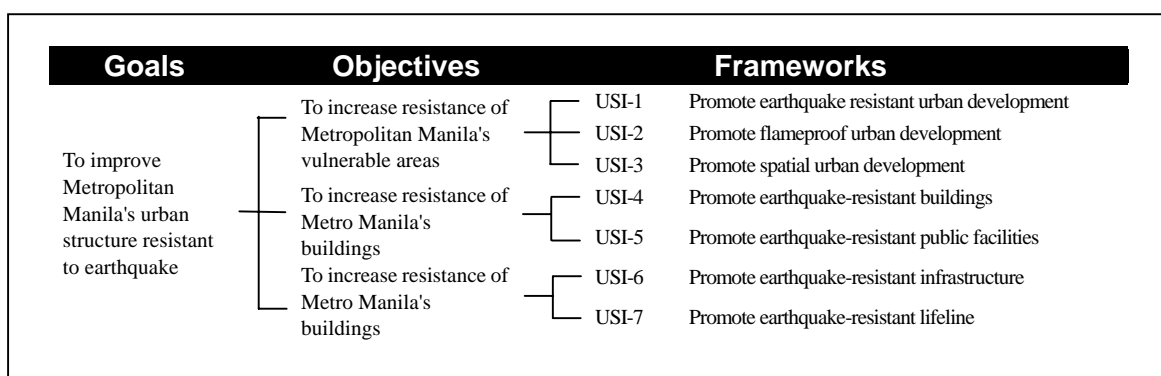
- 1) Strengthen office buildings, etc
- Assess seismic resistance of buildings
 - Establish back-up system of utilities

- 2) Enhance seismic-resistance of office equipment like computers
- 3) Decentralize business functions
- 4) Strengthen governments' emergency services capability

■ **Action Plans:**

- Enhance emergency measures of businesses
- Enhance safety of on-line financial services
- Create a safer business environment
- Enhance emergency finance system

3.3.2 Improvement of Metropolitan Manila's Urban Structure Resistant to Earthquake



Framework USI-1: Promote Earthquake Resistant Urban Development

■ **Understandings / Concerns:**

Metropolitan Manila's damage will mostly be by building collapse. 39.4% of total buildings will somehow be affected. High vulnerable areas by building collapse are especially in Marikina City and Pasig City. Those cities may be isolated from other portion of Metropolitan Manila by the damage.

■ **Basic Policy /Basic Concept of Framework**

- 1) Residential buildings strengthening/ retrofitting
 - Strengthen/ retrofit individual residence to reduce the number of buildings which might collapse
 - Enlightenment of activity on strengthening/ retrofitting residential Buildings
 - Study on the finance system for retrofitting of residential buildings
- 2) Promotion on subdivision development procedures
- 3) Enhancement of social housing policy for slums/ illegal settlement
- 4) Promotion of land use incorporating seismic hazards information
 - Incorporate Seismic hazards data in General Plans
 - Limit Development near existing Faults

■ **Action Plans:**

- Resistance improvement on residential houses
- Subdivision development promotion procedures
- Social housing policy enhancement with earthquake resistance perspectives
- Revise Comprehensive Land Use Plan (CLUP)

Framework USI-2: Promote Flameproof Urban Development

■ **Understandings / Concerns:**

The Old Manila city area has highest flammability possibility, and the Northwestern portion of Metropolitan Manila has utmost fire extinguish service shortage. The cause for fire outbreak is mainly the LPG and excessive power line for electricity, commonly seen in the illegal settlement areas. The cause for fire spread is mainly due to the vulnerable urban structure, i.e. small open spaces and parks, and the wooden building congested areas.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Preventing fire outbreak
 - Reducing risk-components for fire outbreak in the residence
 - Strengthening of possible fire outbreak establishments
 - Replacing gasoline container with unbreakable (plastic-bottled) container
- 2) Preventing fire spreading
 - Promotion of vulnerability reduction measures for urban industrial zones
- 3) Promotion of fire proof district
 - Introduction of Urban Fire Proof Development Method
 - Promotion of subdivision development procedures

■ **Action Plans:**

- Tie down and stabilize propane cylinders against earthquake shaking
- Enforce disaster mitigation measures for possible fire breakout facilities
- Promote replacement to unbreakable (plastic-bottled) gasoline vending
- Promote of vulnerability reduction measures for urban industrial zones
- Introduce urban fire proof development method

Framework USI-3: Promote Spatial Urban Development

■ **Understandings / Concerns:**

Metropolitan Manila fringe areas will be the area of high evacuation difficulty. Areas along the West Valley Fault System and northern half portion of the Manila coastal area have high shortage for evacuation area.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Preservation of open spaces and parks

- Institutional enforcement of limiting further development of the existing open spaces and parks
- 2) Urban re-development
 - Promotion of Disaster Resistant Urban Development
- **Action Plans:**
 - Enforce further development of the existing open spaces and parks
 - Promote disaster resistant urban development
 - Enforce and develop laws and regulations related to urban planning and building code

Framework USI-4: Promote Earthquake-resistant Buildings

■ **Understandings / Concerns:**

Building damage estimation results using the worst case scenario indicates that 13% of the building will collapse or be heavily damaged, and 26% of the buildings will be partly damaged. The figures are higher than those of public buildings. Residential building damage is the major reason of human casualties.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Develop and expand seismic design regulations for masonry buildings
- 2) Develop retrofitting techniques and expand retrofitting work
- 3) Develop construction materials
- 4) Improve building permission system
- 5) Educate and train human resources on building construction

■ **Action Plans:**

- Implement retrofitting work of buildings
- Educate and train administrative staffs on building engineering
- Educate and train building engineer, establish training facility for construction workers
- Improve structural design code by DPWH, ASEP and Researchers
- Develop and diffuse building construction related technologies and engineering
- Develop and diffuse construction materials in collaboration with industry firms
- Introduce tax exemption or subsidy for smooth introduction of retrofitting works
- Educate and train administrative staffs on building engineering
- Educate and train building engineer, establish training facility for construction workers

Framework USI-5: Promote Earthquake-resistant Public Facilities

■ **Understandings / Concerns:**

Building seismic diagnosis results for 80 public buildings identified that 45% of the building have basic or suspicious structural problem but on the other hand 55% of the buildings are sound.

Building damage estimation results using the worst case scenario indicates 8 to 10% of the building will collapse or be heavily damaged and 20-25% of the buildings will be partly damaged.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Diagnose seismic performance of public buildings
- 2) Retrofit problem buildings
- 3) Improve public building function as a facility for emergency activity
- 4) Upgrade seismic design regulations
- 5) Consider detail ground condition in designing structures
- 6) Educate and train human resources on building construction

■ **Action Plans:**

- Strengthen public facilities
- Research and develop for strengthening public buildings
- Develop building engineering related human resources

Framework USI-6: Promote Earthquake-resistant Infrastructure

■ **Understandings / Concerns:**

Infrastructure consists of road, bridge, railway, LRT, MRT, airport, and harbor. It carries the most important role in case of severe earthquake. Maintaining such facilities will help implement emergency activities smoothly.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Strengthening of bridge
 - Retrofitting of Bridge Structure
- 2) Secure safety of airport facility
 - Strengthening of Facility
 - Preparation of Back Up System
- 3) Secure safety of harbor facility
 - Strengthening of Facility

■ **Action Plans:**

- Retrofit bridge structure
- Secure safety of airport facilities
- Secure safety of harbor facilities

Framework USI-7: Promote Earthquake-resistant Lifeline

■ **Understandings / Concerns:**

In the damage estimation, for water network, damaged points reach 4,000 points in the worst case, and for electricity and telecommunication damaged length reaches 31km and 97 km respectively. Stop supplying of lifeline will expand scale of disaster.

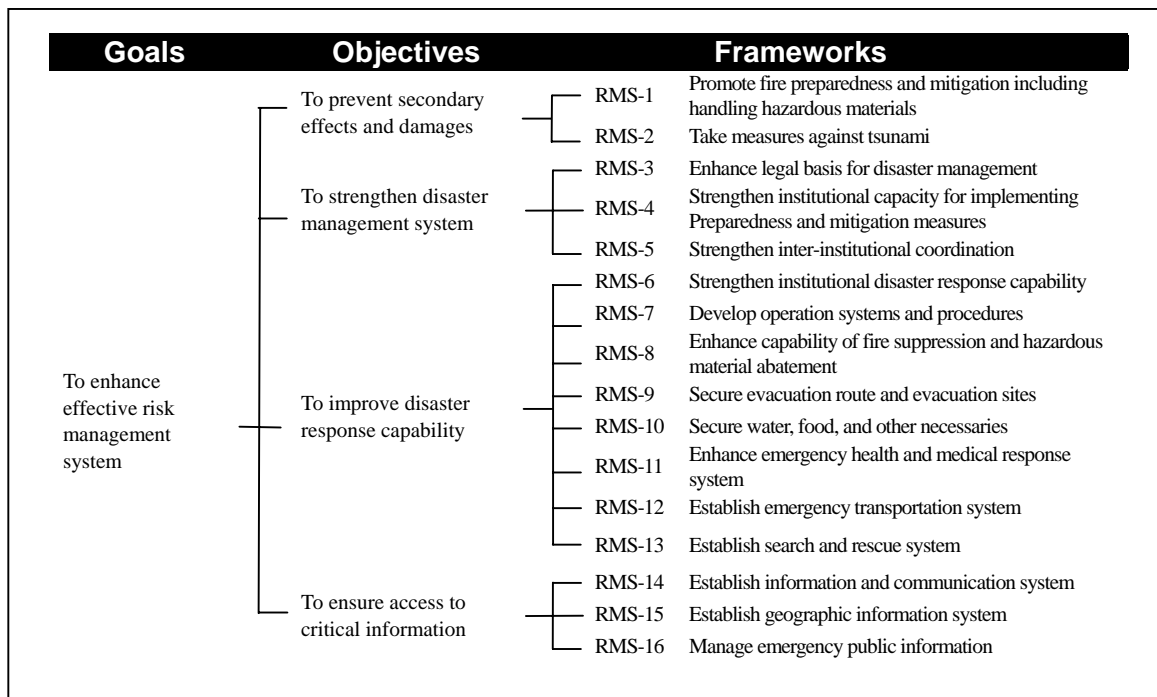
■ **Basic Policy /Basic Concept of Framework:**

- 1) Organizational preparedness among lifeline companies
 - Establishment of Lifeline Sub-Committee in MMDCC
- 2) Detail risk assessment of each lifeline
 - Implementation of Detail Risk Assessment of each Lifeline
- 3) Strengthening of emergency operation ability
 - Preparation of Emergency Operation Manual
 - Strengthening of Emergency Operation Team
- 4) Water distribution
 - Strengthening of Water Distribution Facilities
- 5) Electricity supply
 - Strengthening of Electric Supply Facilities
 - Regulation of illegal connection of electricity in squatter area
- 6) Telecommunications
 - Strengthening of Telecommunications Service Facilities

■ **Action Plans:**

- Prepare organizational system among lifeline companies
- Assess detail risk of each lifeline
- Strengthen emergency operation ability
- Strengthen water distribution function
- Strengthen electricity supply function
- Strengthen telecommunications function

3.3.3 Enhancement of Effective Risk Management System



Framework RMS-1: Promote Fire Preparedness and Mitigation including handling Hazardous Materials

■ **Understandings / Concerns:**

Metropolitan Manila will suffer from fire that would burn down some 1,700 hectares of land and kill 19,300 people in the event of the earthquake because there are so many wooden buildings and hazardous facilities. Such areas as squatters are physically vulnerable to fire, and there exist hazardous facilities and materials in places.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Strengthen fire services capability
 - Enhance personnel and fire equipment
 - Strengthen and development of fire stations
- 2) Improvement of auxiliary fire fighting operations
 - Strengthen the capability of the barangays and private companies
 - Strengthen communities' capability
- 3) Ensure safety of hazardous materials
 - Enhance the safety measures of hazardous materials
 - Promote the relocation of hazardous facilities
- 4) Strengthen inter-organizational coordination and cooperation

■ **Action Plans:**

- Enhance fire-proof of buildings
- Construct new fire stations where the stations are underprovided
- Strengthen fire service resources
- Improve water sources for fire fighting
- Reinforce auxiliary fire fighting operations such as the barangays, communities, and business establishment voluntary fire fighting corps
- Improve management system of hazardous materials, including relocation of hazardous facilities
- Promote inter-organization coordination and cooperation

Framework RMS-2: Take Measures against Tsunami

■ **Understandings / Concerns:**

Preliminary estimated tsunami condition at Manila Bay seashore in case for Manila Trench earthquake are 1) maximum height is 4m, 2) average height is 2m, 3) arrival time is about one hour after the earthquake occurrence. Lowland area, of which elevation is less than 4m, prevails widely around old manila area and these area are severely affected. Tsunami also run up into Passig River and possibly affect Maracanang palace and Pandacan deposit area.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Support ongoing research on tsunami phenomena and damages
- 2) Establish information dissemination system on tsunami phenomena
- 3) Promote public awareness on tsunami effect

■ **Action Plans:**

- Promote Research and development for Tsunami mechanism and damages
- Promote tsunami damages preventive measures

Framework RMS-3: Enhance Legal Basis for Disaster Management

■ **Understandings / Concerns:**

The basic law establishing the framework for disaster management in Metro Manila was established in 1978 and has not been significantly updated to coincide with subsequent legislation affecting the authorities of local governments and the structure of governmental agencies. Moreover, it does not adequately reflect the current holistic approach to disaster management and its relation with urban planning and development. At the local level, a city/municipal ordinance is needed to strengthen the legal framework and institutionalize disaster mitigation programs.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Strengthen legal basis at national level by updating/replacing PD1566
- Pending National Legislation
 - Support of NDCC Proposed Legislation

- 2) Strengthen local government framework for disaster management
 - Institutionalize Disaster Management Offices and Budgets
 - Improve Financial Viability of Disaster Coordinating Councils
 - Promote Adoption of Model City/Municipal Ordinance
- 3) Promote policies that encourage implementation of disaster risk reduction measures
 - **Action Plans:**
 - Strengthen legal basis for disaster management at the national level by updating/replacing PD1566
 - Strengthen legal basis at the local level by adopting model city/municipal ordinance
 - Institutionalize local government framework and financing for disaster management
 - Promote policies that encourage implementation of disaster risk reduction measures

Framework RMS-4: Strengthen Institutional Capacity for Implementing Preparedness and Mitigation Measures

■ **Understandings / Concerns:**

The institutional arrangements for disaster management and structures of the local disaster councils were initiated over twenty years ago and no substantive changes have been made since then, despite legal changes affecting local government authorities and responsibilities and changes in the Government's organizational structure. Also, planning guidance and emergency plans need to be updated, and a training needs assessment needs to be undertaken in order to identify and develop training opportunities for DCC members.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Strengthen local government disaster management through reorganization and revitalization of disaster coordinating councils
 - Strengthen City/Municipal Disaster Coordinating Councils
 - Strengthen Barangay Disaster Coordinating Councils
 - Update Barangay emergency planning guidance and plans
- 2) Promote the development of a disaster management center
- 3) Encourage local mitigation planning through use of "Earthquake mitigation handbook" and "Earthquake mitigation and response checklists – local planning guide"
- 4) Conduct training needs assessment and develop capacity building programs

■ **Action Plans:**

- Promote the reorganization and revitalization of city/municipal and barangay Disaster Coordinating Councils.
- Promote the development of a Disaster Management Center to serve Metro Manila.

- Promote local government mitigation planning through implementation of the Earthquake Mitigation Handbook and the Earthquake Mitigation and Response Checklists -- Local Planning Guide.
- Conduct training needs assessment and develop capacity building programs for local and barangay Disaster Coordinating Council members and institutions.
- Strengthen barangay level preparedness for disaster response and relief.

Framework RMS-5: Strengthen Inter-Institutional Coordination

■ Understandings / Concerns:

Mechanisms for inter-institutional coordination currently exist in the form of Disaster Coordinating Councils, but the functionality of these councils is less than optimal. Most have no regular meetings or agenda for overseeing any pre-disaster preparedness and mitigation programs, which restricts their capacity for effective collaboration during response, relief, and recovery operations. There is need to revitalize the councils, update their plans, strengthen decision-making processes, and encourage lateral communications and mutual aid.

■ Basic Policy /Basic Concept of Framework:

- 1) Strengthen metropolitan manila disaster coordinating council
 - Update MMDCC Structure
 - Organize and implement a MMDCC Work Plan
- 2) Enhance lateral and vertical inter-agency and inter-governmental communication and coordination
- 3) Strengthen Incident Command System (ICS) and response decision-making systems
- 4) Update the National Calamities and Disaster Preparedness Plan and Metro Manila Level Plans
- 5) Encourage inter-local cooperation through zonation of LGUs and Master Mutual Aid Agreement

■ Action Plans:

- Strengthen the MMDCC by updating its structure and organizing and implementing a MMDCC Work Plan
- Update national and Metropolitan Manila level disaster preparedness plans
- Strengthen Incident Command System (ICS) and response decision-making systems
- Encourage inter-local cooperation through zonation of LGUs and Master Mutual Aid Agreement

Framework RMS-6: Strengthen Institutional Disaster Response Capability

■ **Understandings / Concerns:**

The need for training and other resources to upgrade the capacities and capabilities of agencies, institutions, and Disaster Coordinating Councils at each level of government is broadly recognized in Metro Manila. There has been little up-to-date guidance or assistance available to institutions and LGUs to aid them with emergency planning, training, procedures, and identification and procurement of needed resources.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Encourage local emergency response planning through use of “Earthquake mitigation and response checklists -- local planning guide”
- 2) Encourage adoption and utilization of an “Emergency response pocket guide” by agencies and LGUs
- 3) Encourage agencies and local governments to inventory response and relief resources and sources and identify needed disaster management tools and equipment
 - Identify Needed Disaster Management Tools and Equipment
- 4) Enhance capacity for training emergency response personnel in response and relief functions

■ **Action Plans:**

- Encourage local emergency response planning through use of the Earthquake Mitigation and Response Checklists -- Local Planning Guide
- Encourage adoption and utilization of emergency response pocket guide by agencies and LGUs
- Encourage agencies and local governments to inventory response and relief resources and sources and identify needed disaster management tools and equipment
- Enhance capacity for training emergency response personnel in response and relief functions

Framework RMS-7: Develop Operations System and Procedures

■ **Understandings / Concerns:**

A large disaster requires a high level of communication and coordination among responding jurisdictions and agencies to effectively save lives and protect property. Most city/municipality DCCs as well as barangay DCCs do not have Standard Operating Procedures to guide them in carrying out critical response and relief functions, nor do they have fully functional Disaster Operations Centers to coordinate inter-agency operations and serve as the focal point for information gathering, analysis, and dissemination.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Develop and institutionalize Standard Operating Procedures (SOPs) for key response functions
- 2) Develop MMDA Metro Base capabilities for Disaster Operations Center (DOC) operations
- 3) Establish functional Disaster Operations Centers (DOCs) at city/municipal and barangay levels

■ **Action Plans:**

- Develop and institutionalize Standard Operating Procedures (SOPs) for key response functions.
- Develop MMDA Metro Base capabilities for Disaster Operations Center (DOC) operations
- Establish functional Disaster Operations Centers (DOCs) at city/municipal and barangay levels.

Framework RMS-8: Enhance Capacity of Fire Suppression and Hazardous Material Abatement

■ **Understandings / Concerns:**

Metropolitan Manila is estimated to suffer from huge fire-breakout and spreading in the event of earthquake, because of its distribution of wooden buildings and hazardous facilities. About 1,700 hectares of land is estimated burnt down, leaving 19,300 people killed. On the other hand, fire service capacity is far short to handle the estimated secondary damage, so that it is required to improve the total capacity of fire suppression and abatement of hazardous materials scattered in Metro Manila.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Revise response plan and manual of the relevant organizations
- 2) Enhance information and communication system
- 3) Establish system to request and accept support from outside
- 4) Enhance emergency response operations to abate hazardous material
 - Fire services and other public organizations
 - Business establishments

■ **Action Plans:**

- Revise the emergency plan and manuals of the relevant organizations
- Enhance of the information and communication system
- Establish the support request system and conclude mutual aid agreements
- Enhance the emergency response operations of the public organizations and the establishments of hazard materials

Framework RMS-9: Secure Evacuation Route and Evacuation Sites

■ **Understandings / Concerns:**

Based on the damage estimation, at worst 3.15 million people will become refugees because their loss of the houses due to building collapses and fires as secondary disaster. To accommodate such a large number of refugees, it is mandate to formulate a plan to secure temporary evacuation routes and sites are mandate.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Formulate the land use plan including evacuation sites
- 2) Ensure evacuation route network
- 3) Disseminate the plan to the public

■ **Action Plans:**

- Formulate evacuation sites and plans for the LGUs
- Enhance resources for evacuation

Framework RMS-10: Secure Water, Food and Other Necessities

■ **Understandings / Concerns:**

Earthquake disaster leaves many people out of the normal life. People would need daily necessities to maintain their basic life. For that purpose, emergency service delivery plan of water, food, clothes, drugs and so forth are necessary. LGUs must at ordinary time estimate the needs of such necessities for the emergency situation and stockpile them as much as possible. Many LGUs have no stockpiles at all in preparation for emergency. However, even some LGUs with stockpiles like Marikina city, which are kept in preparation for flood at present, are small amount and not enough in case of earthquakes.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Ensure water supply system
- 2) Stockpile food
- 3) Supply clothes
- 4) Stockpile drugs

■ **Action Plans:**

- Secure the large scaled water source
- Formulate emergency supply system of water, food, and other necessities
- Formulate emergency aid agreement

Framework RMS-11: Enhance Emergency Health and Medical Response System

■ **Understandings / Concerns:**

Metropolitan Manila is equipped with scant resources and fragmented systems of emergency medical responses to potential consequences after an earthquake. It is urgently necessary to

formulate networks for LGUs to help each other and to make multi-layered response structure practicable from communities to national and up to international level.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Increase LGUs' self-contained capability by strengthening mutually supporting networks
 - Internal mutual cooperation among LGUs in Metropolitan Manila
 - Wider area cooperation between LGUs in Metropolitan Manila and surrounding Provinces
- 2) Organize the Standardized Treatment Procedures based on planned multi-layered structure
 - Establishment of Standardized Treatment Procedures

■ **Action Plans:**

- Enhance organizational response capacities
- Improve government hospital capacities
- Enforce logistics
- Expand training programs

Framework RMS-12: Establish Emergency Transportation Network

■ **Understandings / Concerns:**

Metro Manila has no recognized emergency transportation network among the government agencies. It is indispensable to designate the primary and secondary network of emergency roads in order to do rescue and relief activities, and transport goods, human resources, etc.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Establish Emergency Road Network within Metropolitan Manila
 - Establishment of Emergency Road network
 - Use of emergency road network
- 2) Establish Metro Manila Accessible Network (Land, sea, air and river transportation)
 - Establishment of Emergency Transportation Network
 - Operation of Emergency Transportation Network

■ **Action Plans:**

- Establish emergency road network
- Arrange machineries to DPWH for emergency road response
- Secure road between Batangas port to Metropolitan Manila south region
- Convert one portion of Manila port to earthquake resistant construction
- Construct Laguna de Bay northern shore uploading facility
- Secure road between Subic port/ Clark field to Metropolitan Manila North region
- Secure Ninoy Aquino airport functions

Framework RMS-13: Establish Search and Rescue System

■ **Understandings / Concerns:**

Search and rescue after disaster is major determining factor to reduce the number of human casualties. Accordingly, it is very vital to enhance community capability of search and rescue in the early stage, lift up the organized search and rescue capability such as fire services, and develop the search and rescue system including maintenance of order and morale by regular trainings and drills. Moreover, because it is essential to accept aid from abroad in case of major disaster, so that training to work with international aids is also mandatory. However, national, regional and city/municipal governments neither have yet well-organized search and rescue structure.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Enhance the community capability of search and rescue
- 2) Enhance the organized system of training and procurement of equipment
- 3) Establish community-based search and rescue structure

■ **Action Plans:**

- Develop capacity of search and rescue system.
- Enhance community search and rescue system
- Establish the system to accept international emergency aid

Framework RMS-14: Establish Information and Communication System

■ **Understandings / Concerns:**

A large traffic of emergency communication at emergency situation causes overflow of information and communication. It is imperative to set up disaster information and communication system that can collect the necessary damage information and deliver emergency response command and other information. Particularly, establishment of the communication network to link the relevant ministries, city/municipalities, and barangays is required.

Presently, OCD, who is the central organization of NDCC, is deploying the information communication system to link with its 16 regional centers, whose headquarters is located in Quezon City. However, because OCD has put priority on typhoon and flood disasters, and NCR (Metropolitan Manila) has less attention in the establishment of this disaster management information system. Among the member LGUs of NCR do not have a unified information system.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Ensure quick collection and delivery of damage information
- 2) Establish emergency information and communication network system among LGUs, fire services, police, MMDA, and national organizations

- 3) Establish Disaster management center and enhance the existing function
- 4) Establish the aerial information collection system
- 5) Establish information system on public relations and individual safety confirmation

■ **Action Plans:**

- Develop disaster information and communication system connecting MMDA, LGUs and barangays
- Establish a disaster management center

Framework RMS-15: Establish Geographic Information System (GIS)

■ **Understandings / Concerns:**

GIS database of the existing various information of Metro Manila is very useful to formulate the disaster management plan and countermeasures at ordinary times and response and command in case of emergency. The JICA's MMEIRS developed the GIS database covering the whole Metro Manila. Based on the JICA database, each LGU must update the information necessary for the disaster management. It is necessary to establish disaster information network system for effective disaster information collection and disaster management measures by data sharing among the fire services and MMDA.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Establish LGU-unit disaster information database
- 2) Standardize database
- 3) Share the database
- 4) The developed database should be networked and shared not only with the LGUs and MMDA, but with the other relevant organizations such as fire services, police, OCD, and PHIVOLCS.
- 5) Maintain and update the disaster information database
- 6) Develop the data analysis system

■ **Action Plans:**

- Develop geographic information database for disaster management
- Train LGU staffs on GIS database and information & communication system

Framework RMS-16: Manage Emergency Public Information

■ **Understandings / Concerns:**

It is the responsibility of government to provide complete and accurate information to the public regarding disasters, and to do this, they must establish appropriate policies and protocols for cooperation with the media and create an atmosphere conducive to media participation in all phases of disaster management. Without these actions, life-saving information may not be communicated to potential disaster victims and rumors and false information may spread.

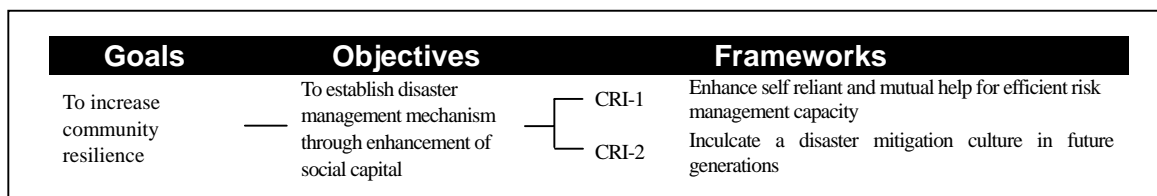
■ **Basic Policy /Basic Concept of Framework:**

- 1) Promote adoption and implementation by local governments and agencies of the Guide for Managing Information concerning Disasters
- 2) Establish partnerships with the media for awareness raising and emergency public information
 - Public Information for Prevention and Mitigation
 - Public Information for Response in case of Emergency

■ **Action Plans:**

- Promote adoption and implementation by local governments and agencies of the Guide for Managing Information concerning Disasters
- Establish partnerships with the media for awareness raising and emergency public information

3.3.4 Increasing Community Resilience



Framework CRI-1: Enhance Self Reliant and Mutual Help for Efficient Risk Management Capability

■ **Understandings / Concerns:**

Metropolitan Manila is posed with great threat due to rupture proximity with the Valley fault system along the eastern part. Barangay is the unique system of “Community Governance” and each of them is supposed to have disaster preparedness plan in the Philippines. However, most barangay in Metropolitan Manila have not prepared any black and white for disaster management, let alone for a catastrophe like earthquake, in which, public help may not function well for the first 72 hours, and this is the time self reliant and mutual help actions take effects to save life and properties.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Knowledge development about earthquake hazards and vulnerabilities
 - Enhancement of community’s perception of their vulnerability
 - Participatory analysis of local capacities and vulnerabilities
- 2) Increase community resistance to earthquake
 - Socializing building safer measures into community practice
- 3) Canalizing community governance
 - Upgrading living standard through community participation

- Community business
- 4) Enhancing potential emergency management capacities
 - Legitimate local community unit and strengthening social cohesion
 - Developing knowledge and exercising drills
 - Preparation of community equipments and family emergency kits
 - Preparation and familiarization of emergency plan and simple manual
 - Establishment of information management system
- **Action Plans:**
 - Knowledge development about earthquake hazards and vulnerabilities
 - Increase community resistance to earthquake
 - Enhance the community governance and linkage with LGUs
 - Enhance potential emergency management capacities (Fire/ search & rescue, and information management)
 - Enhance the administrative system supporting community activities

Framework CRI-2: Inculcate a Disaster Mitigation Culture in Future Generations

■ **Understandings / Concerns:**

The DECS (Dep. of Education, Culture and Sports, now Dep. of Education) ORDER No.14, s. 1997 states that Calamity Disaster and Fire Control Group shall be established in each school. Although conventional fire and evacuation drills are regularly conducted at most schools with the participation of teachers and pupils, teachers propose knowledge development and skill trainings in disaster management to activate the Group and to better educate the pupils. In the calamity, schools are expected to accommodate local community people. The integrated plan in coordination with the local community is essential. In more broader vision, school children are the most significant future generations to inculcate disaster culture that disaster impact reduction begins at individuals and sustainable development is only viable, if disaster impacts are to be reduced.

■ **Basic Policy /Basic Concept of Framework:**

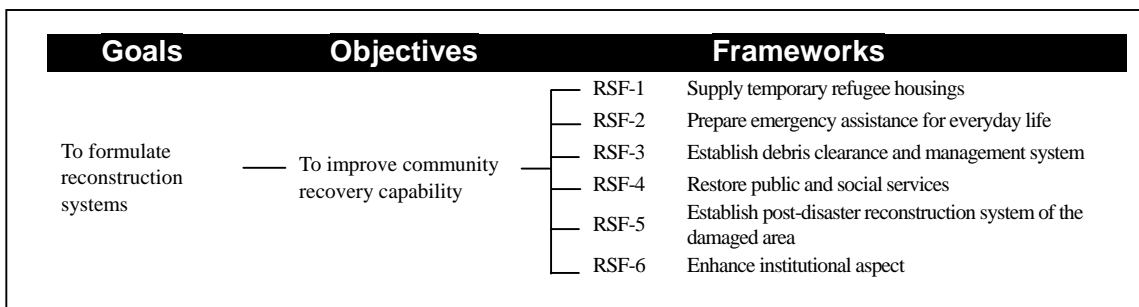
- 1) Enhancement of school risk management capacity
 - Organizing seminars and trainings of disaster management
 - Reviewing and updating school disaster plan
- 2) To inculcate disaster culture in future generations
 - Including earthquake disaster management in school curriculum
 - Dissemination of damage estimation results
 - Drill

■ **Action Plans:**

- Enhance school risk management capacity

- Inculcate a disaster mitigation culture in future generations

3.3.5 Formulation of Reconstruction Systems



Framework RSF-1: Supply Temporary Refugee Housing

■ **Understandings / Concerns:**

It is estimated that 40% of the existing houses will be damaged in the event of the scenario earthquake, and on the assumption of the number of the temporary houses needed is calculated as 223,700 houses. The number is huge for the Philippine government, thus it is mandatory to formulate a temporary housing plan including construction site.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Supply temporary houses
- 2) Supply the public services

■ **Action Plans:**

- Formulate temporary refugee housing plan

Framework RSF-2: Prepare Emergency Assistance for Daily Life

■ **Understandings / Concerns:**

The estimated number of the people affected by the scenario earthquake is estimated more than 3 million. The number is so huge that the government should take a fundamental measure to alleviate their suffer both financially and mentally in order to assist them to feel easier and return to the normal life quicker.

■ **Basic Policy /Basic Concept of Framework**

- 1) Take measures for financial and mental relief for the people affected by the scenario earthquake

■ **Action Plans:**

- Formulate basic policy for emergency assistance for daily life

Framework RSF-3: Establish Debris Clearance and Management System

■ **Understandings / Concerns:**

It is estimated that some 33,555,000 tons of debris will be generated from the 447,400 damaged buildings. Moreover, the total debris including both buildings and infrastructure is estimated to weigh some 50 million tons. It is compulsory to study the method of treatment and the dumping site of debris, for the smooth recovery and reconstruction of the urban area and infrastructure.

■ **Basic Policy /Basic Concept of Framework:**

- 1) To formulate estimated debris clearance plan based on the estimated amount of the debris

■ **Action Plans:**

- Formulate the debris clearance plan for the LGUs

Framework RSF-4: Restore Public and Social Services

■ **Understandings / Concerns:**

The government agencies would act based on the pre-prepared plan for their tasks designated beforehand to maintain the stability of the society after the disaster as much as possible. However, even so, the society will be confused and it is difficult to maintain the law and order, especially to prevent looting and unnecessary damage.

■ **Basic Policy /Basic Concept of Framework:**

- 1) To create plan to secure the peace and order for the affected areas by the government

■ **Action Plans:**

- Formulate basic policy for post-disaster peace and order keeping activities

Framework RSF-5: Establish Post-Disaster Reconstruction System of the Damaged Area

■ **Understandings / Concerns:**

The estimated damage is huge, but quick post-disaster recovery and reconstruction are mandatory to restore the normal life and activities. For the prompt recovery and reconstruction, pre-disaster arrangements to cope with post-disaster situation are imperative.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Facilitate quick return to the normal: people's living, housing, employment, and economic activities
- 2) Make living environment much safer and better than before the disaster
 - Draft pre-disaster guideline on the post-disaster reconstruction of the damaged area
 - Enhance the planned reconstruction in the slum areas
 - Establish the procedure for post-disaster reconstruction
 - Establish housing financial scheme

■ **Action Plans:**

- Formulate basic reconstruction policies for living, housing, employment and economic activities
- Formulate guidelines on urban reconstruction and make a scheme of finances and credits

Framework RSF-6: Enhance Institutional Aspect of Recovery Planning

■ **Understandings / Concerns:**

When a major disaster occurs, everyone -- government, businesses, communities and families--must pull together to recover. Regaining normalcy is much easier and quicker if the policies, partnerships, and organizational structures to guide and facilitate recovery are in place before the disaster.

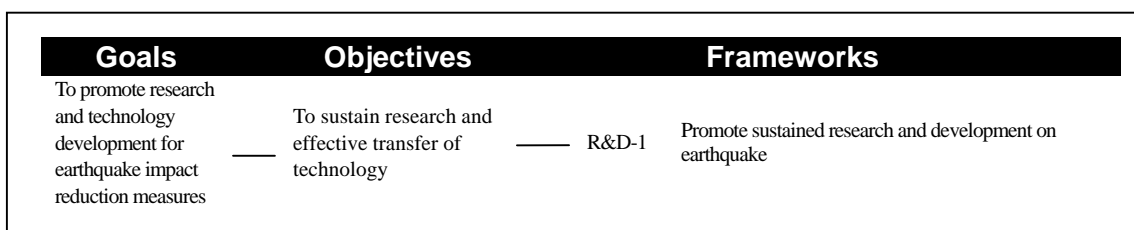
■ **Basic Policy /Basic Concept of Framework:**

- 1) Establish pre-disaster policies and institutional arrangements for post-disaster reconstruction and mitigation
- 2) Prepare recovery plans and procedures to ease post-disaster human and physical recovery and rehabilitation

■ **Action Plans:**

- Establish pre-disaster policies and institutional arrangements for post-disaster reconstruction and mitigation
- Prepare pre-disaster recovery plans and procedures to ease post-disaster human and physical recovery and rehabilitation

3.3.6 Research and Technology Promotion for Earthquake Impact Reduction Measures



Framework R&D-1: Promote Sustained Research and Development on Earthquake

■ **Understandings / Concerns:**

Once huge earthquake occurs in Metropolitan Manila area or at Manila Trench great damages are estimated. Earthquake science, earthquake engineering studies are developed in depth to achieve development of earthquake impact resistant national system, improvement to earthquake resistant urban structure, enhancement of effective risk management system.

■ **Basic Policy /Basic Concept of Framework:**

- 1) Evaluate activity of the Valley Fault System
- 2) Integrate ground information as a unique and comprehensive database
- 3) Expand basic inventory on buildings and population for detail damage estimation purpose
- 4) Promote detail study on comprehensive earthquake disaster estimation

■ **Action Plans:**

- Evaluate activity of the Valley Fault System by PHIVOLCS and research institutions
- Promote comprehensive census survey
- Promote detail study on comprehensive earthquake disaster estimation by NDCC

3.4 Action Plans

3.4.1 List of Action Plans

105 action plans are prepared to put in practice the policies and strategies represented in the frameworks. The action plans by the framework are enumerated in Table 3.4.1.

Table 3.4.1 Frameworks and List of Action Plans (1)

Frameworks		Action Plans
NSD-1: Protect stability of national government function		1) Enhance security capability of national government function with the office of the President 2) Promote urban reform around the nationally important facilities
NSD-2: Protect stability of socio-economic system		1) Enhancing Emergency Measures of businesses 2) Enhance safety of on-line financial services 3) Create a safer business environment 4) Enhance emergency finance system
USI-1: Promote earthquake resistant urban development		1) Improve resistance of residential buildings 2) Promote subdivision development procedures 3) Enhance social housing policy for Illegal Settlement and Poverty Areas 4) Revise comprehensive land use plan
USI-2: Promote flameproof urban development		1) Tie down and stabilize propane cylinders against earthquake shaking 2) Enforce disaster mitigation measures for possible fire breakout facilities 3) Promote replacement to unbreakable (plastic-bottled) gasoline vending 4) Promote vulnerability reduction measures for urban industrial zones 5) Introduce urban fire proof development method
USI-3: Promote spatial urban development		1) Enforce further development of existing open spaces and parks 2) Promote disaster resistant urban development
USI-4: Promote earthquake-resistant buildings		1) Research and develop on strengthening buildings 2) Promote construction and improvement for earthquake resistant building 3) Develop building engineering related human resources/ Improve building construction permission system
USI-5: Promote earthquake-resistant public facilities		1) Strengthen public facilities 2) Research and develop for strengthening public buildings 3) Develop building engineering related human resources
USI-6: Promote earthquake-resistant infrastructure		1) Retrofit bridge structure 2) Secure safety of airport facility 3) Secure safety of harbor facility
USI-7: Promote earthquake-resistant lifeline		1) Prepare organizational system among lifeline companies 2) Assess Detail Risk of Each Lifeline 3) Strengthen emergency operation ability 4) Strengthen water distribution function 5) Strengthen electricity supply function 6) Strengthen telecommunications function
RMS-1: Promote fire preparedness and mitigation including handling hazardous materials		1) Revise the emergency plan and manuals of the relevant organizations 2) Enhance information and communication system 3) Enhance the emergency response operations of the public organization, LGUs, and the establishments with hazardous materials 4) Establish the support request system and conclude mutual aid agreements
RMS-2: Take measures against tsunami		1) Promote Research and development for Tsunami mechanism and damages 2) Promote tsunami damages preventive measures
RMS-3: Enhance legal basis for disaster management		1) Strengthen legal basis for disaster management at the national level by updating/replacing PD1566 2) Strengthen legal basis at the local level by adopting model city/municipal ordinance 3) Institutionalize local government framework and financing for disaster management 4) Promote policies that encourage implementation of disaster risk reduction measures

Table 3.4.1. Frameworks and List of Action Plans (2)

Frameworks	Action Plans
RMS-4: Strengthen institutional capacity for implementing preparedness and mitigation measures	<ol style="list-style-type: none"> 1) Promote the reorganization and revitalization of city/municipal and barangay Disaster Coordinating Councils 2) Promote local government mitigation planning through implementation of the Earthquake Mitigation Handbook and the Earthquake Mitigation and Response Checklists -- Local Planning Guide 3) Conduct training needs assessment and develop capacity building programs for local and barangay Disaster Coordinating Council members and institutions 4) Strengthen barangay level preparedness for disaster response and relief
RMS-5: Strengthen inter-institutional coordination	<ol style="list-style-type: none"> 1) Strengthen the MMDCC by updating its structure and organizing and implementing a MMDCC Work Plan 2) Strengthen and update national and Metropolitan Manila level disaster preparedness plans 3) Strengthen Incident Command System (ICS) and response decision-making systems 4) Encourage inter-local cooperation through zonation of LGUs and Master Mutual Aid Agreement
RMS-6: Strengthening of institutional disaster response capability	<ol style="list-style-type: none"> 1) Encourage local emergency response planning through use of the Earthquake Mitigation and Response Checklists -- Local Planning Guide 2) Encourage adoption and utilization of emergency response pocket guide by agencies and LGUs 3) Encourage agencies and local governments to inventory response and relief resources and sources and identify needed disaster management tools and equipment 4) Enhance capacity for training emergency response personnel in response and relief functions
RMS-7: Develop operation systems and procedures	<ol style="list-style-type: none"> 1) Develop and institutionalize Standard Operating Procedures (SOPs) for key response functions. 2) Develop MMDA Metro Base capabilities for Disaster Operations Center (DOC) operations 3) Establish functional Disaster Operations Centers (DOCs) at city/municipal and barangay levels.
RMS-8: Enhance capability of fire suppression and hazardous material abatement	<ol style="list-style-type: none"> 1) Revise the emergency plan and manuals of the relevant organizations 2) Enhance information and communication system 3) Enhance the emergency response operations of the public organizations, LGUs, and the establishments with hazardous materials 4) Establish the support request system and conclude mutual aid agreements
RMS-9: Secure evacuation route and evacuation sites	<ol style="list-style-type: none"> 1) Formulate evacuation site and plan for the LGUs 2) Enhance resources for evacuation
RMS-10: Secure Water, Food, and Other Necessaries	<ol style="list-style-type: none"> 1) Secure the large scaled water source 2) Formulate emergency supply system of water, food, and other necessities 3) Formulate emergency aid agreement
RMS-11: Enhance emergency health and medical response system	<ol style="list-style-type: none"> 1) Enhance organizational response capacities 2) Improve government hospital capacities 3) Enforce logistics 4) Expand training programs
RMS-12: Establish emergency transportation system	<ol style="list-style-type: none"> 1) Establish emergency road network 2) Arrange machineries to DPWH for emergency road response 3) Secure road between Bagangas Port to Metropolitan Manila south region 4) Convert one portion of Manila port to earthquake resistant construction 5) Construct Laguna de bay northern shore unloading facility 6) Secure road between Subic port/ Clark field to Metropolitan Manila North region 7) Secure Ninoy Aquino airport functions
RMS-13: Establish search and rescue system	<ol style="list-style-type: none"> 1) Develop capacity on search and rescue for refugees 2) Enhance community search and rescue system 3) Establish the system to accept international emergency aid

Table 3.4.1. Frameworks and List of Action Plans (3)

Frameworks	Action Plans
RMS-14: Establish information and communication system	<ol style="list-style-type: none"> 1) Develop disaster information collection and dissemination system in MMDA, LGUs and Barangays 2) Establish a disaster management center
RMS-15: Establish geographic information system	<ol style="list-style-type: none"> 1) Develop geographic database development for disaster management 2) Train LGU staffs on GIS database and information/ communication system
RMS-16: Manage emergency public information	<ol style="list-style-type: none"> 1) Promote adoption and implementation by local governments and agencies of the Guide for Managing Information concerning disasters 2) Establish partnerships with the media for awareness raising and emergency public information
CRI-1: Enhance self-reliant and mutual help for efficient risk management capacity	<ol style="list-style-type: none"> 1) Knowledge development about earthquake hazards and vulnerabilities 2) Increase community resistance to earthquake 3) Enhance the community governance and linkage with LGUs 4) Enhance potential emergency management capacities (Fire/search & rescue, and information management) 5) Enhance the administrative system supporting community activities
CRI-2: Inculcate a disaster mitigation culture in future generations	<ol style="list-style-type: none"> 1) Enhance school risk management capacity 2) Inculcate a disaster mitigation culture in future generations
RSF-1: Supply temporary refugee housings	<ol style="list-style-type: none"> 1) Formulate temporary refugee housing plan
RSF-2: Prepare emergency assistance for everyday life	<ol style="list-style-type: none"> 1) Formulate basic policy for emergency assistance for everyday life.
RSF-3: Establish debris clearance and management system	<ol style="list-style-type: none"> 1) Formulate debris clearance plan for the LGUs
RSF-4: Restore public and social services	<ol style="list-style-type: none"> 1) Formulation of basic policy for post-disaster peace and order keeping activities
RSF-5: Establish post-disaster reconstruction system	<ol style="list-style-type: none"> 1) Formulate basic reconstruction policies for living, housing, employment and economic activities. 2) Formulate guidelines to urban reconstruction and make a scheme of finances and credits.
RSF-6: Enhance institutional aspect of recovery planning	<ol style="list-style-type: none"> 1) Establish pre-disaster policies and institutional arrangements for post-disaster reconstruction and mitigation 2) Prepare pre-disaster recovery plans and procedures to ease post-disaster human and physical recovery and rehabilitation
R&D-1: Promote sustained research and development on earthquake	<ol style="list-style-type: none"> 1) Evaluate activity of the Valley Fault System 2) Expand of basic inventory on buildings and population for detail damage estimation purpose 3) Promote detail study on comprehensive earthquake disaster estimation

3.4.2 High Priority Action Plans

1) Prioritization Needs and Process

Among the 105 identified priority action plans in the master plan, 40 of them are selected as high priority action plans. These selected high priority action plans are essential plans to be initiated as initial steps within 3-6 years, in accordance with the overall basic strategies to improve the existing situation.

For selecting the high priority action plans, five areas were focused to prioritize the action plans. The areas of focus are identified as in the following table together with the aim and reason.

Table 3.4.2 Areas of Focus for Prioritization

Area	Aim/Reason
Area 1: Enhance legal framework and institutional capacity for disaster management	By consolidating the legal background for disaster management from national to barangay level, the disaster management system of Metropolitan Manila will be strengthened
Area 2: Build Basic Capacity for Relief and Recovery	Prepare for responding to the survival needs of the people
Area 3: Strengthen Community Preparedness for the Earthquake	To survive by the community's own capacity without relying on governmental institutions
Area 4: Reduce Dangers of Residential Buildings	Reducing the amount of damages to residential buildings will minimize the estimated losses
Area 5: Enhance National System Resistant to Earthquake	Enhancing national systems resistant to earthquake damage and disruption

2) Selected High Priority Action Plans

The following table gives the brief description of selected 40 high priority action plans, including framework number, outline, and implementation agencies.

Table 3.4.3 List of High Priority Action Plans

Area 1 : Enhance legal framework and institutional capacity for disaster management		
Strategy 1: Enhance legal basis for disaster management		
No.	Action Plan	Implementing Agency
RMS-3:	Strengthen legal basis for disaster management at the national level by updating/replacing PD1566	The President, acting on the request of stakeholders such as the NDCC and MMDCC
RMS-3:	Strengthen legal basis at the local level by adopting model city/municipal ordinance	MMDA, Metropolitan Manila Council, Mayors and Local Legislative Councils
Strategy 2: Strengthen institutional capacity for mitigation, preparedness and response		
No.	Action Plan	Implementing Agency
RMS-4:	Promote the reorganization and revitalization of city/municipal and barangay Disaster Coordinating Councils	MMDCC, Mayors, City and Municipal DCCs
RMS-4:	Promote local government mitigation planning through implementation of the Earthquake Mitigation Handbook and the Earthquake Mitigation and Response Checklists -- Local Planning Guide	MMDCC to distribute the guides with endorsement and instructions; appropriate agencies to place guides on their websites.
RMS-4:	Conduct training needs assessment and develop capacity building programs for local and barangay DCCs	MMDCC, with assistance of DILG and OCD
RMS-6:	Encourage local emergency response planning through use of the Earthquake Mitigation and Response Checklists---Local Planning Guide	MMDCC to distribute the guide with endorsement and instructions; appropriate agencies to place on websites.
RMS-6 /RMS-16:	Encourage adoption and utilization of Emergency Response Pocket Guide and Guide for Managing Information by agencies and LGUs	MMDCC, C/MDCCs MMDCC, MMDA, and LGUs
Strategy 3: Strengthen inter-institutional coordination		
No.	Action Plan	Implementing Agency
RMS-5:	Strengthen MMDCC by updating its structure and organizing and implementing a MMDCC Work Plan	MMDCC, MMDA
RMS-5:	Encourage inter-local cooperation through zonation of LGUs and Mutual Aid Agreements	MMDCC, MMC, LGUs
Concept 2 : Build Basic Capacity for Relief and Recovery		
Strategy 1: Enhance emergency health and medical response system		
No.	Action Plan	Implementing Agency
RMS-11:	Enhance organizational response capacities	1. Prime: LGU, Coordinator: MMDA and DOH 2. Prime: LGU, Coordinator: MMDA and DOH 3. Prime: DOH, some of LGUs and other governments' hospitals
RMS-11:	Improve government hospital capacities	Prime: DOH and Provincial Governments
RMS-11:	Enhance logistics and medical supplies	Prime: LGU, DOH and other government's agency with hospitals

Strategy 2: Establish emergency transportation system		
No.	Action Plan	Implementing Agency
RMS-12:	Establish emergency road network	MMDA
RMS-12:	Secure road between Batangas Port to Metropolitan Manila south region	DPWH
RMS-12:	Convert one portion of Manila port to earthquake resistant construction	PPA
RMS-12:	Secure road between Subic port/ Clark field to Metropolitan Manila North region	DPWH
RMS-12:	Construct Laguna de bay northern shore unloading facility	MMDA/PPA
RMS-12:	Secure Ninoy Aquino airport function	DOTC
Strategy 3: Secure water		
No.	Action Plan	Implementing Agency
RMS-10:	Secure the large scaled water source for drinking	MMDA, DSWD
RMS-10:	Formulate emergency supply system of water, (food, and other necessities)	LGUs, MMDA, DSWD
Concept 3 : Strengthen community preparedness for the earthquake		
Strategy 1: Enhance self reliant and mutual help for efficient risk management capacity		
No.	Action Plan	Implementing Agency
CRI-1:	Knowledge development about earthquake hazards and vulnerabilities	PHIVOLCS, MMDA, LGUs
CRI-1:	Enhance the community governance and linkage with LGUs	LGU, barangay (pilot)
CRI-1:	Enhance potential emergency management capacities	MMDA, LGU, barangay
CRI-1:	Enhance the administrative system supporting community activities	Barangay, LGU
Strategy 2: Inculcate a disaster mitigation culture in future generations		
No.	Action Plan	Implementing Agency
CRI-2:	Enhance school risk management capacity	Dep Ed, LGU, schools
CRI-2:	Inculcate a disaster mitigation culture in future generations	Dep Ed, LGU, schools
Concept 4 : Reduce dangers of residential buildings		
Strategy 1: Strengthen buildings against earthquake		
No.	Action Plan	Implementing Agency
USI-1:	Promote subdivision development procedures	HUDCC, MMDA, Private
USI-3:	Promote disaster resistant urban development/ re-development	LGUs (Monitored by HLURB)
USI-3:	Enforce and develop laws and regulations related to urban planning and building code	HUDCC, DPWH
USI-4:	Research and development on strengthening buildings	DPWH, ASEP, PEIS and Researchers, Construction Industry
USI-4:	Promote construction and improvement for earthquake resistant buildings	Residents, Housing developer, LGUs

Strategy 2: Avoid fire outbreaks from residential buildings		
No.	Action Plan	Implementing Agency
USI-2:	Tie down and stabilize propane cylinders against earthquake shaking	LGU/ barangay
USI-2:	Promote replacement to unbreakable (plastic-bottled) gasoline vending	BFP
Strategy 3: Propel research and technology development on earthquake impact reduction		
No.	Action Plan	Implementing Agency
R&D-1:	Evaluate activity of the valley fault system	PHIVOLCS
Concept 5 : Enhance National System Resistant to Earthquake		
Strategy 1: Protect stability of national government function		
No.	Action Plan	Implementing Agency
NSD-1:	Enhance continuity of national government function with the President's office	LGUs, MMDA, Presidential Office
NSD-1:	Promote urban reform around the nationally important facilities	MMDA, Presidential Office
Strategy 2: Protect stability of socio-economic system		
No.	Action Plan	Implementing Agency
NSD-2:	Enhance emergency measures by businesses	MMDA, Presidential Office, Chamber of Commerce
NSD-2:	Enhance safety of online financial services	MMDA, Presidential Office, Chamber of Commerce
NSD-2:	Enhance disaster finance system	Presidential Office, Chamber of Commerce, NEDA