

Japan International Cooperation Agency (JICA)  
Metropolitan Manila Development Authority (MMDA)  
Philippine Institute of Volcanology and Seismology (PHIVOLCS)

# **Earthquake Impact Reduction Study for Metropolitan Manila, Republic of the Philippines**

**Final Report  
Volume 2  
Main Report 1**

**March 2004**

Pacific Consultants International  
OYO International Corporation  
PASCO Corporation

## **Formation of the Final Report**

The Final Report is comprised of the following volumes:

**Volume 1: Executive Summary**

**Volume 2: Main Report 1**

**Volume 3: Main Report 2**

**Volume 4: Main Report 3**

**Volume 5: Supporting Report**

**Volume 6: Data Book**

Volume 1, Executive Summary, contains the background information of this MMEIRS study, brief information of earthquake damage scenario for Metropolitan Manila, and summary of the master plan for a safer Metropolitan Manila for earthquake impact.

Volume 2, Main Report 1, contains the information of overall study and its results; that is the background information of this study, earthquake damage scenario, and master plan and action plans for safer Metropolitan Manila.

Volume 3, Main Report 2, defines problem of the present condition of Metropolitan Manila, and represents damage estimation results together with its assumptions and methodologies.

Volume 4, Main Report 3, contains supportive components related to master plan to help understanding the development of master plan.

Volume 5, Supporting Report, contains information on GIS Development and Topographic Map Compilation. It also includes other important outputs of the study, such as city ordinance of earthquake disaster management, earthquake disaster mitigation handbook, and earthquake mitigation and response checklists. Those outputs will be utilized when implementing the master plan.

Volume 6, Data Book, contains various data used for analysis in this Study. In addition, data related to earthquake hazard analysis and damage analysis are stored in CD-ROM.

The following foreign exchange rate is applied on this study report;

US\$1.00=P56.055

(February 2004)

## PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct Earthquake Impact Reduction for Metropolitan Manila, Republic of the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team, headed by Mr. Noboru IKENISHI of Pacific Consultants International, consisted of Pacific Consultants International, OYO International Corporation, PASCO Corporation, between August 2002 and March 2004. In addition, JICA set up an advisory committee headed by Mr. Masayuki WATANABE, Senior Advisor, Institute for International Cooperation JICA, between August 2002 and March 2004, which examined the study from specialist and technical point of view.

The team held discussions with the officials concerned of the Government of the Republic of the Philippines and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

March, 2004

Kazuhisa MATSUOKA  
Vice-President  
Japan International Cooperation Agency

Mr.Kazuhisa MATSUOKA  
Vice President  
Japan International Cooperation Agency  
Tokyo, Japan

March 2004

### **Letter of Transmittal**

Dear Mr. MATSUOKA,

We are pleased to formally submit herewith the final report of “Earthquake Impact Reduction Study for Metropolitan Manila, Republic of the Philippines”.

This report compiles the result of the study which was undertaken in the Republic of the Philippines from August 2002 through March 2004 by the Study Team organized by Pacific Consultants International, OYO International Corporation and Pasco Corporation under the contract with the JICA.

The Final Report is composed of the “Summary Report”, “Main Reports”, “Supporting Report”, and “Data Book”. In the main report, existing social and physical conditions of the Metropolitan Manila are described and earthquake damage analysis was carried out based on the scenario earthquake. Urban vulnerability of Metropolitan Manila was also analyzed to indicate the regional characteristic of earthquake damage. Based on the results of these analyses, recommendations for earthquake disaster mitigation for short, middle, and long term perspectives were prepared as a master plan of this study.

In addition to the report compilation, 1:5,000 scale topographic maps covering the whole Metropolitan Manila were compiled by digital mapping methodology. Integrated GIS database for the study area was also developed by the study team. These digital data will support not only the future disaster management planning, but also the land use planning, environmental management and urban development of the Metropolitan Manila.

Finally, we would like to express our sincere gratitude and appreciation to all the officials of your agency, the JICA advisory Committee, the Embassy of Japan in Philippines, JICA Philippine office, and Ministry of Foreign Affairs. We also would like to send our great appreciation to all those extended their kind assistance and cooperation to the Study Team, in particular, relevant officials of Metropolitan Manila Development Authority and Philippine Institute of Volcanology and Seismology, the Philippine counterpart agencies.

Very truly yours,

Noboru IKENISHI  
Team Leader  
Earthquake Impact Reduction  
Study for Metropolitan Manila,  
Republic of the Philippines



REPUBLIKA NG PILIPINAS  
TANGGAPAN NG PANGULO

**Pangasiwaan Sa Pagpapaunlad Ng Kalakhang Maynila**

(Metropolitan Manila Development Authority)

*"Tapat na Serbisyo sa Bagong Milenyo"*

**METRO MANILA COUNCIL**

MMDA Resolution No. 04-03  
Series of 2004

**DECLARING THE COMMITMENT TO MAKE METRO MANILA SEISMICALLY SAFE AND ESTABLISHING THE MUTUAL AID AGREEMENT AMONG THE LOCAL GOVERNMENT UNITS OF METRO MANILA IN THE EVENT OF DISASTERS**

**WHEREAS**, the recent Earthquake Impact Reduction Study for Metro Manila (MMEIRS) being conducted by the Metropolitan Manila Development Authority (MMDA), Philippine Institute of Volcanology and Seismology (PHIVOLCS) and the Japan International Cooperation Agency (JICA) with support from the Government of Japan, indicate that the region is exposed to high risk from a strong-magnitude earthquake;

**WHEREAS**, aware and conscious about the adverse impact of such risk in the development of Metropolitan Manila and on the lives and properties of its constituents, there is a need to implement measures to reduce the vulnerability of the metropolis from the seismic hazard;

**WHEREAS**, the Local Government Code and Presidential Decree No. 1566 mandate the local government units and all instrumentalities of government with the participation of the private sector to enhance their respective capacities to prevent, prepare for, and respond effectively to disaster situations respectively;

**WHEREAS**, the resources that may be needed to cope with large disaster situations, particularly brought about by a strong earthquake may be beyond the capacity of a single Local Government Unit in Metro Manila;

**WHEREAS**, the Metro Manila Council (Council) recognizes the urgent need to implement necessary measures that will reduce and mitigate the negative impacts of a strong earthquake in view of the findings of the Study.

**NOW, THEREFORE**, be it resolved as it is hereby resolved, pursuant to Section 6 of RA 7924, that the Council hereby declares its commitment to make Metro Manila seismically safe and hereby establishes the mutual aid agreement among the Local Government Units in the event of disasters.

**MMDA Building EDSA Cor. Orense St. Guadalupe, Makati City**  
Trunklines: 8824151-77 • Fax No. (632) 8822628  
Emergency No. (Metrocall) 136  
METROBASE Tel. Nos. 8820877 • 8820860 • Fax No. 8820889

DECLARING THE COMMITMENT TO MAKE METRO MANILA SEISMICALLY SAFE  
AND ESTABLISHING THE MUTUAL AID AGREEMENT AMONG THE LOCAL  
GOVERNMENT UNITS OF METRO MANILA IN THE EVENT OF DISASTERS

X-----X

**RESOLVED FURTHER**, that as part of its commitment, it shall enjoin the Local Government Units (LGUs) of Metro Manila to:

- a. Revitalize their respective Disaster Management Councils and enhance their emergency preparedness and response capacities particularly to reduce and cope with earthquake disasters;
- b. Include earthquake disaster reduction projects and activities in their respective City or Municipal Priority Programs and provide financial support thereof; and,
- c. Institutionalize each Local Government Unit's Emergency Management Office or Unit to provide direction and continuity of disaster management programs implementation duly supported by Executive Orders and Ordinances.

**RESOLVED FURTHERMORE**, that the Council hereby urges the component Local Government Units of Metro Manila to bind themselves to mutually assist each other in the following aspects:

1. Implementing disaster preparedness and mitigation programs by sharing experiences, knowledge and technical skills;
2. Providing resources and assistance to LGUs that are greatly affected by disasters and whose needs have gone beyond their means to cope based on pre-arranged protocols; and,
3. Establishing Metro Manila Disaster Management Clusters in accordance with geographic contiguity for more efficient programs, response and assistance management.

**RESOLVED FINALLY**, that the Council hereby ensures to undertake the following:

1. Urge the Metropolitan Manila Development Authority to strengthen itself and the Metro Manila Disaster Coordinating Council (MMDCC) in order to provide efficient and effective coordinating mechanism and complement regional disaster management activities in support to the efforts of the local government units;
2. Respectfully request the President of the Republic of the Philippines through the National Disaster Coordinating Council (NDCC) to certify as urgent the various bills pending before the House of Congress aimed to strengthen the Philippine's Disaster Management System; and,

DECLARING THE COMMITMENT TO MAKE METRO MANILA SEISMICALLY SAFE  
AND ESTABLISHING THE MUTUAL AID AGREEMENT AMONG THE LOCAL  
GOVERNMENT UNITS OF METRO MANILA IN THE EVENT OF DISASTERS

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3. Further respectfully request the President of the Republic of the Philippines through the National Economic Development Authority (NEDA) to include disaster management as part of the priority concerns in the Philippine Development Plan.


Let copies of this Resolution be furnished to the Local Government Units of Metro Manila, the Member-Agencies of MMDCC, the NDCC and the NEDA.

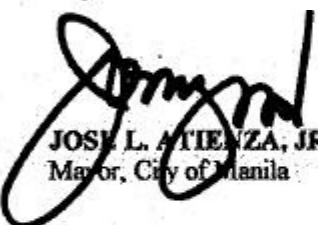
This Resolution shall take effect upon approval.

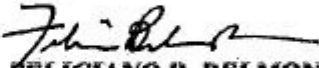
**DONE** this **29th** day of **January 2004**, in Makati City, Metro Manila, Philippines.

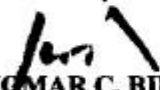
  
**BAYANI F. FERNANDO**  
Chairman

  
**BENJAMIN C. ABALOS, JR.**  
Mayor, Mandaluyong City

  
**VERGEL A. AGUILAR**  
Mayor, Las Piñas City

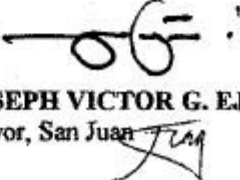
  
**JOSE L. ATIENZA, JR.**  
Mayor, City of Manila

  
**FELICIANO R. BELMONTE, JR.**  
Mayor, Quezon City

  
**JEJOMAR C. BINAY**  
Mayor, City of Makati

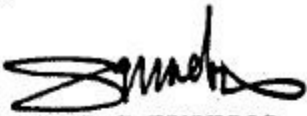
  
**ROSENDO T. CAPCO**  
Mayor, Pateros

  
**BOBBIN L. CARLOS, M.D.**  
Mayor, Valenzuela City

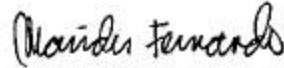
  
**JOSEPH VICTOR G. EJERCITO**  
Mayor, San Juan

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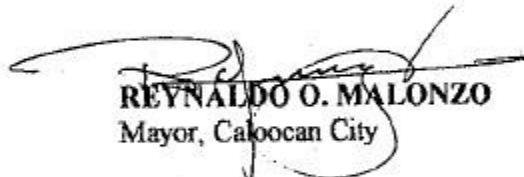
**SOLEDAD C. EUSEBIO**  
Mayor, Pasig City



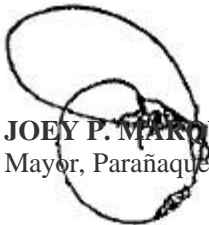
**MA. LOURDES C. FERNANDO**  
Mayor, Marikina City



**JAIME R. FRESNEDI**  
Mayor, City of Muntinlupa



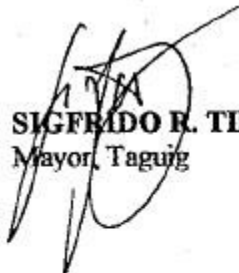
**REYNALDO O. MALONZO**  
Mayor, Caloocan City



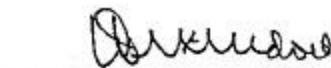
**JOEY P. MARQUEZ**  
Mayor, Parañaque City



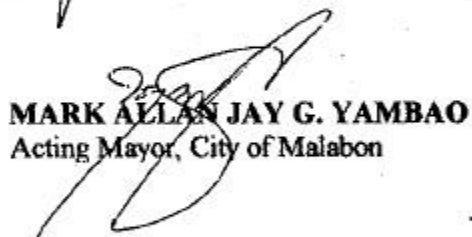
**TOBIAS M. TIANGCO**  
Mayor, Navotas



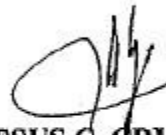
**SIGFRIDO B. TINGA**  
Mayor, Taguig



**WENCESLAO B. TRINIDAD**  
Mayor, Pasay City



**MARK ALLAN JAY G. YAMBAO**  
Acting Mayor, City of Malabon



**JESUS C. CRUZ**  
Chairman  
Metro Manila Vice Mayors League



**PERPETUO F. CAMILA**  
President  
Metro Manila Councilors League



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## ***PROFILE OF THE STUDY***

### ***1. GENERAL***

#### **1.1 Study Outline**

Outline of the Study is as follows:

Study Title: Study for Earthquake Impact Reduction for Metropolitan Manila in the Republic of the Philippines (MMEIRS)

Implementation Agency: Japan International Cooperation Agency

Counterpart Agency: Metropolitan Manila Development Authority (MMDA)

Philippine Institute of Volcanology and Seismology (PHIVOLCS)

Study Period: From August 2002 to March 2004

#### **1.2 Background and Contents of the Study**

Metropolitan Manila, composed of 13 cities and 4 municipalities by its administrative boundaries, is the political, economic, and cultural center of the Philippines. The population of Metropolitan Manila is approximately 10 million at present and it is now one of the most densely populated areas in Southeast Asia. Geographically, Metropolitan Manila is located on Luzon Island. Numerous earthquake sources are located in and around it. Among these faults, the Valley Fault System, which transects the study area, is considered to potentially cause the largest impact to the Metropolitan Manila area should it generate a large earthquake. Many research studies indicate that active phases of the Valley Faults are approaching and the estimated magnitude will be around 7 or more. In order to manage a potential earthquake disaster in Manila, it is necessary to prepare an earthquake disaster mitigation plan, and to start actions as soon as possible. The objectives of the Study are: 1) to formulate a master plan for earthquake impact reduction for Metropolitan Manila in the Republic of the Philippines, and 2) to carry out technology transfer to Philippine counterpart personnel of MMDA and PHIVOLCS in the course of the Study. Major contents of the Study are: 1) existing data collection and evaluation, 2) geological survey, 3) social condition survey, 4) Building and infrastructure survey, 5) important public facilities survey and dangerous material treatment facilities survey, 6) GIS database development, 7) production of 1:5,000 scale digital topographic maps, 8) analysis of earthquake ground motion and hazards, 9) earthquake damage estimation, 10) preparation of disaster management plan for Metropolitan Manila, and 11) community based disaster management activities.

### ***2. EARTHQUAKE DAMAGE SCENARIO***

#### **2.1 Scenario Earthquake**

Analyzing past historically recorded earthquakes and instrumentally recorded earthquakes, a total 18 earthquakes were selected as scenario earthquakes, which have potential damaging effect to

Metropolitan Manila; also earthquake ground motion, liquefaction potential, slope stability and tsunami height are estimated. Finally three models (namely, model 08 (West Valley Faults M.7.2), Model 13 (Manila Trench M.7.9), Model 18 (1863 Manila Bay M.6.5)), were selected for detail damage analysis because these scenario earthquakes show typical and severe damages to Metropolitan Manila.

Model 08, as the worst case, 170,000 residential houses will collapse, 340,000 residential houses will be partly damaged, 34,000 persons will die, 114,000 persons will be injured.

Fire will breakout and burnt approximately 1,710 hectares and totally 18,000 additional persons will be killed by this secondary disaster. Moreover, infrastructures and lifelines will also be heavily damaged.

## 2.2 Urban Vulnerability against Earthquake Damage

Based on the damage analysis results, urban vulnerability of Metropolitan Manila was analyzed.

Regional vulnerability characteristics against earthquake are as follows:

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

Metropolitan Manila will possibly be separated into four regions by the earthquake impact. Reasons for regional separation are summarized as follows:

Metropolitan Manila West	Western part of Metropolitan Manila will be isolated from other part of Metropolitan Manila by fire and building collapse
Metropolitan North, and Metropolitan South	Northern and Southern part of Metropolitan Manila will be separated by the building collapse and the geographical condition. The intersecting area between Mandaluyong and Makati has a high possibility of building collapse; moreover, Pasig River is running through east-west which is naturally disadvantageous in terms of separation.
Metropolitan East	All road networks running east-west, which are on the fault will be broken due to the movement. Other roads running North-South in fault areas will be difficult to use, due to the high number of building collapse.

## 3. MASTER PLAN

### 3.1.1 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.

### **3.1.2 Overall Structure of the Plan**

#### **1) Assumption**

Based on the damage estimation by MMEIRS Study of the potential rupture of West Valley Fault, approximately 40% of the total number of residential buildings within Metropolitan Manila will collapse or be affected. This building collapse directly affects large numbers of people, since it is estimated to cause 34,000 deaths and 114,000 injuries. Moreover, additional 18,000 deaths are anticipated by the fire spreading after the earthquake event. This human loss, together with properties and economy losses of Metropolitan Manila will be a national crisis.

#### **2) Vision**

“The earthquake impact reduction plan for Metropolitan Manila” prepared by the Metropolitan Manila Earthquake Impact Reduction Study anticipates the mitigation and reduction of the expected impact. The vision of this plan is to ultimately achieve “*A Safer Metropolitan Manila from Earthquake Impact*”.

#### **3) Goals, Objectives and Frameworks**

To attain this *vision*, six goals have been addressed as follows:

- 1) To develop a national system resistant to earthquake impact
- 2) To improve Metropolitan Manila’s urban structure resistant to earthquake
- 3) To enhance effective risk management system
- 4) To increase community resilience
- 5) To formulate reconstruction systems
- 6) To promote research and technology development for earthquake impact reduction measures.

These goals have 10 objectives, and the objectives are broken down into 34 frameworks. The frameworks represent main policies and strategies to achieve goals and objectives. This organization of the vision, goals, objectives, and frameworks is summarized in Figure 1.

#### **4) Frameworks and Action Plans**

The frameworks contain 105 action plans. The action plans are prepared to put in practice the policies and strategies represented in the frameworks.

### **3.2 Priority Action Plans**

Among the 105 identified 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.

## ***EXECUTIVE SUMMARY OF THE STUDY RESULTS***

### **1. GENERAL**

#### **1.1 Introduction**

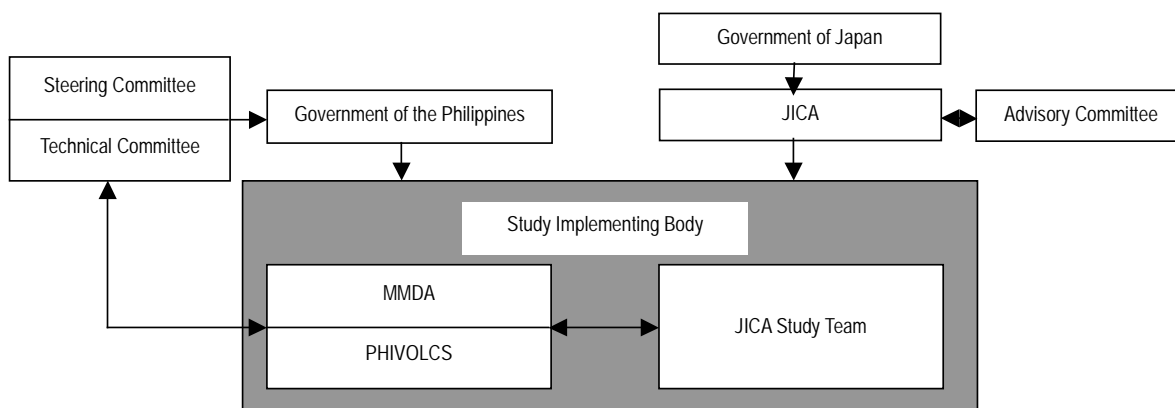
The basic organizational information of the Study and its organizational relationships are as follows:

Study Title: Study for Earthquake Impact Reduction for Metropolitan Manila in the Republic of the Philippines (MMEIRS)

Implementation Agency: Japan International Cooperation Agency

Counterpart Agency: Metropolitan Manila Development Authority (MMDA)  
Philippine Institute of Volcanology and Seismology (PHIVOLCS)

Study Period: From August 2002 to March 2004



Study Organization

#### **1.2 Background of the Study**

Metropolitan Manila, which is composed of 13 cities and 4 municipalities, is the political, economic, and cultural center of the Philippines. The population of Metropolitan Manila is approximately 10 million at present and it is now one of the most densely populated areas in Southeast Asia. The rapid urbanization of Metropolitan Manila has resulted in unsatisfactory infrastructure construction, poor housing condition, highly dense areas, and areas characterized by mixed land use and other inappropriate conditions. Thus, the potential for natural disaster in Metro Manila is high and the reduction of its vulnerability is a pressing issue for the safety of residents.

Geographically, Metropolitan Manila is located on Luzon Island. It is transected or surrounded by numerous earthquake generators. Among the active faults, the Valley Fault System, which

transects the eastern part of the study area, is considered to potentially cause the largest impact to the Metropolitan Manila area should it generate a large maximum earthquake. Recent studies show that the West Valley Fault has moved at 4 times and generated strong earthquakes within the last 1400 years. The approximate return period of these earthquakes is less than 500 years and no event along the West Valley Fault is known after 17th century, it means that the active phases of the Valley Faults is approaching. Many research studies indicate that the estimated magnitude will be around 7 or more.

In order to manage the potential earthquake disaster in Metropolitan Manila, it is necessary to prepare an earthquake disaster mitigation plan, and to start actions as soon as possible. The disaster management plan will focus on raising awareness of concerned organizations, employ a comprehensive disaster management approach, and strengthen vertical synergetic networks from the central government to local governments, and communities.

### **1.3 Scope of the Study**

The objectives of the Study are to:

- 1) Formulate a master plan for earthquake impact reduction for Metropolitan Manila in the Republic of the Philippines, and
- 2) Carry out technology transfer to Philippine counterpart personnel, of MMDA and PHIVOLCS, in the course of the Study.

The major contents of the Study are, 1) existing data collection and evaluation, 2) geological survey, 3) social condition survey, 4) building and infrastructure survey, 5) important public facilities survey and dangerous material treatment facilities survey, 6) GIS database development, 7) production of 1:5,000 scale digital topographic maps, 8) analysis of earthquake ground motion and hazards, 9) earthquake damage estimation, 10) preparation of disaster management plan for Metropolitan Manila, and 11) community based disaster management activities.

## **2. *EARTHQUAKE DAMAGE SCENARIO***

### **2.1 Scenario Earthquake**

Based on analyses of historically recorded earthquakes and instrumentally recorded earthquakes, 18 earthquakes are selected as scenario earthquakes, which has potential damage effect to Metropolitan Manila. The corresponding earthquake ground motion, liquefaction potential, slope stability and height of tsunami that might be generated are estimated. Finally three models, Model 08 (West Valley Faults), Model 13 (Manila Trench), Model 18 (1863 Manila Bay), are selected for detailed damage analysis because these scenario earthquakes might cause severe damages to Metropolitan Manila.

Scenario Earthquake	Model	Model 08	Model 13	Model 18
	Magnitude	7.2	7.9	6.5
	Fault Mechanism	Inland Fault	Subduction	Unknown
	Seismic Intensity (PEIS)	Almost VIII, IX alongside Marikina River and Manila Bay,	VIII at West of Metropolitan Manila, VII at other area	Almost VIII, VII at Quezon City
	Tsunami	Will not occur	Maximum 4m, Average 2m alongside Manila Bay	Small effect

### PHIVOLCS Earthquake Intensity Scale (PEIS)

Scale	Condition	Modified Mercalli Intensity	Japan Metrological Agency Intensity	Scale	Condition	Modified Mercalli Intensity	Japan Metrological Agency Intensity
I	Scarcely Perceptible	I	0	VI	Very Strong	VI	4
II	Slightly Felt	II	1	VII	Destructive	VII	4
III	Weak	III	2	VIII	Very Destructive	VIII, IX	5-6
IV	Moderately Strong	IV	2-3	IX	Devastating	X, XI	7
V	Strong	V	3	X	Completely Devastating	XII	7

## 2.2 Residential Building Damage and Human Casualties

Scenario Earthquake	Model		Model 08	Model 13	Model 18
	Magnitude		7.2	7.9	6.5
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%)

## 2.3 Fire Damage

Scenario Earthquake	Model		Model 08	Model 13	Model 18
	Magnitude		7.2	7.9	6.5
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%)	-	-

## 2.4 Infrastructure and Lifeline Damage

Scenario Earthquake	Model		Model 08	Model 13	Model 18	
	Magnitude		7.2	7.9	6.5	
Bridge 213 (with detailed inventory and stability analysis 189) Flyover 80 (with detailed 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%

## 2.5 Damage Scenario

Earthquake damage scenario during one week after the earthquake occurrence is compiled for scenario earthquake model 08 (West Valley Fault, Magnitude 7.2). Furthermore, this is translated into a script for better understanding.

## 2.6 Urban Vulnerability against Earthquake Damage

Regional vulnerability characteristics against earthquake are as follows:

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

Metropolitan Manila will possibly be separated into four regions because of the earthquake impact. Reasons for regional separation are summarized as follows:

Metropolitan Manila West	Western part of Metropolitan Manila will be isolated from other part of Metropolitan Manila by fire and building collapse
Metropolitan North, and Metropolitan South	Northern and Southern part of Metropolitan Manila will be separated by the building collapse and the geographical condition. The intersecting 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.
Metropolitan East	All road networks running east-west, which are on the fault will be broken due to the movement. Other roads running North-South in fault areas will be difficult to use, due to the high number of building collapse.

### **3. MASTER PLAN**

#### **3.1 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 system in the Philippines is not enough to cope with expected earthquakes damages

Each framework describes the following:

- Understandings / Concerns
- Basic policy / Basic concept of framework
- Action plans

The Basic policy / Basic concept of framework include several strategies that are encapsulated in various action plans designed to lead to accomplishment of the framework's goal and objectives. The highest 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 Overall structure of the Plan**

##### **1) Assumption**

Based on the damage estimation by MMEIRS Study of the potential rupture of West Valley Fault, approximately 40% of the total number of residential buildings within Metropolitan Manila will collapse or be affected. This building collapse directly affects large numbers of people, since it is estimated to cause 34,000 deaths and 114,000 injuries. Moreover, additional 18,000 deaths are anticipated by the fire spreading after the earthquake event. This human loss, together with properties and economy losses of Metropolitan Manila will be a national crisis.



## 2) Vision

“The earthquake impact reduction plan for Metropolitan Manila” prepared by the Metropolitan Manila Earthquake Impact Reduction Study anticipates the mitigation and reduction of the expected impact. The vision of this plan is to ultimately achieve “*A Safer Metropolitan Manila from Earthquake Impact*”.

## 3) Goals, Objectives and Frameworks

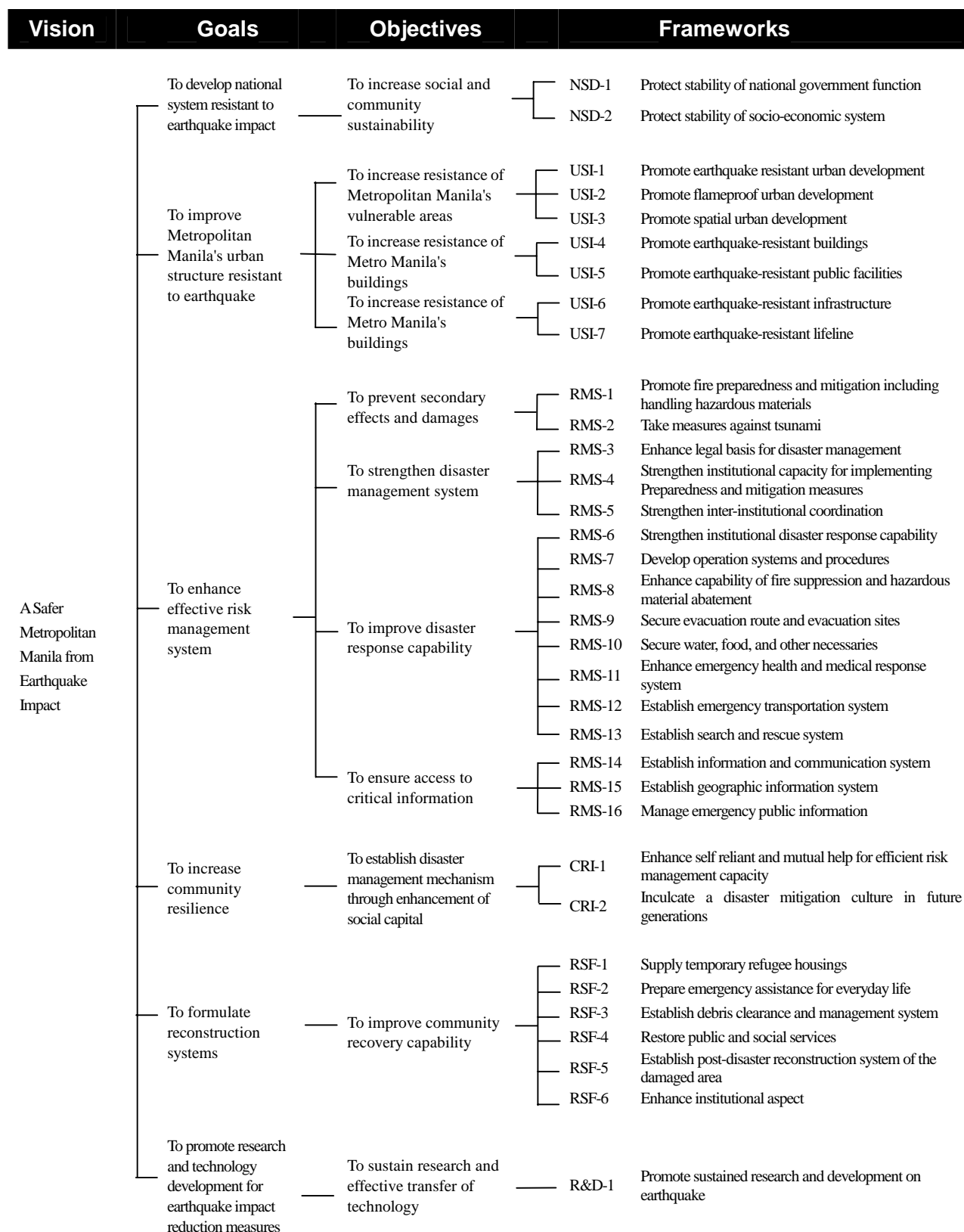
To attain this *vision*, six goals have been addressed as follows:

- 1) To develop a national system resistant to earthquake impact
- 2) To improve Metropolitan Manila’s urban structure resistant to earthquake
- 3) To enhance effective risk management system
- 4) To increase community resilience
- 5) To formulate reconstruction systems
- 6) To promote research and technology development for earthquake impact reduction measures.

These goals have 10 objectives, and the objectives are broken down into 34 frameworks. The frameworks represent main policies and strategies to achieve goals and objectives. This organization of the vision, goals, objectives, and frameworks is summarized in Figure 1.

## 4) Frameworks and Action Plans

The frameworks contain 105 action plans. The action plans are prepared to put in practice the policies and strategies represented in the frameworks.



**Figure 1. Structure of the Disaster Management Plan for Metropolitan Manila**

### 3.3 High Priority Action Plans

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. Table 3.3.1 shows the list of high priority action plans.

**Table 3.3.1 List of High Priority Action Plans**

<b>Concept 1 : Enhance legal framework and institutional capacity for disaster management</b>	<b>Concept 3 : Strengthen community preparedness for the earthquake</b>
<b>Strategy 1: Enhance legal basis for disaster management</b>	<b>Strategy 1: Enhance self reliant and mutual help for efficient risk management capacity</b>
RMS-3: Strengthen legal basis for disaster management at the national level by updating/replacing PD1566	CRI-1: Knowledge development about earthquake hazards and vulnerabilities
RMS-3: Strengthen legal basis at the local level by adopting model city/municipal ordinance	CRI-1: Enhance the community governance and linkage with LGUs
<b>Strategy 2: Strengthen institutional capacity for mitigation, preparedness and response</b>	CRI-1: Enhance potential emergency management capacities
RMS-4: Promote the reorganization and revitalization of city/municipal and barangay Disaster Coordinating Councils	CRI-1: Enhance the administrative system supporting community activities
RMS-4: Promote local government mitigation planning through implementation of the Earthquake Mitigation Handbook and the Earthquake Mitigation and Response Checklists -- Local Planning Guide	<b>Strategy 2: Inculcate a disaster mitigation culture in future generations</b>
RMS-4: Conduct training needs assessment and develop capacity building programs for local and barangay DCCs	CRI-2: Enhance school risk management capacity
RMS-6: Encourage local emergency response planning through use of the Earthquake Mitigation and Response Checklists--Local Planning Guide	CRI-2: Inculcate a disaster mitigation culture in future generations
RMS-6 /RMS-16: Encourage adoption and utilization of Emergency Response Pocket Guide and Guide for Managing Information by agencies and LGUs	<b>Concept 4 : Reduce dangers of residential buildings</b>
<b>Strategy 3: Strengthen inter-institutional coordination</b>	<b>Strategy 1: Strengthen buildings against earthquake</b>
RMS-5: Strengthen MMDCC by updating its structure and organizing and implementing a MMDCC Work Plan	USI-1: Promote subdivision development procedures
RMS-5: Encourage inter-local cooperation through zonation of LGUs and Mutual Aid Agreements	USI-3: Promote disaster resistant urban development/ re-development
<b>Concept 2 : Build Basic Capacity for Relief and Recovery</b>	USI-3: Enforce and develop laws and regulations related to urban planning and building code
<b>Strategy 1: Enhance emergency health and medical response system</b>	USI-4: Research and development on strengthening buildings
RMS-11: Enhance organizational response capacities	USI-4: Promote construction and improvement for earthquake resistant buildings
RMS-11: Improve government hospital capacities	<b>Strategy 2: Avoid fire outbreaks from residential buildings</b>
RMS-11: Enhance logistics and medical supplies	USI-2: Tie down and stabilize propane cylinders against earthquake shaking
<b>Strategy 2: Establish emergency transportation system</b>	USI-2: Promote replacement to unbreakable (plastic-bottled) gasoline vending
RMS-12: Establish emergency road network	<b>Strategy 3: Promote research and technology development on earthquake impact</b>
RMS-12: Secure road between Batangas Port to Metropolitan Manila south region	R&D-1: Evaluate activity of the valley fault system
RMS-12: Convert one portion of Manila port to earthquake resistant construction	<b>Concept 5 : Enhance National System Resistant to Earthquake</b>
RMS-12: Secure road between Subic port/ Clark field to Metropolitan Manila North region	<b>Strategy 1: Protect stability of national government function</b>
RMS-12: Construct Laguna de bay northern shore unloading facility	NSD-1: Enhance continuity of national government function with the President's office
RMS-12: Secure Ninoy Aquino airport function	NSD-1: Promote urban reform around the nationally important facilities
<b>Strategy 3: Secure water</b>	<b>Strategy 2: Protect stability of socio-economic system</b>
RMS-10: Secure the large scaled water source for drinking	NSD-2: Enhance emergency measures by businesses
RMS-10: Formulate emergency supply system of water, (food, and other necessities)	NSD-2: Enhance safety of online financial services
-	NSD-2: Enhance disaster finance system

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## **Supporting Report**

### **<Part V GIS Development and Topographical Map Compilation>**

#### **Chapter 1. Topographical Mapping**

#### **Chapter 2. GIS Database System**

### **<Part VI Appendices>**

#### Outputs of the Study

1. City Ordinance on Disaster Management
2. Earthquake Disaster Mitigation Handbook
3. Earthquake Mitigation and Response Checklists -Local Planning Guide-
4. Guide for Managing Information Concerning Disasters
5. Community Activity Guidebook

#### Other Materials

Records of Workshops and Seminars

Sub contract outputs and other analysis (stored only in CD)

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## Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Official
ABC	Associate of Barangay Captains
ACP	Advance Command Post
ADB	Asian Development Bank
ADOC	Advance Disaster Operations Center
AMMS	Administrative & Manpower Management Service
AMP	Advanced Medical Post
ASEP	Association of Structural Engineers of the Philippines
ATC	Applied Technical Council
ATI	Asia Terminal Incorporated
BAC	Bids and Awards Committee
BDCC	Barangay Disaster Coordination Council
BFP	Bureau of Fire Protection
BOC	Bureau of Construction
BOD	Bureau of Design
BOE	Bureau of Equipment
BOM	Bureau of maintenance
BRS	Bureau of Research and Standards
C/GP	Clean/Green Personnel
CAR	Cordillera Administrative Region
CBD	Central Business District
CBDM	Community-Based Disaster Management
CBO	Community Based Organization
CDCC	City Disaster Coordination Council
CDMC	Core Disaster Medical Center
CDPP	Calamities & Disaster Preparedness Plan
CFMS	Comptrollership & Financial Management Service
CFS	City Fire Station
CH	City Hall
CHB	Concrete Hollow Brick
CHED	Commission on Higher Education
CHO	City Health Officers
CLUP	Comprehensive Land Use Plan
CMP	Community Mortgage Plan
COA	Commission on Audit
CSSR	Collapsed Structure Search and Rescue
DAO	Disaster Action Officer
DBM	Department of Budget & Management
DCC	Disaster Coordination Council
DECS	Department of Education, Culture & Sports
DENR	Department of Environment and Natural Resources
DEO	District Engineering Office
DIG	Disaster Imagination Game
DILG	Department of Interior and Local Government
DMCC	Disaster Management Coordinating Council
DMH	Disaster Medical Hospitals
DND	Department of National Defense
DOC	Disaster Operations Center
DOCCP	Disaster Center Command Post
DOH	Department of Health
DOTC	Department of Transportation and Communications
DPD	Division of Preventable Disease
DPOS	Department of Public Order and Safety
DPWH	Department of Public Works and Highways



DSO	Directorate for Special Operation
DSWD	Department of Social Welfare and Development
DepEd	Department of Education
ED	Engineering Department
EDM	Earthquake Disaster Management
EMB	Environmental Management Bureau
EMI	Earthquake and Megacities Initiative
EMIP	Emergency Management Institute of the Philippines
EMS	Emergency Medical Service (or System)
EMSA	Emergency Medical Services Authority
EMT	Emergency Medical Treatment
ESC	Environmental Sanitation Center
EVF	East Valley Fault
FD	Fire Department
FEMA	Federal Emergency Management Agency; The United States of America
FS	Fire station
FT	Fire Truck
GDP	Gross Domestic Product
GESI	Global Earthquake Safety Initiative
GIS	Geographic Information System
GMR	Greater Manila Region
GOJ	Government of Japan
GOP	Government of Republic of the Philippines
GPS	Global Positioning System
HEMS	Health Emergency Management Staff
HLURB	Housing and Land use Regulatory Board
HUDCC	Housing and Urban Development Coordination Council
ICS	Incident Command System
ICTSI	International Container Terminal Services, Inc
ICU	Intensive Care Unit
IEC	Information and Education Campaign
IRA	Internal Revenue Allotment
JICA	Japan International Cooperation Agency
JMAI	Japan Methodological Agency Intensity
KI	Key Informants
LCE	Local Chief Executives
LDCC	Local Disaster Coordinating Committee
LGC	Local Government Code
LGU	Local Government Unit
LHP	Local Health Personnel
LLO	Legislative Liaison Office
LPG	Liquefied Petroleum Gas
LRT	Light Rail Transit
LWUA	Local Water Utilities Administration
MAYERT	Makati Youth Emergency Rescue Unit
MCDCC	Makati City Disaster Coordinating Council
MDCC	Municipal Disaster Coordination Council
MEC	Ministry of Education and Culture
MERALCO	Manila Electric Company
MERG	Manila Emergency Response Group
MFS	Municipality Fire Station
MICT	Manila International Container Terminal
MIS	Monitoring and Information
MMA	Metro Manila Authority
MMDA	Metropolitan Manila Development Authority
MMDCC	Metropolitan Manila Disaster Coordinating Council
MMDOC	Metro Manila Disaster Operations Center
MMEIRS	Metropolitan Manila Earthquake Impact Reduction Study

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MMI	Modified Mercalli Intensity
MMUTIS	Metropolitan Manila Urban Transportation Integration Study (JICA)
MOA	Memorandum of Agreement
MRT	Metro Rail Transit
MRTC	Metropolitan Manila Transit Corporation
MSSD	Ministry of Social Services and Development
MSW	Marine Slipway
MWSS	Manila Waterworks and Sewerage System
NAIA	Ninoy Aquino International Airport
NAMRIA	National Mapping and Resource Information NAMRIA
NAPOCOR	National Power Corporation
NBCP	National Building Code of the Philippines
NCDA	National Civil Defense Administration
NCR	National Capital Region
NCRPO	National Capital Regional Police Office
NDCC	National Disaster Coordinating Council
NDMC	National Disaster Management Center
NEMA	National Emergency Management Association
NGO	Non-Governmental Organization
NHA	National Housing Authority
NHMFC	National Home Mortgage Finance Corporation
NPC	National Power Corporation
NS	Nurse Supervisor
NSCB	National Structure Code for Buildings
NSCP	National Structural Code of Philippines
NSO	National Statistics Office
NTC	National Telecommunications Commission
OCD	Office of Civil Defense
OPCEN	Operation center
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAHO	Pan American Health Organization
PD	Presidential Decree
PEAC	Pre-Qualification, Evaluation and Awards Committee for Consultancy
PEIS	PHIVOLCS Earthquake Intensity Scale
PERR	Philippine Earthquake Reconnaissance Report
PFZ	Philippine Fault Zone
PGA	Peak Ground Acceleration
PGV	Peak Ground Velocity
PHA	Philippine Hospital Association
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PICE	Philippine Institute of Civil Engineering
PIO	Public Information Officer
PLDT	Philippine Long Distance Telephone Company
PNCC	Philippine National Construction Corporation
PNP	Philippine National Police
PNRC	Philippine National Red Cross
PPA	Philippine Ports Authority
PTSD	Post-traumatic Stress Disorder
RA	Republic Act
RB	Road Board
RC	Reinforced Concrete
RCDG	Reinforced Concrete Deck Girder
RES	Regional Equipment Services
ROD	Regional Operations Division
RQD	Rock Quality Designation
RROZ	Rescue & Relief Operation Zones
RS	Resident Survey
RVS	Rapid Visual Screening

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S.W.M.O	Solid Waste Management Office
SARS	Severe Acute Respiratory Syndrome
SEAOC	Structural Engineers Association of California
SFS	Sub Fire Stations
SO	Surveillance Officer and RSI
SOP	Standard Operating Procedure
SPT	Standard Penetration Tests
SS	Strike Slip
SUMA	Supply Management Methodology
SWD	Solid Waste Department
TOT	Training of Trainers
UBC	Uniform Building Code
UHLP	Unified Home Lending Program
UNHCR	United Nations High Commissioner for Refugees
UN-OCHA	United Nations Office for the Coordination of Humanitarian Affairs
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator Projection
VCA	Vulnerability and Capacity Assessment
VFS	Valley Fault System
WB	World Bank
WHO	World Health Organization
WVF	West Valley Fault
WVFS	West Valley Fault System

***Part I      Main Report 1***  
***Outline of the Study***

***Chapter 1. General***

## **CHAPTER 1. GENERAL**

### **1.1 Introduction**

In response to the request of the Government of the Republic of the Philippines (hereinafter referred to as “GOP”), the Government of Japan (hereinafter referred to as “GOJ”) decided to conduct the “Study for Earthquake Impact Reduction for Metropolitan Manila in the Republic of the Philippines” (hereinafter referred to as “the Study” or by the acronym “MMEIRS” for short).

The Japan International Cooperation Agency (hereinafter referred to as “JICA”), the official agency responsible for the implementation of technical cooperation programs of GOJ, undertook the Study in accordance with the relevant laws and regulations in force in Japan.

On the part of GOP, the Metropolitan Manila Development Authority (hereinafter referred “MMDA”) and the Philippine Institute of Volcanology and Seismology (hereinafter referred “PHIVOLCS”), acted as the counterpart agencies to the Japanese Study Team (hereinafter referred “the Team”) and also as the coordinating bodies in relation with other governmental and non-governmental organizations concerned with the smooth implementation of the Study.

This Final Report is compiled to summarize all the Study contents.

### **1.2 Background of the Study**

Metropolitan Manila, which is composed of 13 cities and 4 municipalities, is the political, economic, and cultural center of the Philippines. The population of Metropolitan Manila is approximately 10 million at present. It has been developing and is now one of the most densely populated areas in Southeast Asia. Rapid population growth started in the 1970’s, when the population was approximately 4 million. It increased to 6 million in the 1980s, 8 million in the 1990s and 10 million at present. The population has increased by 2.5 times in the last 30 years. Additionally, this rapid population growth is affecting the fringe areas of Metropolitan Manila, and the population is expected to grow to 25 million by the year 2015 based on the estimate of another JICA Study.

Rapid urbanization usually occurs without satisfactory infrastructure construction. This condition often results in the poor housing condition, highly dense areas, and areas characterized by mixed land use and other inappropriate conditions. Thus, the potential for natural disaster increases and the reduction of vulnerability to disasters is a pressing issue for the safety of residents.

Geographically, Metropolitan Manila is located in Luzon Island. Numerous earthquake generators, such as the Valley Fault System (VFS), Philippine Fault, Lubang Fault, Manila Trench, and Casiguran Fault, are located in and around it. Among these faults, the Valley Fault System,

which transects the study area, is considered to potentially cause the largest impact to the Metropolitan Manila area should it generate a large maximum earthquake.

Topographically, the Metropolitan Manila area is composed of coastal lowlands, a central plateau where the central district including Makati is located, as well as alluvial lowlands along the Marikina River and the Laguna Lake. In case of an earthquake, liquefaction in these lowland areas may cause damage to buildings and infrastructure. In addition, tsunami can also occur along the Manila Bay.

Recent studies show that the West Valley Fault has moved at least 4 times and generated strong earthquakes within the last 1,400 years. The approximate return period of these earthquakes is less than 500 years and no event along the West Valley Fault is known after 17th century. This means that the active phases of the Valley Fault is approaching. Many research studies indicate that the estimated magnitude will be around 7 or more.

In order to manage the potential earthquake disaster in Metropolitan Manila, it is necessary to prepare an earthquake disaster mitigation plan, and to start actions as soon as possible. The disaster management plan will be focused on raising awareness of concerned organizations, employing a comprehensive disaster management approach, and strengthening vertical synergetic networks from the central government to local governments to communities.

Therefore, GOP requested GOJ to conduct this Study as a technical cooperation program. JICA, as the official implementation agency of this Study, sent a Team to the Philippines in middle of August 2000 to commence the project.

## **1.3 Scope of the Study**

### **1.3.1 Study Objectives**

The objectives of the Study were :

- 1) To formulate a master plan for earthquake impact reduction for Metropolitan Manila in the Republic of the Philippines.
- 2) To carry out technology transfer to Philippine counterpart personnel, of MMDA and PHIVOLCS, in the course of the Study.

### **1.3.2 Study Area**

The Study area covered the entire Metropolitan Manila, with an area of 636 km<sup>2</sup> (Figure 1.3.1).



Figure 1.3.1 Study Area



### 1.3.3 Schedule of the Study

The Study consisted of a variety of tasks. Figure 1.3.2 shows the work schedule of, and interrelations among the tasks, and shows the logical flow of the Study.

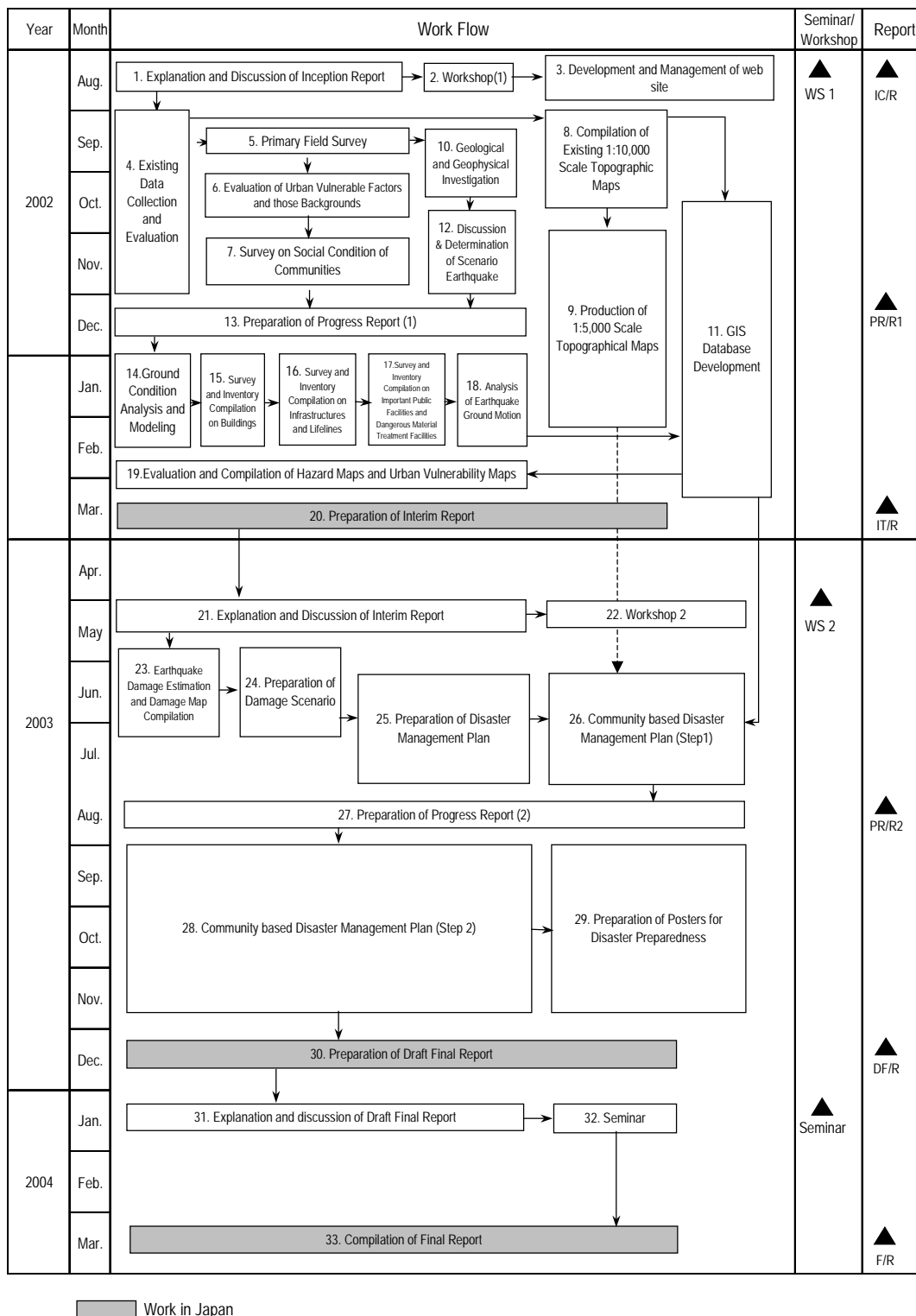


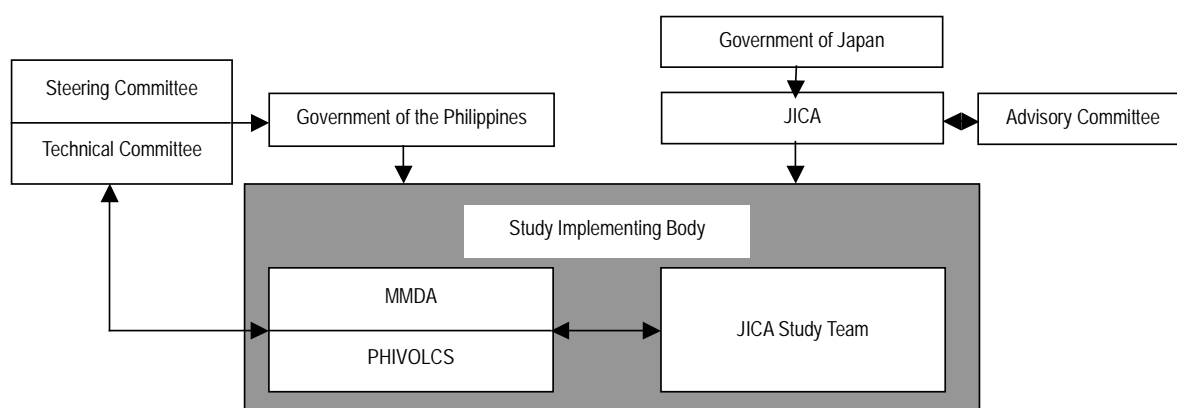
Figure 1.3.2 Work Flow of the Study

### 1.3.4 Implementing Organizations

The Study was carried out through the joint efforts of the JICA Study Team and Filipino counterpart personnel, who formed a study implementing body. The JICA Study Team was comprised of members from Pacific Consultants International (PCI), OYO International Corporation (OYO) and Pasco Corporation (PASCO). The Filipino counterparts were delegated from the Metropolitan Manila Development Authority (MMDA) and Philippine Institute of Volcanology and Seismology (PHIVOLCS), Department of Science and Technology.

In the Philippines, many agencies including governmental organizations, universities and research institutes have been conducting seismic research and disaster management activities. These agencies have accumulated a great amount of research data, information and reports on earthquakes of the Philippines. The valuable information, opinions and experiences of different agencies on earthquakes in the Philippines should be well integrated into the JICA Study. Information on existing urban conditions and future urban development in Manila is another significant data for the estimation of seismic damage. Therefore, a Steering and Technical Committee, composed of representatives from organizations involved in seismic research, and urban planning were organized to participate in MMEIRS to guide and advise on the directions and policy-related matters relating to the project.

Figure 1.3.3 shows the Study Organization. Table 1.3.1 to Table 1.3.4 shows the members of the Study Team, the Steering Committee, the Technical Committee, and the Counterparts, respectively.



**Figure 1.3.3 Study Organization**

**Table 1.3.1 Members of the Study Team and Assignments to be covered**
**JICA Advisory Committee**

Mr. Masayuki Watanabe	Leader/ Disaster Management Planning	Senior Advisor, JICA Institute for International Cooperation
Dr. Mitsumasa Midorikawa	Earthquake-resistance Assessment	Research Coordinator, Building Research Institute, Independent Administrative Institution
Mr. Ryohei Miura (April 2003-) Mr. Hitoshi Nishino (August 2002 – March 2003)	Urban Disaster Management	Construction Management Division, Research Center for Land and Construction Management, National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure and Transport

**Study Team**

Mr. Noboru Ikenishi	Team Leader/ Disaster Management Planning
Mr. Yutaka Koike	Deputy Team Leader/Geotechnical Engineering, Earthquake Disaster Management
Mr. Shukyo Segawa	Earthquake and Tsunami Engineering
Mr. Nobuhiko Toyama	Geological and Geophysical Survey
Dr. Tsunehisa Tsugawa	Building Engineering, Seismic Code
Mr. Ryoji Takahashi	Lifeline Engineering
Mr. Ryo Miyazaki	Infrastructure Engineering
Mr. Haruhiko Imai	Urban Planning
Mr. Hideyuki Sasaki	Regional Disaster Planning
Mr. Takeshi Morita	Fire Prevention, Dangerous Material Treatment
Ms. Tomoko Shaw	Community based Disaster Management
Ms. Shirley Mattingly	Institution and Organization 1
Dr. Gaudioso C. Sosmeña Jr.	Institution and Organization 2
Mr. Kazumi Akita	Disaster Relief, Medical Treatment
Mr. Yutaka Kokufu	Topographical Mapping
Mr. Joel Ferrer Cruz	GIS Development/ Disaster Information System
Ms. Kanako Iuchi	Urban-social Survey/ Project Administrator

**JICA Tokyo Headquarters**

Mr. Itsu Adachi (April 2003-) Mr. Senichi Kimura (August 2002 – March 2003)	Director	Director, Second Study Division, Social Development Study Department
Mr. Masafumi Nagaishi (December 2003 - ) Mr. Akio Kagawa (August 2002 – November 2003)	Deputy Director	Deputy Director, Second Study Division, Social Development Study Department
Mr. Hiroshi Fujimoto (December 2003 - ) Dr. Hisashi Suzuki (August 2002 – November 2003)	Staff	Staff, Second Study Division, Social Development Study Department

**JICA Expert, MMDA**

Mr. Yoshio Tanaka	JICA Expert	Sr. Urban Development Advisor
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**Table 1.3.2 Members of the Steering Committee**

Ms. Corazon Bautista-Cruz, EnP (September 2002- ) Mr. Rogelio U. Uianza (August 2002 – September 2002)	MMDA	MMDA AGM for Planning, Chair Ex-Chairman / AGM for Operation
Dr. Renato U. Solidum, Jr. (December 2002- ) Dr. Raymundo Punongbayan (August 2002 – December 2002)	PHIVOLCS	Director, Co-Chair Ex-Co-Chairman / Director
Mr. Arnel C. Capili	Office of Civil Defense	Regional Director
Dir. Emmy B. Reyes	Presidential Management Staff	Director, Admin Mgt Office
Engr. Liberato L. Requioma, Jr.	Department of Public Works & Highways (DPWH)	Engineer III
Engr. Ildelfonso T. Patdu Jr. (April 2003-present) Engr. Samuel C. Custodio (August 2002 – April 2003)	Department of Transportation and Communications	Director, Transport Planning Service Director, Transport Planning Service
Engr. Alvin T. Claridades	Housing and Urban Development Coordination Council (HUDCC)	PEO IV
Dr. Edmundo B. Lopez, MD., MPH.	Department of Health (DOH)	
Ms. Dominica P. Godinez	Department of Social Welfare and Development	Social Welfare Officer
Mr. Rizalino Jose P. Rosales	Department of Education	Admin Office V, DepEd – NCR
Mr. Elmer H. Dorado	National Economic and Development Authority	Division Chief, Social Infra. Dev.
Dr. Johnny O. Aguino, Jr.	Department of Interior and Local Government (DILG)	NCR Asst Regional Director
Sr. Supt. Danilo R. Cabrera	Bureau of Fire Protection NCR	Fire Marshall, NCR
Dir. Corazon C. Davis	Department of Environment and Natural Resources	NCR Regional Director

**Table 1.3.3 Members of the Technical Committee**

PHIVOLCS	Dr. Renato U. Solidum, Jr. (December 2002- ) Dr. Raymundo Punongbayan (August 2002 – December 2002)	Director; Chairperson – TWC Ex- Chairperson – TWC
MMDA	Dir. Ramon J. Santiago	Co-Chair, TWC
ASEP	Engr. Ronaldo S. Ison Dr. Benito Pacheco	President, ASEP Past President
BAYANTEL	Mr. Rene Mababangloob	Asst. Manager, Site & Construction Property & Facilities Department
CHED	Dr. Jean C. Tayag	Director
DepED	Mr. Ernesto T. Salita	Education Program Specialist II
DPWH	Engr. Wilfredo S. Lopez	Chief, Structural Division, Bureau of Design
DOTC	Engr. Samuel C. Custodio Engr. Ferdinando I. Caberto	Director, Transport Planning Service Sr. Transportations Development Officer
HUDCC	Ronald G. Fontamilla Engr. Alvin Claridades	Director
HLURB	Roque Arrieta Magno Engr. Julius Tan (alternate)	Commissioner

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**Table 1.3.3 Members of the Technical Committee (continued)**

MWSS	Engr. Jose Alfredo Escoto, Jr.	
Manila Water	Selwyn Cabaluna	Dept. Manager, Pumping Plant Section
MAYNILAD	Anita Calderero Vilma Cembrano	Head, Environmental Assessment Acting Head, Environmental Compliance, Environment Management Department
MAYNILAD	Anita Calderero Vilma Cembrano	Head, Environmental Assessment Acting Head, Environmental Compliance, Environment Management Department
MERALCO	Pedro F. Co Nestor P. Sarmiento	System Control Center
NAMRIA	Engr. Ofelia Castro	Chief, Photogrammetry Division
NHA	Engr. Victor Balba Engr. Arlyn Puzon (Alternate)	OIC, Housing Technology Office
NPC	Mr. Cirilo Q. Sebandal	Head, CE & Architecture & Drafting Services, Dev't & Design Grp, Technical & Maintenance Services
NTC	Engr. Ariel H. Padilla	Acting Chief, Special Service Division
OCD	Major Ronald George F. Reario	Military Asst. for Operations & Sp. Projects
PICE	Dr. Erenster S. De Castro	National Director
PLDT	Mr. Augusto Locsin, Jr.	Center Head, MM Project Center
PUP-College of Engineering	Dr. Vicky S. Cruz Ms. Marvic R. Monteloyola Engr. Renato Aguilar Engr. Manuel Muhi	Dean, College of Engineering Director, Special Project Office Head, CE Laboratory Chairperson, CE Laboratory
TUP-College of Engineering	Dr. Bernardo Leyano Engr. Loreto Aguila	Dean, College of Engineering
UP-Civil Engineering	Dr. Victor Pulmano	Head, Dept. of Civil Engineering
UP-Dept. of Geography	Dr. Doracie Z. Nantes Ms. Vangie Katigbak	Chairman, Dept. of Geography
Globe	Mr. Glenn Gracia	Manager, Luzon Operations
Smart	Ms. Amalia Tuazon Mr. Virgilio T. Valles	
Digitel	Mr. Hector G. Dimalanta	VP, GSM Network Operations
DOH	Dr. Edmundo Lopez Ms. Irma Javier (Alternate)	Medical Officer VII, Chief, ELHAD
DSWD	Ms. Dominica Godinez	Social Welfare Officer III
TRANSCO	Mr. Wilmer M. Suzara	Principal Engineer A, CE Design Division
BFP	Ediberto C. Flormata	Chief Insp.
DILG	Dr. Teresita M. Mistal	Director, Bureau of Local Government
NCTS	Mr. Ricardo G. Sigua	
PNRC	Mr. James Sian Mr. Danila Atienza (Alternate)	

**Table 1.3.4 Members of the Counterparts****Metropolitan Manila Development Authority**

Mr. Ramon J. Santiago	Director III, DSO
Ms. Corazon L. Macasieb	Actg Div. Chief, EPRD, DSO
Ms. Luzviminda C. Murao	Special Operations Officer II, DSO
Ms. Corazon DJ Agulan	Special Operations Officer II, DSO
Ms. Ma. Teresa M. Amarillo	Special Operations Officer I, DSO
Mr. Roderick Teofilo Joel B Aguilar	Emergency Medical Technician - Basic
Mr. William A Olangco	Emergency Medical Technician - Basic
Mr. Mario F. Malacad	Actg Div. Chief, DCPM, DSO
Ms. Margeline J. Serion	Special Operations Officer II, DSO
Ms. Josephine R. Sy	Special Operations Officer II, DSO
Mr. Pedro B. Rafuson, Jr.	Special Operations Officer I, DSO
Ms. Veronica G. Villamor	Planning Officer
Ms. Cora M. Medallo	Planning Officer
Mr. William H. Chavez	Planning Officer
Mr. Rommel C. Millora	Technical Staff
Ms. Janette R. Castillo	Technical Staff
Ms. Janice B. Franco	Technical Staff

**Philippine Institute of Volcanology and Seismology**

Dr. Bartolome C. Bautista	Chief, Science Research Specialist
Dr. Maria Leonila C. Bautista	Associate Scientist, DOST
Engr. Angelito G. Lanuza	Senior Science Research Specialist
Dr. Ishmael C. Narag	Supervising Science Research Specialist
Ms. Esmeralda L. Banganan	Science Research Specialist II
Dr. Norman M. Tungol	Supervising Science Research Specialist
Ms. Lynn P. Melosantos	Senior Science Research Specialist
Ms. Ma. Antonia V. Bornas	Senior Science Research Specialist
Ms. Ma. Carmencita B. Arpa	Science Research Specialist II
Ms. Hannah T. Mirabueno	Science Research Specialist II
Mr. Roberto Tiglao	Science Research Specialist
Ms. Mylene M. Villegas	Chief, Science Research Specialist
Ms. Janila B. Deocampo	Science Research Specialist II
Mr. Erlinton Antonio B. Olavere	Science Research Specialist I
Ms. Jane T. Punongbayan	Senior Science Research Specialist
Ms. Mylene C. Carlos	Science Research Assistant
Mr. Rommel Grutas	Science Research Assistant
Ms. Sheila I. Insauriga	Senior Science Research Specialist
Mr. Dindo Javier	Science Research Analyst
Ms. Regina Quiambao	Science Research Specialist I
Mr. Paolo Reniva	Science Research Assistant
Mr. Melcario Pagtalunan	Science Research Specialist I
Dr. Jessie A. Daligidig	Associate Scientist, DOST
Dr. Glenda M. Besana	Associate Scientist, DOST
Ms. Joan C. Salcedo	Science Research Specialist II
Mr. Arturo Daag	Supervising Science Research Specialist
Mr. Benjamin Santos	Science Research Specialist I
Ms. Julianita Ranola	Science Research Specialist II
Ms. Kathleen L. Papióna	Science Research Assistant

## 1.4 Major Activities of the Study

The major activities of the Study are summarized in Table 1.4.1.

**Table 1.4.1 Major Topics of the Study**

Study Stage	Date	Topics
First Stage	August 15, 2002	Commencement of the Study in the Philippines
	August 28, 2002	First Steering committee meeting, at MMDA Building
	August 28, 2002	Orientation for the City and Municipal Disaster Action Officers (DAO) at MMDA Building
	October 9, 2002	First Technical Committee Meeting, at PHIVOLCS Auditorium
	November 15, 2002	First Workshop for Metropolitan Manila Disaster Management at EDSA Shangri-La Hotel
	December 12, 2002	Orientation on progress of GIS database development, at PHIVOLCS meeting room
	March 13, 2003	Second Steering committee meeting, at MMDA Manila Conference Hall
Second Stage	May 8, 2003	Submission of Interim Report
	May 15, 2003	Explanation of the Study Progress to MMDCC Meeting, At MMDA Manila Conference Hall
	May 26, 2003	Second Technical Committee Meeting, at PHIVOLCS Auditorium
	June 5, 2003	Explanation of the Study Progress to 17 LGU Planning Officer Meeting at MMDA Building
	June 12, 2003	Technical Committee, Sub Committee Meeting on Structural Engineering, Discussion of Building Damage Estimation, at PHIVOLCS Auditorium
	August 5, 2003	Workshop for Community Based Disaster Management, at Manila Pavilion Hotel
	August 8, 2003	Explanation of the Study Progress to MMDA Chairman, at MMDA Building
	August 11, 2003	Explanation of the Study Progress to NDCC Chairman, at OCD Building
	August 19, 2003	Third Steering committee meeting, at MMDA Manila Conference Hall
	August 19, 2003	Explanation of the Study Progress to 17 LGU City Administrators at Makati City Hall
	August 20, 2003	Explanation of the Study Progress to UN-OCHA, request from NDCC, at OCD Building
	August 26, 2003	Second Workshop for Metropolitan Manila Disaster Management at EDSA Shangri-La Hotel
	September 25 - 26, 2003	Makati City Disaster Management 1 <sup>st</sup> Workshop, at Makati City Hall
	November 13-14, 2003	Makati City Disaster Management 2 <sup>nd</sup> Workshop, at Makati City Hall
	November 25, 2003	GIS Technical Transfer to PHIVOLCS, at PHIVOLCS Lecture Room
	November 27, 2003	GIS Technical Transfer to MMDA, at MMDA Manila Hall
	November 28, 2003	Topographical Map Turn Over, at Mandarin Oriental Hotel
	February 3, 2004	Third Steering committee meeting, at MMDA Manila Conference Hall
	February 4, 2004	Seminar on Earthquake Disaster Management, at Makati Shangri-la Hotel
	February 5, 2004	Seminar on Community Based Disaster Management, at Manila Pavilion Hotel

LGU Local Government Unit

MMDCC Metropolitan Manila Disaster Coordination Council

NDCC National Disaster Coordination Council

OCD Office of Civil Defense

UN-OCHA United Nations, Office for the Coordination of Humanitarian Affairs