Chapter 3

DATABASE AND HYDRODYNAMIC MODEL DEVELOPMENT

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3.1 DATABASE DEVELOPMENT

3.1.1 OBJECTIVE OF DATABASE DEVELOPMENT

Main objectives of development of database in the Study are as follows:

- To develop an integrated database of the drainage system in the core area of Metropolitan Manila; and
- To develop an easy-to-understand, useful and visualized database, especially for effective O & M activities and sustainable use by managing organizations: DPWH, MMDA and LGUs.

3.1.2 CONCEPT OF DATABASE STRUCTURE OF THE STUDY

(1) Design of Database Structure

In the Study, the data stored in the database are used not only for presenting the condition of the existing drainage system but also for planning and evaluating them in combination with the information of drainage system and various data such as topographical, hydrological, hydraulic, social and economic data. In that case, it is better to have capabilities of processing and analyzing the special (graphic) data/information. In this context, it is proposed that the database be developed mainly based on a Geographic Information System (GIS).

Concept of Database Structure of this Study is shown in the following figure.

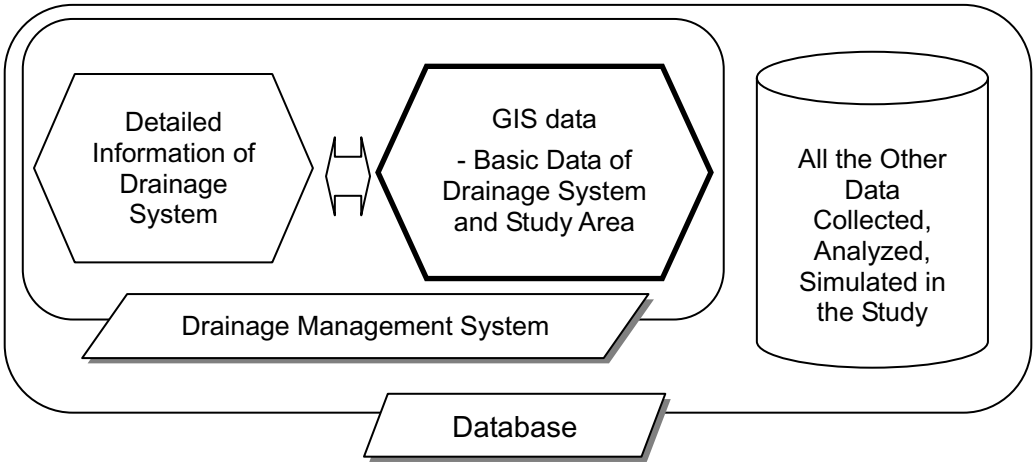


Figure 3.1.1 Concept of Database Structure

The database consists of three parts, 1) GIS data including basic data of drainage systems and the study area, 2) detailed data of drainage systems, and 3) all the data relating to the Study.

Contents of each part are discussed below:

1) GIS Data

Fundamental data of the study area such as administrative boundary, population, contours, geology, land use, and infrastructure, and basic data of drainage systems and facilities with

location, name, completion year, code number, etc. are stored as GIS data classified into specific fields.

2) Detailed Information of Drainage System

Detailed data and information regarding drainage systems and drainage facilities, which are difficult to input as GIS data due to the data type and high frequency of the data addition, are stored. Data include not only drawing data of cross-sections and longitudinal profiles of drains, and operating condition of drainage facilities but also records for daily O&M activities and pictures. The data are linked with GIS data of drainage system and drainage facilities, and users can find out the relation between these data and GIS data from GIS application.

3) All the other data relating to the Study

The other data, mainly raw data collected and analyzed in the Study, such as rainfall data, questionnaire survey data, and geological data, are stored carefully in expectation of further use for the other projects in future, not only for this study. Data are categorized and stored in specific fields.

The above 1) and 2) constitute the main part of the database of the Study, which is named Drainage Management System.

(2) Basic Data for Database of the Study

In Metropolitan Manila, multi-purpose database has already been developed in the JICA Study of "Earthquake Impact Reduction Study for Metropolitan Manila, Republic of the Philippines, (MMEIRS)" in 2004. Regarding the database of drainage system, it was developed in the other JICA Study "Study on the Existing Drainage Laterals in Metro Manila in the Republic of the Philippines (SEDLMM)" in 2000.

It is often the case that these data are not suitable for the database of the Study due to the difference of the purpose and approach of the database construction, even though these databases were well developed. For example, MMEIRS database are well arranged as GIS data, but information of drainage system is insufficient for this study because the main purpose of the study is earthquake impact reduction. And SEDLMM database is specified in drainage system, but inconformity of location from CAD data and Access data is occasionally found so that database is not arranged as GIS data.

Therefore, in this study, the database is developed modifying and importing the above existing database, and inputting the new data, which are collected, analyzed and simulated in the course of this study.

(3) Necessary Application

In the Study, the database is developed mainly by using the database function of GIS software of ArcView 8.*.

After completion of this study, the data will be transferred to DPWH and distributed to concerned agencies such as MMDA and LGUs, which are responsible for conducting daily O&M activities. But it is possible that some agencies are not available to prepare the software due to the budgetary deficit. Therefore, free software provided by distributing company of GIS software is also included in the system and distributed to them, so that at least users can see, check and use the data without any particular software.

3.1.3 DATABASE FOR THE STUDY

Database structure is shown in *Figure 3.1.2*.

As mentioned in *Chapter 3.1.2*, the database consists of three parts, 1) GIS data including basic data of drainage system and Study Area, 2) detailed data of drainage system, and 3) all the data relating to the Study. In the actual database, the above three parts are organized as "GIS_Data", "Drainage Management System" and "Study Data Aggregate" folders, respectively.

Contents of each folder are described below.

(1) GIS_Data

This folder contains all the GIS data and data list of GIS data. GIS data are stored in "Shape" folder. First, it classified data into three, "ExistingConditions," "MasterPlanPlaning" and "Simulation." The data of "MasterPlanPlaning" and "Simulation" folders are especially for Master Plan and its evaluation for this study, and volume of these data is small. Almost all the data are categorized into 15 fields and put in "ExistingConditions" folder as shown in *Figure 3.1.2*. Some of fields/folders have easy-to-recognize sub-folders. For example, "DrainageSystem" folder has five sub-folders, in which two to nine GIS files are stored.

Table 3.1.1 shows a list of GIS data. Every GIS data has not only spatial data but also various attribute data such as code number, name, length, specification of facilities, and survey results. Detailed list of GIS data including all the attributes and those detailed explanation is put in "GIS_Data¥Explanations" folder.

GIS data regarding estero, drainage main, pumping station and operation and maintenance have the attribute indicating a linkage with "DrainageManagementSystem." As for these data, many kinds and types of data are collected through this study and put together in "DrainageManagementSystem" folder. When users see the indicated folder, they can get more detailed information of them.

(2) DrainageManagementSystem

This folder includes 1) detailed data and information especially regarding drainage system and drainage facilities, 2) guidelines for planning, design, construction and O & M of drainage system and facilities, and 3) free software for using drainage management system.

"Facility_Information" folder is for detailed data and information, which are difficult to input as GIS data due to the data type and high frequency of the data addition. This folder is categorized into sub-folders by facility. Each sub-folder is segmentized further and segmentized folder contains various data such as drawing of cross-section and longitudinal profile of drains, operating condition of drainage facilities, and pictures. Some of the folders are empty at present, but these will become very much useful in future especially for O & M activities if the data continue to be added in these folders.

In order to use this database, six kinds of software are needed, which are Microsoft WORD, Microsoft EXCEL, Adobe Acrobat Reader, software for images, software for CAD drawing and software for GIS. Among them, software for CAD drawing and GIS may be difficult to prepare due to budget deficit of users/agencies. Therefore, free software for them are put in the "SystemSoftware" folder. Users can see and check the CAD drawing and GIS data by installing the required software.

(3) StudyDataAggregate

This folder contains the other various data, which are collected, analyzed and made in the Study, such as land use maps, Meteo-hydrological data and figures showing the results of the Study. This folder keeps data from missing so that they can be utilized not only for the Study but also for the other projects in future. It is also expected to contribute to save the time for data gathering in the other projects. The data are categorized and stored in specific fields.

3.1.4 RECOMMENDATION FOR EFFECTIVE AND SUSTAINABLE USE

Once the integrated database is constructed, a large-scale modification is unnecessary especially for the GIS data in case that drainage system or conditions of the study area will not change drastically. Instead, a part of the database directly linked to O & M activities ("DrainageManagementSystem" folder in this database) should be updated routinely in order to utilize and sustain the database effectively for future O & M activity as well as present, actual one.

Consequently, the following are recommended:

1) To distribute the database to all the concerned agencies;
2) To assign the person who can grasp the contents of database and has technique to add and input the data, in the units in charge of O&M activities of each agency;
3) To update and input data routinely in each unit, and to modify the database structure such as making new folders if necessary;
4) To hold a meeting of concerned agencies periodically, in order to share the data which each unit input, integrate all the data at least to principal agency's database and discuss the database structure so as to be easy-to-use and efficient; and
5) To review the database especially the part of GIS data at least once a year. In case that drainage system or conditions of the study area changes drastically, principal agency modifies the correspondent data and distributes the revised data to all the concerned agencies.

The activities outlined above can be carried out as part of daily routine work without any preparation and budget except the minimum equipment such as computers. Although this is but a first step and the system proposed in *Chapter 4.5* could be constructed in the future, commencing to incorporate the database into daily O & M is good for a start.

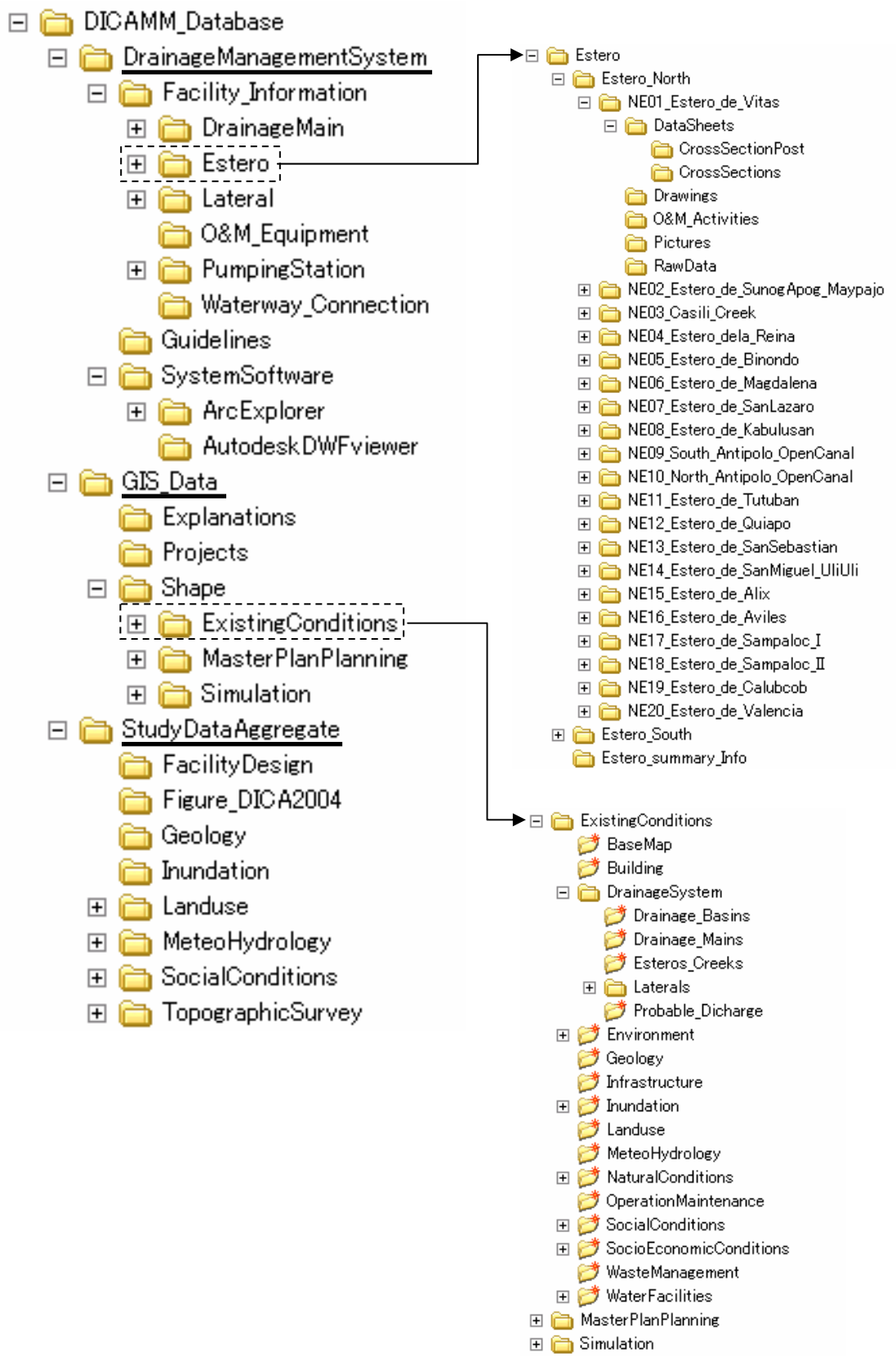


Figure 3.1.2 Database Structure

Table 3.1.1 List of GIS Data (1/4)

1. Exsitning Conditions

	File Name	*Description*
BASE MAP	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\BaseMap	
Study Area	BC_StudyArea.shp	Study Area
	BC_StudyArea_N.shp	Northern part of the Study Area
	BC_StudyArea_S.shp	Southern part of the Study Area
	BC_StudyArea_Buffer1km.shp	Buffer of Study Area
	BC_StudyArea_Mask.shp	Mask of Study Area
	BC_StudyArea_Mask1km.shp	Mask of Study Area
DRAINAGE SYSTEM	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\DrainageSystem	
Esteros/Creeks	DC_Estero_N.shp	Esteros and Creeks in the Northern part
	DC_Estero_S.shp	Esteros and Creeks in the Southern part
	DC_Estero_Section_N.shp	Estero Sections in the Northern part
	DC_Estero_Section_S.shp	Estero Sections in the Southern part
	DC_Estero_Edge_N.shp	Estero Edges in the Northern part
	DC_Estero_Edge_S.shp	Estero Edges in the Southern part
	DC_Estero_Poly.shp	Polygon of Estero
	DC_Estero_CS_N.shp	Cross Section Point of Esteros in the Northern part
	DC_Estero_CS_S.shp	Cross Section Point of Esteros in the Southern part
Drainage Mains	DC_DrainageMain_N.shp	Drainage Mains in the Northern part
	DC_DrainageMain_S.shp	Drainage Mains in the Southern part
	DC_DM_Section_N.shp	Drainage Main Sections in the Northern part
	DC_DM_Section_S.shp	Drainage Main Sections in the Southern part
	DC_DM_MTH_N. shp	Maintenance Hole for Drainage Main in the Northern part of Study Area
	DC_DM_MTH_S. shp	Maintenance Hole for Drainage Main in the Southern part of Study Area
	DC_DM_MTH_Link_N.shp	Maintenance hole link and culvert characteristic of drainage main in the Northern part of Study Area
	DC_DM_MTH_Link_S.shp	Maintenance hole link and culvert characteristic of drainage main in the Southern part of Study Area
Laterals	DC_Lateral.shp	Laterals in the Study Area
	DC_Connection_N.shp	Laterals to connect estero and estero, or estero and drainage main
	DC_Connection_S.shp	Laterals to connect estero and estero, or estero and drainage main
	DC_Manhole.shp	Manhole
Drainage Basins	DC_Block_N.shp	Drainage Block
	DC_Block_S.shp	Drainage Block
	DC_Basin_N.shp	Drainage Basins
	DC_Basin_S.shp	Drainage Basins
	DC_Reach_N.shp	Drainage Reach Basins
	DC_Reach_S.shp	Drainage Reach Basins
	DC_SubBasin_N.shp	Drainage Sub basins
	DC_SubBasin_S.shp	Drainage Sub basins
Probable Discharge	DC_ProbableDischarge_N.shp	Probable Peak Discharge of Specific Point
	DC_ProbableDischarge_S.shp	Probable Peak Discharge of Specific Point
WATER FACILITIES	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\WaterFacilities	
Pumping Stations	WC_PumpingSta_All.shp	Pumping Stations
	WC_PumpingSta_N.shp	Pumping Stations in the Northern part
	WC_PumpingSta_S.shp	Pumping Stations in the Southern part
	WC_PumpingSta_Major.shp	Large Pumpning Stations
	WC_PumpingSta_Small.shp	Small Pumping Stations
Water Gates	WC_ControlGate.shp	Control Gate
	WC_ControlWall.shp	Control Wall
	WC_IndependentFloodGate.shp	Independent Flood Gate

Table 3.1.1 List of GIS Data (2/4)

	File Name	*Description*
Automatic Trash Screen	WC_TrashScreen_S.shp	Automatic Trash Screens in the Northern part

O & M	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\OperationMaintenance	
Operation and Maintenance	OC_OM_Zone.shp	Boundary for Operation & Maintenance

INUNDATION	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Inundation	
Actual Inundation Map In 1999 flood	IC_ActInunDepth_N_1999.shp IC_ActInunDepth_S_1999.shp IC_ActInunDuration_N_1999.shp IC_ActInunDuration_S_1999.shp	Inundation depth of 1999 flood Inundation depth of 1999 flood Inundation duration of 1999 flood Inundation duration of 1999 flood
	depth_n depth_s duration_n duration_s	Inundation depth of 1999 flood Inundation depth of 1999 flood Inundation duration of 1999 flood Inundation duration of 1999 flood
	IC_ActInunPoint1999.shp	Inundation data of 1999 flood
	Intersection_building_depth_n.shp Intersection_building_depth_s.shp Intersection_building_duration_n.shp Intersection_building_duration_s.shp	Building Classification by inundation depth Building Classification by inundation depth Building Classification by inundation duration Building Classification by inundation duration
Actual Inundation Map In 2004 flood	IC_ActInunDepth_N_2004.shp IC_ActInunDepth_S_2004.shp IC_ActInunDuration_N_2004.shp IC_ActInunDuration_S_2004.shp	Inundation depth of 2004 flood Inundation depth of 2004 flood Inundation duration of 2004 flood Inundation duration of 2004 flood
	dep_n_2004 dep_s_2004 dur_n_2004 dur_s_2004	Inundation depth of 2004 flood Inundation depth of 2004 flood Inundation duration of 2004 flood Inundation duration of 2004 flood
	IC_ActInunPoint2004	Inundation data of 2004 flood

NATURAL CONDITIONS	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\NaturalConditions	
Contours	NC_Contour.shp	Contours
Elevations	NC_BenchMark elevation elev_dpwh	Bench Mark for the Study Elevation grid map in Raster Format Elevation grid map in Raster Format
Slope	slope NC_Slope	Slope grid map in Raster Format Slope classification
Rivers	NC_Pasig_River_Centerline.shp NC_Pasig_River_Polygon.shp NC_PasigIsland.shp	Pasig River center line River Polyogn Islands in Pasig River
Reservoir/Pond	NC_ReservoirN.shp NC_ReservoirS.shp NC_Pond_S.shp	Reservoir or Pond in Northern part of Study Area Reservoir or Pond in Southern part of Study Area Pond in the Southern part of the Study area
Manila Bay	NC_ManilaBay.shp	Manila Bay

METEOHYDROLOGY	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Meteohydrology	
Meteorological Station	MC_MeteoSta.shp	Meterologigal Station in Metropolitan Manila
Water Level Station	MC_WLSta.shp	Water Level Station in Metropolitan Manila
Tide Level Station	MC_TideSta.shp	Tide Level Station in Metropolitan Manila
Thiessen Polyline	MC_Thiessen.shp	Thiessen Polyline

Table 3.1.1 List of GIS Data (3/4)

	File Name	*Description*
WASTE MANAGEMENT	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\WasteManagement	
Waste Survey Point	WC_SurveyPoint.shp	Waste Survey Point
GEOLOGY	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Geology	
Geological Formations	G_Formation1.shp	Geological Formations - Phivolcs
	G_Formation2.shp	Geological Formations - Oyo
ENVIRONMENT	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Environment	
Water Quality	EC_WaterQualiry.shp	Water Quality survey result
Sediment Quality	EC_SedimentQuality.shp	Sediment Quality survey result
Pollution Source	EC_PollutionSource.shp	Pollution source survey result
SOCIAL CONDITIONS	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\SocialConditions	
Barangay Boundaries	SC_BgyBnd.shp	Barangay Boundaries Edited Boundaries to match NSO Boundaries
City/Municipal Boundaries	S_CityBnd.shp	City/Municipal Boundaries
	S_CityBnd2003.shp	City/Municipal Boundaries in 2003
EIS01 (Survey for Estero Informal Settlers along selected Esteros) Building	EIS01_Building.shp	Building along Estero de Sunog Apog and Tripa de Gallina
	EIS01_Building_Clip.shp	Building within Estero de Sunog Apog and Tripa de Gallina
	EIS01_DenseArea.shp	Densely Buildup Area along Estero de Sunog
	EIS01_DenseArea_Clip.shp	Densely Buildup Area within Estero de Sunog
Reach	EIS01_Reach00.shp	Area of Water Body of Selected Esteros
	EIS01_Reach04.shp	Area of 4m outside from Edge of Selected Esteros
	EIS01_Reach10.shp	Area of 10m outside from Edge of Selected Esteros
	EIS01_Reach20.shp	Area of 20m outside from Edge of Selected Esteros
Structure	EIS01_EmbankmentType.shp	Type of Embankment along Selected Esteros
	EIS01_Road.shp	Roads along Selected Esteros
EIS02 (Survey for Estero Informal Settlers along Esteros except two)	EIS02_Building_SSHW.shp	Buildings along South Super Highway and Sen. Gil J. Puyat Avenue
	EIS02_DenseArea.shp	Densely Buildup Area along Esteros except Sunog Apog and Tripa de Gallina
	EIS02_DenseArea_Clip.shp	Densely Buildup Area within Esteros except Sunog Apog and Tripa de Gallina
	EIS02_EsteroReach.shp	Area of Water Body of Esteros except Sunog Apog and Tripa de Gallina
SOCIO-ECONOMIC CONDITIONS	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\SocioEconomicConditions	
Land Price	SC_landprice.shp	Land price
	Landprice	landprice grid map in Raster Format
	Landprice_n	landprice grid map in Raster Format
	Landprice_s	landprice grid map in Raster Format
LANDUSE	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Landuse	
Landuse	LC_Landuse_N.shp	Land Use of Northern Part of Study Area
	LC_Landuse_S.shp	Land Use of Southern Part of Study Area
	LC_Landuse_Per_SubBasin_N.shp	Land Use per Sub Basin
	LC_Landuse_Per_SubBasin_S.shp	Land Use per Sub Basin

Table 3.1.1 List of GIS Data (4/4)

	File Name	*Description*
BUILDING	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Building	
Building	BC_Building_Poly_N.shp	Polygon of Building
	BC_Building_Poly_S.shp	Polygon of Building
	BC_Building_Point_N.shp	Center Point of Building
	BC_Building_Point_S.shp	Center Point of Building

INFRASTRUCTURE	\DICAMM_Database\GIS_Data\Shape\ExistingConditions\Infrastructure	
Roads	IC_RoadCenter.shp	Road Centerlines
	IC_RoadEdge.shp	Road Edges
Railroads	IC_Railroads.shp	Railway Lines

2. Master Plan Planning

DRAINAGE SYSTEM	\DICAMM_Database\GIS_Data\Shape\MasterPlanPlanning\DrainageSystem	
Esteros/Creeks	DP_Estero_Section_Plan_N.shp	Estero Sections in the Northern part
	DP_Estero_Section_Plan_S.shp	Estero Sections in the Southern part
	DP_Estero_Plan_CS_N.shp	Cross Section Point of Esteros in the Northern part
	DP_Estero_Plan_CS_S.shp	Cross Section Point of Esteros in the Northern part
Drainage Mains	DP_DM_Section_Plan_N.shp	Drainage Main Sections in the Northern part
	DP_DM_Section_Plan_S.shp	Drainage Main Sections in the Southern part
Drainage Basins	DP_Block_Plan_N.shp	Drainage Block for Master Plan
	DP_Block_Plan_S.shp	Drainage Blockfor Master Plan
	DP_Basin_Plan_N.shp	Drainage Basins for Master Plan
	DP_Basin_Plan_S.shp	Drainage Basins for Master Plan
	DP_Reach_Plan_N.shp	Drainage Reach Basins for Master Plan
	DP_Reach_Plan_S.shp	Drainage Reach Basins for Master Plan
	DP_SubBasin_Plan_N.shp	Drainage Sub basins for Master Plan
	DP_SubBasin_Plan_S.shp	Drainage Sub basins for Master Plan
Probable Discharge	DP_ProbableDischarge_N.shp	Probable Peak Discharge of Specific Point
	DP_ProbableDischarge_S.shp	Probable Peak Discharge of Specific Point

3. Simulation

INUNDATION MAP	\DICAMM_Database\GIS_Data\Shape\Simulaiton\Inundation_Depth_Duration	
Simulated Inundation Map	n_a1_dep.shp	Simulated Inundation Depth Map
	n_a2_dep.shp ~ s_p2_dep.shp	Simulated Inundation Depth Maps
	n_a1_dur2.shp	Simulated Inundation Duration Map
	n_a2_dur2.shp ~ s_p2_dur2.shp	Simulated Inundation Duration Maps

INPUT DATA	\DICAMM_Database\GIS_Data\Shape\Simulaiton\Input_Data	
Simulated Inundation Points	res_n_a1.shp	Point Data of Simulated Inundation Result
	res_n_a2.shp ~ res_s_p2.shp	Point Data of Simulated Inundation Results
Elevation of Simulated Points	Flood_Input_Ele_N.shp	Elevation of Points used to Inundation Calculation in the Northern Part
	Flood_Input_Ele_S.shp	Elevation of Points used to Inundation Calculation in the Southern Part

3.2 HYDRODYNAMIC MODEL DEVELOPMENT AND SIMULATION

3.2.1 OUTLINE OF SIMULATION MODEL

The study area comprises a complex network of interconnected esteros, drainage mains, laterals, and connecting pipes. In addition, hydraulic facilities like trash screens, gates, reservoirs and especially pump stations connected by esteros and drainage mains make the flow condition highly unpredictable during inundation. To analyze the highly dynamic behavior of the interconnected drainage system of the study area, comprehensive hydrodynamic models for north and south drainage systems have been developed. The main objectives of the model development are:

- to evaluate the existing capacity of the drainage system;
- to evaluate the performance of the drainage system under design condition (different alternatives/scenarios such as with and without project condition) and
- to prepare inundation maps for different scenarios and return periods.

MOUSE of DHI (Danish Hydraulic Institute) has been selected as the hydrodynamic modeling software for this study. A schematic diagram of simulation by MOUSE is shown in *Figure 3.2.1*. MOSUE applies implicit finite difference method to solve St. Venant's fully dynamic wave equation using Double-Sweep algorithm. Please refer to MOUSE Pipe Flow Reference Manual for details.

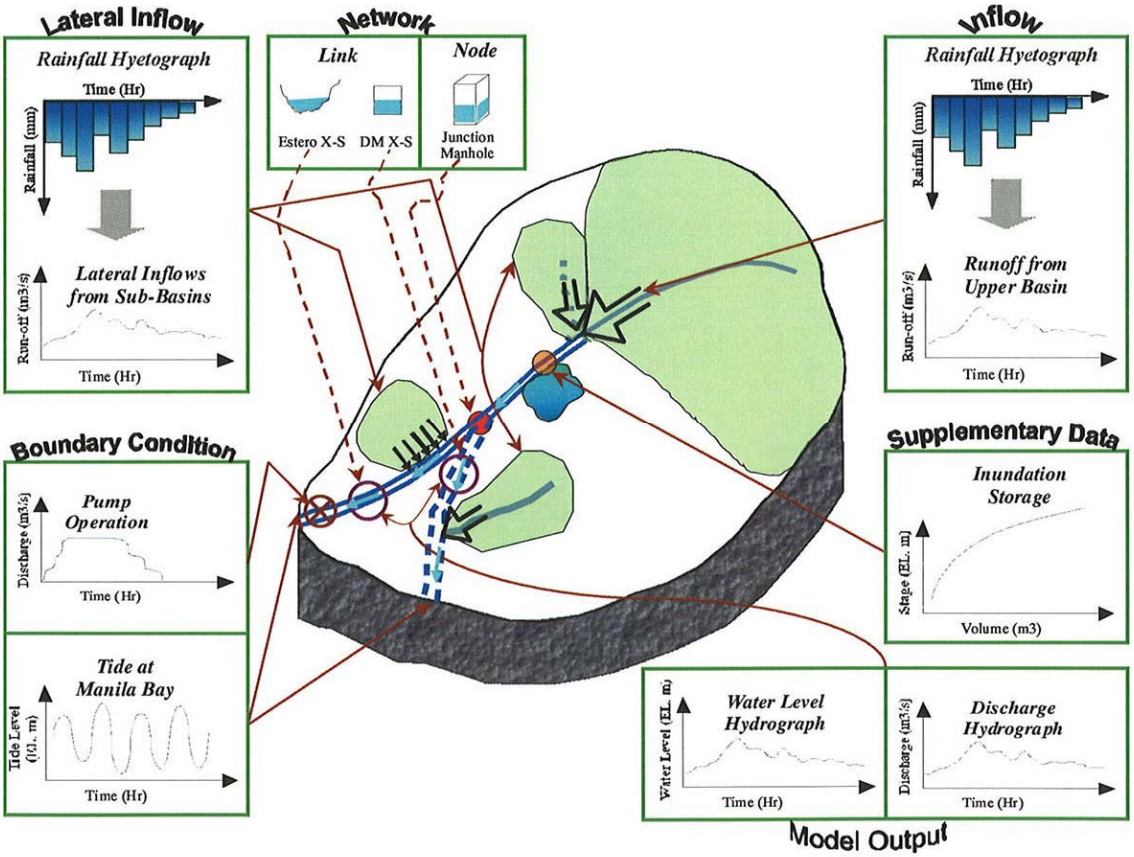


Figure 3.2.1 Schematic Diagram of Simulation by MOUSE

In the Study, almost all of esteros/creeks and drainage mains in low-lying area are included in the model networks. Runoff from hilly area is treated as inflow into the networks. Flow in laterals is treated as lateral inflow into the networks. In addition, over land flow from esteros/creeks and/or drainage mains due to those insufficient capacity against storm water is simulated by adding road networks as virtual flood plain channels

Summary of features of simulation setup for south and north drainage areas under existing condition is presented in *Table 3.2.1*.

Table 3.2.1 Summary of Features of Model Development

Feature	Attribute	Drainage Area		
		North	South	Total
Nodes (maximum) (varies by case)	Manholes along drainage mains, junctions of esteros and drainage mains, nodes on roads (number of nodes)	389	360	749
Links (maximum) (varies by case)	Esteros, drainage mains and roads (number of links)	616	469	1,085
Estero and Drainage Mains (maximum) (varies by case)	Estero (length in m)	24,117	35,054	59,171
	Estero (number of reaches)	18	17	35
	Drainage main (length in m)	17,154	20,788	37,942
	Drainage main (number)	18	18	36
Roads (maximum) (varies by case)	9 m wide (length in m)	13,835	8,768	22,603
	16 m wide (length in m)	12,399	10,594	22,993
	20 m wide (length in m)	14,378	26,401	40,779
Cross-Sections (maximum) (varies by case)	JICA Study Team (2004) survey (number)	49	132	181
	SEDLMM (2000) survey (number)	132	85	217
Hydraulic Facilities (maximum) (varies by case)	Pumping stations (number)	8	9	17
	Gates (number)	8	9	17
Reach-Basins (maximum) (varies by case)	Area (ha)	2,839	4,076	6,915
	Catchment (number)	51	55	106

3.2.2 CASES OF SIMULATION

The Study went through the following five stages (or cases) while carrying out simulation by MOUSE:

- *Model Calibration*: Simulation network without project condition has been developed during this stage. Existing esteros, drainage mains, hydraulic facilities / structures etc. have been used to set up the model. In addition, main roads have been added to incorporate flow connectivity and storage effect. Runoff analysis and hydrodynamic simulation under existing condition has been carried out during this stage. Runoff analysis has been carried out using divisions of reach-basins delineated based on existing drainage network, time of concentration computed based on existing drainage condition

and runoff coefficient estimated under the existing land use condition. The developed model has been calibrated against August 1999 inundation. For calibration, inundation maps for both depth and duration have been used. The calibrated parameters were roughness of road which acts as flood plain, time of concentration and inundation storage from the uppermost catchments.

- *Sensitivity Analysis*: After calibrating the model, simulations under existing condition as well as for dredged condition, with and without channel improvement works and also with and without pump stations have been carried out to understand the effect of tide, dredging, channel improvements, pump operation etc.
- *Alternative Study*: Simulation network has been reconstructed during this stage with project condition based on proposed drainage system and facilities improvement plans for different alternatives. Divisions of sub-basins based on alternative plans, time of concentration based on improved drainage condition and runoff coefficient under future land use condition has been taken into account for runoff analysis.
- *Scenario Simulation*: Simulation has been carried out with and without project condition under different design rainfall events. As for rainfall events, 2, 3, 5, 10, 20 and 30 years return period have been used. For with project condition, proposed plan has been applied.

Table 3.2.2 lists all the simulation cases. In total, 57 cases have been simulated: 26 for North Manila (Case E-4 = Case D-1 and Case S-4 = Case A-1) and 31 for South Manila (Case E-4 = Case D-1 and Case S-4 = Case A-2).

3.2.3 MODEL CALIBRATION

The developed simulation models for both North and South Manila have been calibrated against 1999 inundation depth and duration surveyed by SEDLMM (2000). The 1999 inundation has a return period of 10 years or less. After developing model networks for North and South Manila under existing condition, model calibration has been carried out through the process of runoff analysis and hydrodynamic simulation. The following conditions have been applied for the calibration.

Rainfall:

- Hourly rainfall data at Port Area from August 1-6, 1999 (5 days) has been used.

Runoff:

- Existing land use and runoff coefficients are assumed. Flow velocity to give time of concentration is estimated assuming the existing channel condition, which reflects the effects of deposition of garbage and sediment.

Boundary Conditions:

- Hourly tide level at Manila Bay and observed water level along the Pasig River during 1999 inundation have been applied as dynamic boundary condition at the downstream mouths of esteros and drainage mains. No return flow from the Pasig River through small outlets of drainage was taken into account in the simulation model, because of difficulty to estimate it and its uncertainty.

Pump and Gate:

- There exist 7 large pumps in North and 8 large pumps in South Manila. Start and stop levels of each pump station along with design capacity is listed in *Table 3.2.5*.

Differential type pumps have been set up in the MOUSE model along with non-return valves at gate of each pump station. Capacity curve (dH-Q data) of each pump station has been calculated based on only available experimental data at Vitas pump station assuming that all the pump stations behave in a similar way.

The main model parameters were time of concentration of the catchments' contributing flow and storage in the flood plain or reach basins. However, to keep the calibration process simple, time of concentration has been estimated separately instead of calibrating it inside the MOUSE model. During the estimation of time of concentration by reach basin, runoff analysis has been carried out repeatedly with different flow velocity and the peak runoff by each reach basin has been checked so that the runoff analysis produces reasonable specific runoff for all the reach basins. The estimated times of concentration (called lag time in MOUSE runoff model) by reach basins as well as other basin parameters like runoff coefficient, area reduction factor etc. were inputted directly in the runoff model of MOUSE. As for the storage in the reach basins, road network, as detailed as possible, has been carefully integrated into the model through repeated simulation of the hydrodynamic model. In a similar manner, after several runs of the hydrodynamic model of MOUSE, roughness coefficient of road has been selected as 0.10, which produces good agreement with 1999 observed inundation maps. This means that roads in the present simulation model act as virtual floodplain channels that reflect the effects of buildings surrounding those on inundation flow. For catchments in the uppermost reaches of the esteros for which no road network has been set up, storages of those catchments have been included in the basin nodes of uppermost estero of those catchments as elevation-area data. Stage-storage relation of the above mentioned reach basins have been extracted using GIS database of contour and basin boundary.

3.2.4 SIMULATION RESULTS

Except for the calibration case, all other simulation cases have been run with design rain, tide and water levels, by assuming future land use and runoff coefficient and improved channel condition.

The results of simulation for all the cases have been compiled using GIS in the form of inundation area by depth and duration as well as inundation maps. Inundation depths have been calculated at junctions of esteros and drainage mains and on roads after careful checking of the ground elevations at calculation points and the inundation maps have been prepared based on the calculated depths and durations where durations are calculated as time for inundation depth of more than 0.2 m.

Effect of Dredging and Declogging

Figure 3.2.2 shows the simulated inundation conditions for the existing channels and for the dredged and declogged channels. The rainfall given here is the design rainfall for a 10-year return period. The dredging and declogging reduce the inundation depth and duration remarkably, especially for the area along trunk channels.

Effect of Pump

Figure 3.2.3 demonstrates the simulated inundation condition without pump and gate operation. The gate was assumed to be kept fully opened. The rainfall given is the design rainfall for a 10-year return period. As seen in the figure, deep inundation area extends to the entire low-lying area, which brings about much more severe damage in the capital of the Philippines.

Effects of Proposed Works

Figure 3.2.4 shows the effects of proposed works in master plan and phase 1 projects. By executing the phase 1 projects, it is expected that inundation depth in almost all of Aviles-Sampaloc area in North Manila and San Isidro, San Antonio and Pio del Pilar area in South Manila for design rainfall becomes less than 1.0 m. By executing all of the proposed works, it is expected that inundation depth in almost all of the study area for design rainfall becomes less than 0.2 m.

Inundation Characteristics of the Study Area

From simulations results, inundation characteristics of the study area have been interpreted as shown in *Figure 3.2.5*. It can be seen again that the proposed drainage improvement works are highly effective in reducing inundation depth. *Figure 3.2.5* also shows the trend in increase of inundation areas by return periods.

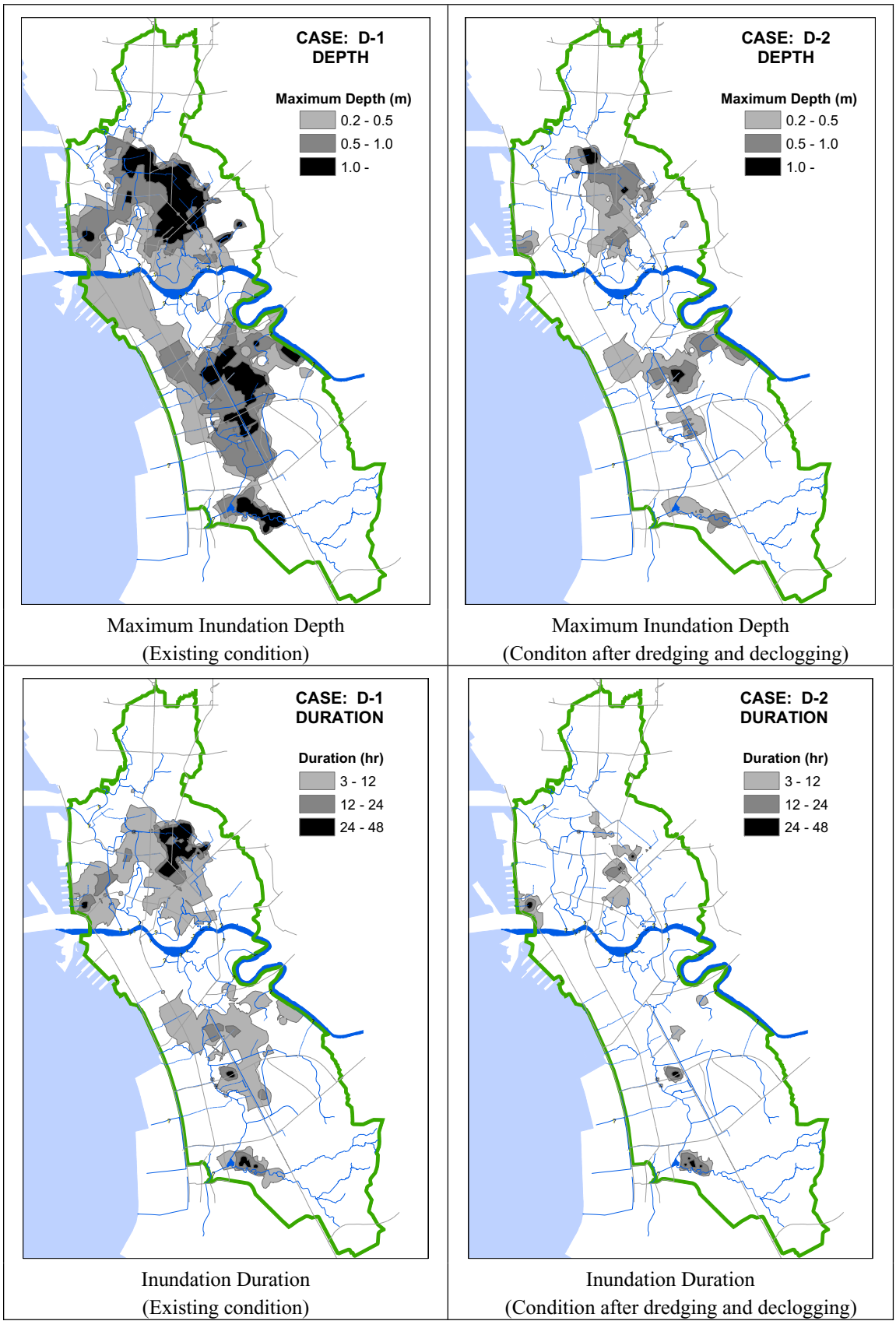
Table 3.2.2 Hydrodynamic Simulation Cases

North Manila

Model Cases				Model Network					Boundary Condition			Comment
Simulation				Estero &	Other Improvement	Reach Basin	Pump	Sampaloc	Rainfall	Tide or	Landuse	
Main Case	Sub-Case	ID	Run	Drainage Main	Works			Interceptor		Water Level		
Calibration	Calibration	C	C-1	Existing	-	Existing	Existing	-	August-99	August-99	Existing (2003)	Model Calibration
Sensitivity Analyses	Pump Effect	P	P-1	Existing	No	Existing	No operation	No	Design 10-yr	Design	Future	Effect of pump
			P-2	Fully dredged								
	Channel Improvement Effect	D	D-1	Existing	No	Existing	Existing	No	Design 10-yr	Design	Future	Effect of improvement works
			D-2	Fully dredged								
			D-3		Fully implemented	Proposed						
Alternative Study	Alternative-1	A	A-1	Fully dredged	Fully implemented	Proposed	Aviles increased, UriUri pump added	No	Design 10-yr	Design	Future	Alternative selection
	Alternative-2		A-2				Existing	Yes				
Scenario Simulation	Existing	E	E-1	Existing	No	Existing	Existing	No	Design 2-yr	Design	Future	For damage analysis without project condition
			E-2						Design 3-yr			
			E-3						Design 5-yr			
			E-4						Design 10-yr			
			E-5						Design 20-yr			
			E-6						Design 30-yr			
	Selected Alternative	M	M-1	Fully dredged	Fully implemented	Proposed	Aviles increased, UriUri pump added (Same as Alternative A-1)	No	Design 2-yr	Design	Future	For damage analysis with full project implementation (as of M/P menu)
			M-2						Design 3-yr			
			M-3						Design 5-yr			
			M-4						Design 10-yr			
			M-5						Design 20-yr			
			M-6						Design 30-yr			
	Selected Alternative	F	F-1	Partially dredged	Partially implemented	Proposed	Aviles increased	No	Design 2-yr	Design	Future	For damage analysis with partial project implementation (as of F/S menu)
			F-2						Design 3-yr			
			F-3						Design 5-yr			
			F-4						Design 10-yr			
			F-5						Design 20-yr			
			F-6						Design 30-yr			

South Manila

Model Cases				Model Network						Boundary Condition			Comment
Simulation				Estero &	Other Improvement	Reach Basin	Pump	Libertad	Maricaban	Rainfall	Tide or	Landuse	
Main Case	Sub-Case	ID	Run	Drainage Main	Works			Pond	Diversion		Water Level		
Calibration	Calibration	C	C-1	Existing	No	Existing	Existing	No	No	August-99	August-99	Existing (2003)	Model Calibration
Sensitivity Analyses	Tide Effect	T	T-1	Existing	No	Existing	Existing	No	No	Design 10-yr	0-hr Lag	Existing (2003)	Determine Lag time between design rainfall and tide peak
			T-2								1-hr Lag		
			T-3								2-hr Lag		
			T-4								3-hr Lag		
	Pump Effect	P	P-1	Existing	No	Existing	No operation	No	No	Design 10-yr	Design	Future	Effect of pump
			P-2	Fully dredged									
	Channel Improvement Effect	D	D-1	Existing	No	Existing	Existing	No	No	Design 10-yr	Design	Future	Effect of improvement works
			D-2	Fully dredged	No			No					
			D-3		No			Yes					
			D-4		Fully implemented	Proposed		Yes					
Alternative Study	Alternative-1	A	A-1	Fully dredged	Fully implemented	Proposed	Gallina increased	Yes	No	Design 10-yr	Design	Future	Alternative selection
	Alternative-2		A-2				Existing	Yes	Yes				
Scenario Simulation	Existing	E	E-1	Existing	No	Existing	Existing	No	No	Design 2-yr	Design	Future	For damage analysis without project condition
			E-2							Design 3-yr			
			E-3							Design 5-yr			
			E-4							Design 10-yr			
			E-5							Design 20-yr			
			E-6							Design 30-yr			
	Selected Alternative	M	M-1	Fully dredged	Fully implemented	Proposed	Existing	Yes	Yes (Same as Alternative A-2)	Design 2-yr	Design	Future	For damage analysis with full project implementation (as of M/P menu)
			M-2							Design 3-yr			
			M-3							Design 5-yr			
			M-4							Design 10-yr			
			M-5							Design 20-yr			
			M-6							Design 30-yr			
	Selected Alternative	F	F-1	Partially dredged	Partially implemented	Proposed	Existing	No	No	Design 2-yr	Design	Future	For damage analysis with partial project implementation (as of F/S menu)
			F-2							Design 3-yr			
			F-3							Design 5-yr			
			F-4							Design 10-yr			
			F-5							Design 20-yr			
			F-6							Design 30-yr			



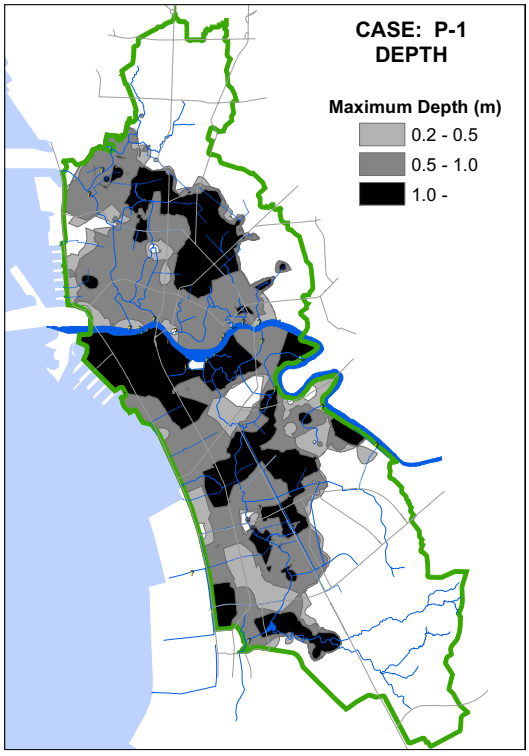
Maximum Inundation Depth
(Existing condition)

Maximum Inundation Depth
(Conditon after dredging and declogging)

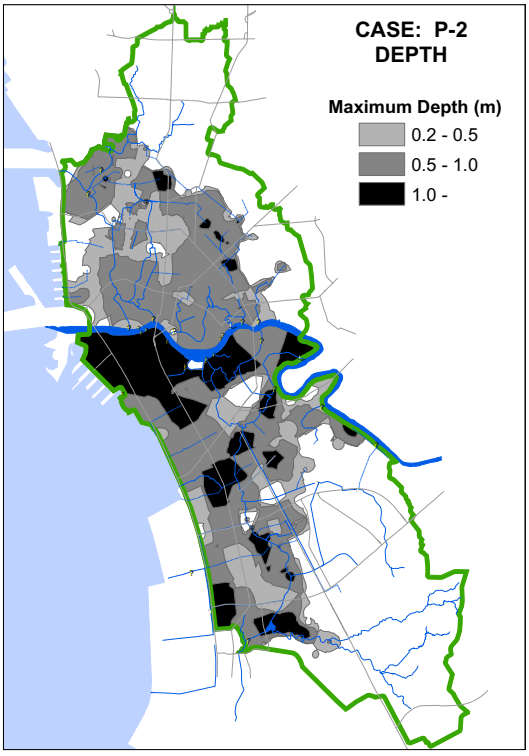
Inundation Duration
(Existing condition)

Inundation Duration
(Condition after dredging and declogging)

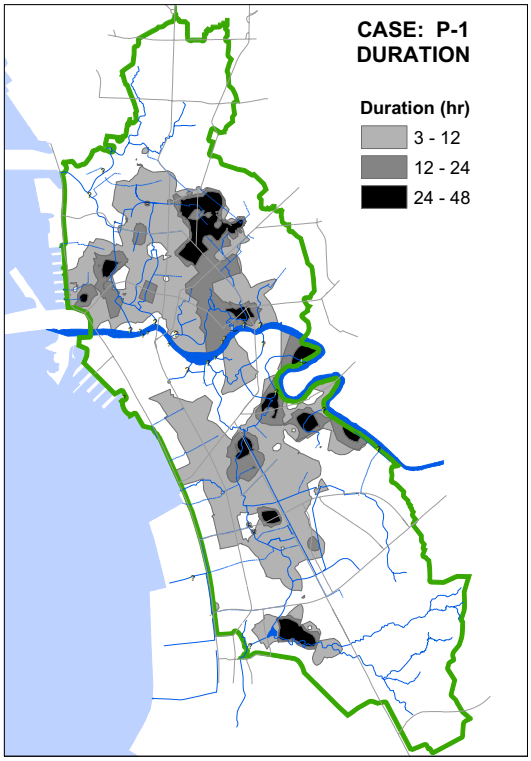
Figure 3.2.2 Simulated Inundation Conditions - Effect of Dredging and Declogging



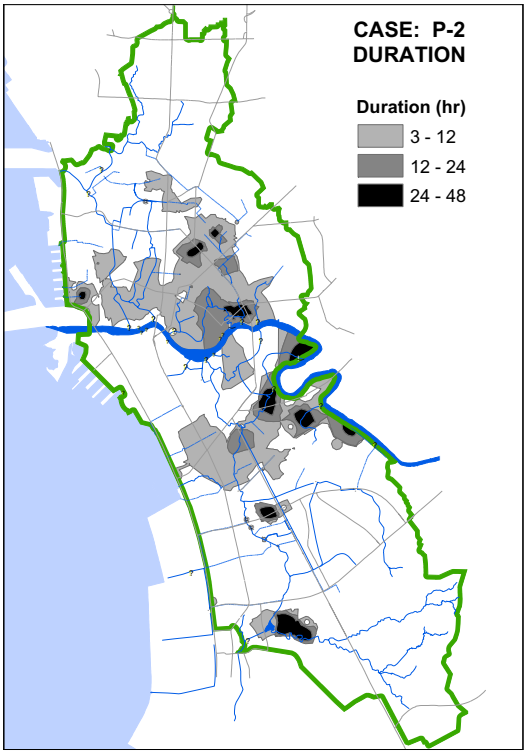
Maximum Inundation Depth
(Without pump and gate operation for existing condition)



Maximum Inundation Depth (Without pump and gate operation for condition after dredging and declogging)

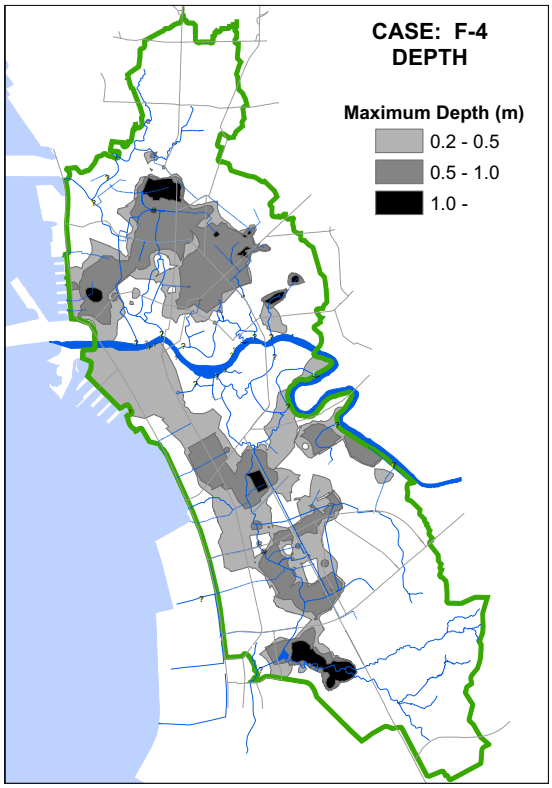


Inundation Duration
(Without pump and gate operation for existing condition)

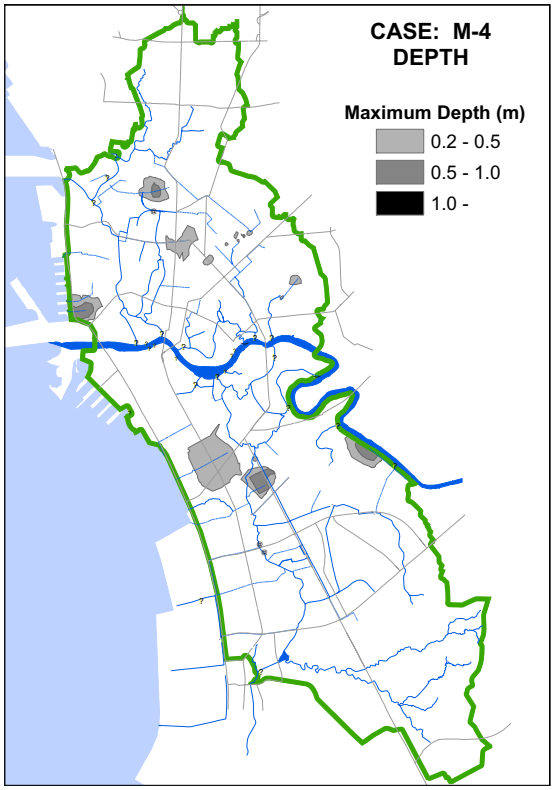


Inundation Duration (Without pump and gate operation for condition after dredging and declogging)

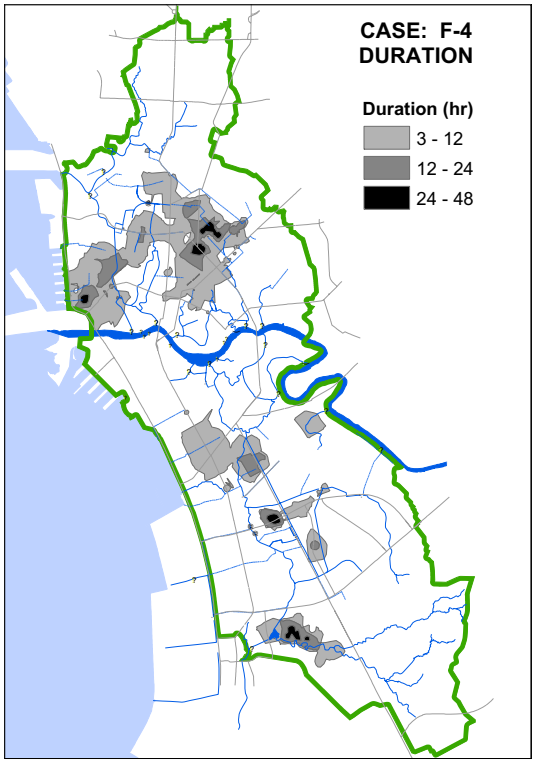
Figure 3.2.3 Simulated Inundation Conditions - Effect of Pumping Stations



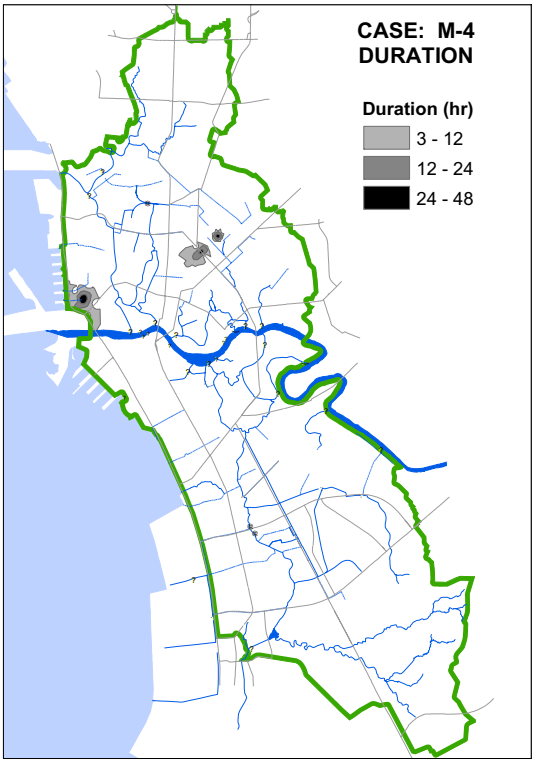
Maximum Inundation Depth
(Condtion after Phase 1)



Maximum Inundation Depth
(Condition after completion of proposed works)

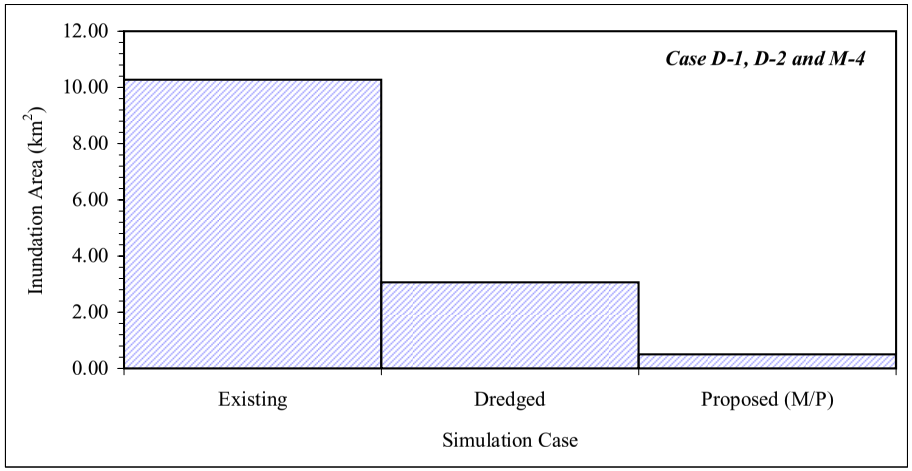


Inundation Duration
(Condtion after Phase 1)

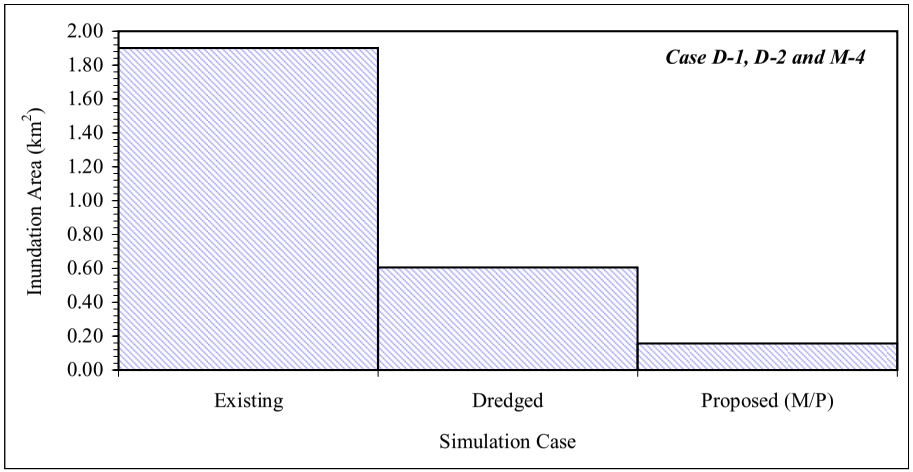


Inundation Duration
(Condition after completion of proposed works)

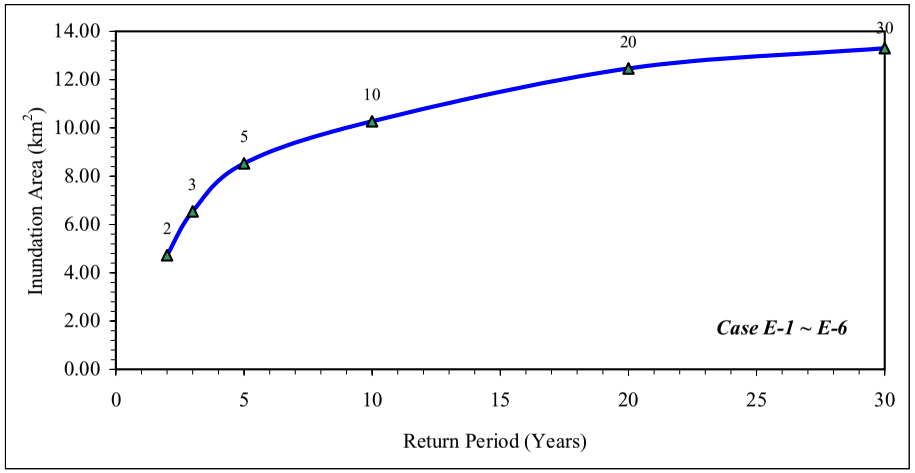
Figure 3.2.4 Simulated Inundation Conditions after Completion of Proposed Works



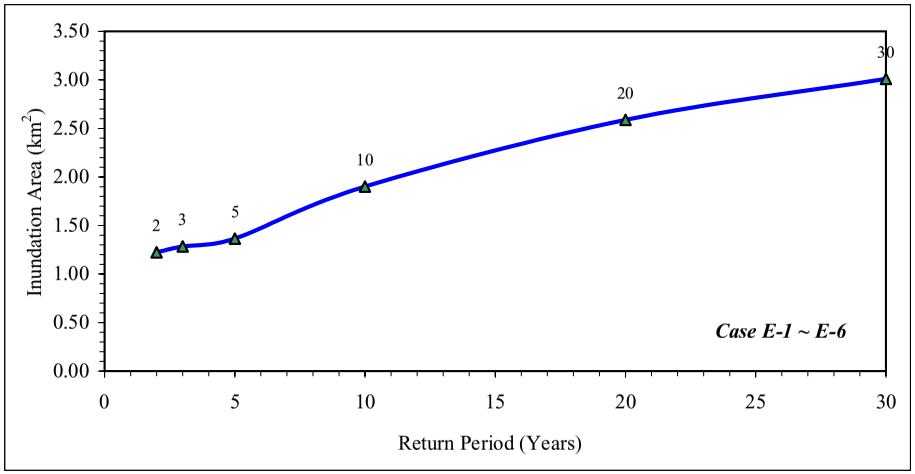
Inundation Area (10-Yr Return Period) by Improvement Condition for Depth 0.5 ~ 1.0 m



Inundation Area (10-Yr Return Period) by Improvement Condition for Duration 12 ~ 24 hrs



Inundation Area by Return Periods for Depth 0.5 ~ 1.0 m under Existing Condition



Inundation Area by Return Periods for Duration 12 ~ 24 hrs under Existing Condition

Source: Hydrodynamic simulation results by MOUSE

Figure 3.2.5 Inundation Characteristics of the Study Area from Simulation Result

Chapter 4

MASTER PLAN

CHAPTER 4 MASTER PLAN

4.1 BASIC CONCEPT

4.1.1 GENERAL

The core area of Metropolitan Manila is vulnerable to floods and stormwater because of its low-lying topography, and meteorological and hydrological conditions. The Government of the Philippines has taken various measures to mitigate the flood and inundation damages since the 1940s, but the drainage problem still remains as one of the major tasks in the Metropolitan Manila. In order to improve the drainage capacities, comprehensive approaches: technical, institutional and public participation, are applied. The basic concept of formulation of a master plan for drainage improvement of the core area of Metropolitan Manila is discussed as follows.

(1) Measures for reduction of flood and inundation conditions (extension, depth and duration) and severe regional inundation areas in both North Manila and South Manila are to be considered. The measures are composed of rehabilitation of the existing drainage facilities, remedial works and/or additional works to cope with the current runoff conditions during heavy rains, and also include strengthening of the existing O&M organizations and activities, and promoting of public participation at barangay levels.

Due to the assessment of the flood and inundation damage in the 1999 flood, the flood and inundation affected a half of the core area and caused a severe inundation locally in both North Manila and South Manila. The flood and inundation affected 1.24 million people, 97,000 houses and about a half of the road network, causing heavy traffic and disturbing commercial activities and urban living in the core area. The drainage improvement in the core area will bring various effects not only reducing of flood and inundation damages to the people living in flood and inundation area, but also promoting of economic activities in Metropolitan Manila, which could level up the living conditions in general in Metro Manila.

(2) Rehabilitation of the existing drainage facilities should be the base for drainage improvement of the core area. The existing drainage facilities are composed of drainage pumping stations and drainage channels: esteros/creeks, drainage main/outfalls and laterals; however, major drainage pumping stations are aging and major drainage channels like esteros/creeks are missing the discharge capacities because of heavy deposits caused by illegal dumping of solid waste.

(3) The 15 major drainage pumping stations are key facilities for the drainage system in the core area and should be sustained by proper rehabilitation, because they have been working effectively in improving the stormwater drainage in the core area. However, 10 of them have been in operation since the 1970s-1980s and had problems of deterioration of casing liner, corrosion of guide casing, crack of various major parts and units of engine, etc., due to aging, extremely low quality of water, clogged and overloaded with solid waste, decreasing of cooling effect, etc. Two others are also requiring replacement of pump equipment.

(4) The capacities of the existing drainage channels should be recovered by dredging and declogging, because the discharge capacities of existing drainage channels are assessed

mostly as less than the peak discharge with 2-year return period rainfall event, though the major channel were designed to have the capacities to convey the peak discharge with 10-year return period, and required to recover the original capacities by dredging. The volume of bottom deposits of drainage channels are estimated to be 840,000 m^3in esteros/creeks and 80,000 m^3 in drainage mains/outfalls, which should be dredged and declogged in order to recover the original capacities of the existing drainage channels.

(5) The informal house buildings in drainage channels should be moved or relocated before dredging bottom deposits of drainage channels. There are numerous informal house buildings encroaching public spaces in and along drainage channels, which are part of the causes of missing discharge capacities of the drainage channels and become major obstacles for the O & M activities including dredging. For improvement of the existing drainage channels it is indispensable to remove informal house buildings within drainage channels before dredging. Among 2,100 house buildings within esteros/creeks, which have been identified in the Study, 1,900 house buildings should be removed before dredging works and informal settlers who live in those house buildings should be relocated during the Master Plan stage by stage.

(6) Proper O & M organizations and activities should be required to sustain the discharge capacities and protect the drainage channels against illegal activities: encroachment of informal settlers and dumping of solid waste in drainage channels. For the purposes strengthening of O & M organizations and community-involved O & M system are considered.

(7) For improvement of the drainage facilities in the core area many agencies of central and local governments are to be involved and an optimum coordination organization should be established for smooth implementation of the projects.

(8) Public participation should be promoted at the barangay level by enhancement of public awareness for drainage management in order to improve and sustain the drainage channels including solid waste collection management, and various community-involved activities are considered.

4.1.2 TARGET OF MASTER PLAN

(1) Target Area

The target area for the Master Plan is about 73 km^2 in the core area of Metropolitan Manila as agreed in the I/A. The area covers the drainage basin of the core area of Metropolitan Manila.

(2) Target Year

Target year of the Master Plan is 2020, and the Master Plan is to be implemented by three terms as follows:

1) Short-term for 1st phase projects from 2005 to 2010
2) Mid-term for 2nd phase projects from 2011 to 2015
3) Long-term for 3rd phase projects from 2016 to 2020

(3) Target of Drainage Improvement

The targets of the drainage improvement plan are:

- ***To recover and sustain the original and potential functions of the existing drainage channels and drainage pumping stations; and***
- ***To improve inundation conditions in severe regional inundation areas in which channel network of the present system is insufficient.***

4.1.3 NECESSARY MEASURES OF DRAINAGE IMPROVEMENT

In order to achieve drainage improvement in the core area of Metropolitan Manila, it is necessary to carry out integrated measures that include structural, non-structural and supporting measures.

(1) Structural Measures

The structural measures aim to mitigate the inundation by rehabilitation works of drainage pumping stations, dredging of drainage channels, additional works including construction of interceptors, etc.

(2) Non-structural Measures

The non-structural measures aim to reduce flood damage indirectly. It includes recommendation for countermeasures against rapid urbanization and usage of existing flood forecasting and warning system.

(3) Supporting Measures

The supporting measures aim to support and sustain the above two measures by improving and developing organizational aspects of O & M system including community involvement, and by installing several O & M related equipment and facilities. Solid waste management along drainage channels to reduce accumulation of bottom deposits are proposed. Guideline for resettlement will be also prepared.

4.1.4 MAJOR COMPONENTS FOR THE MASTER PLAN

The drainage improvement plan will be composed of the following components:

- Improvement and rehabilitation plan for drainage channels (*Chapter 4.2*),
- Improvement and rehabilitation plan for drainage pumping stations (*Chapter 4.3*),
- Improvement plan for solid waste management along drainage channels (*Chapter 4.4*),
- Improvement plan for O&M organizations and activities (*Chapter 4.5*),
- Social framework of resettlement (*Chapter 4.6*).

Table 4.1.1 shows the relationship between the major components for the master plan and necessary measures. The detail of each component is explained in *Chapter 4.2 - 4.6*.

Table 4.1.1 Major Components and Measures

Components	*Chapter*	*Structural Measures*	*Non-Structural Measures*	*Supporting Measures*
Improvement and Rehabilitation Plan for Drainage Channels	*4.2*	*# Rehabilitation Works for Drainage Channels* *# Additional Works for Drainage Channels*	*# Recommendation of Countermeasures for Rapid Urbanization* *# Recommendation of Application of Existing Floodplain Management System*	
Improvement and Rehabilitation Plan for Drainage Pumping Stations	*4.3*	*# Rehabilitation Works for Drainage Pumping Stations* *# Additional Works for Drainage Pumping Stations*		
Improvement Plan for Solid Waste Management along Drainage Channels	*4.4*			*# Establishment of Community-Involved Solid Waste Management*
Improvement Plan for O&M Organizations and Activities	*4.5*			*# Improvement of O&M Organization and Activities* *# Installation of Equipment and Facilities for Effective O&M Activities*
Social Framework of Resettlement	*4.6*			*# Preparation of Guideline for Resettlement*

4.2 DRAINAGE FACILITY IMPROVEMENT PLAN

4.2.1 BASIC CONSIDERATION ON DRAINAGE FACILITY IMPROVEMENT

(1) Necessity of Pumping Stations

About 70% of the study area is drained by drainage pumping stations in the core area. The pumping stations, especially 12 stations constructed in the '70s and '80s, are aging and losing their service lives. All of the stations will lose their function completely, if any rehabilitation works would not be executed. This condition is equivalent to the condition before the pumping stations were constructed. As shown in *Chapter 3.2*, if both pump and gate are not functioning, it is expected that deep inundation area extends to the entire low-lying area, which brings about much more severe damage in the capital of the Philippines. This proves the necessity of pumping stations. To keep the pump drainage system is costly. However, it is indispensable for the core area to rely on the pump drainage system and the rehabilitation works for the pumping stations will be fundamental for the drainage improvement plan.

(2) Original and/or Potential Capacity of Existing Drainage Channels

As have been discussed in *Chapter 2.5*, dredging and declogging of drainage channels are remarkably effective to increase the discharge capacity. It has also been clarified by the hydrodynamic simulation by MOUSE, as shown in *Chapter 3.2*. It means that the original and potential capacity of the existing drainage channel is basically large enough; therefore, the existing drainage channels should be utilized as much as possible by executing rehabilitation works.

(3) Disposal of Dredged and Declogged Material

Total volumes to be dredged and declogged from esteros/creeks and drainage mains are estimated at about 840,000 m^3 and about 80,000 m^3, respectively. Based on the results on the sampling survey of bottom sediment from estero bed during the Study, the concentration of toxic material in the sediment was lower than the one for hazardous waste specified in DAO No. 22-29, as shown in *Chapter 2.1*. Therefore, it can be deposited by ordinary landfill method. However, because the number of samples taken during the Study is limited and there is always uncertainty, it is strongly recommended that detailed investigation on harmful chemical parameters be conducted before implementation of the project.

Dredged and declogged material from esteros and drainage mains should be appropriately transported and disposed at appropriate sites.

(4) Encroachment of Structures within Esteros

Encroachment of structures has been observed in many esteros. It is estimated that about 6,000 families are living in such structures in the study area. If the structures nearby esteros are included, the number of families who live along esteros is expected to be much larger. When the bottom deposits will be dredged to recover the original cross-sectional area of esteros, such structures within esteros should be removed and those who live in the structure within esteros should be basically relocated first.

In general, as a principle of river management, not only such encroachment within esteros but also encroachment in maintenance roads along esteros must be prevented. On the other hand, negative impact for those who have already lived in such structures, due to the project implementation, should be minimal. Considering both views, the following compromised plan would be preferable. That is to say, to recover the original cross-sectional area of esteros and

consequently original discharge capacity, dredging work would be implemented after the structures within esteros are removed without touching the structures outside of esteros tentatively.

There are three main reasons for necessity of removal of the structure within esteros. First, both overhanged structures from bank and self-standing structures within esteros will be obstacles for dredging work itself. Second, the lowered estero bed by dredging will threaten the stability of self-standing structures within esteros. Third, the structures themselves may become obstacles against water flow during storm although it is difficult to estimate its quantitative effect due to limited information.

The removal of the structures within esteros requires relocation of those who are living in there. To mitigate negative impact upon them, a well-considered and socially acceptable relocation plan and procedure is crucial to implement dredging work of esteros.

(5) Maintenance Hole (or Manhole) of Drainage Main

Many of maintenance holes of drainage main have been improperly maintained. Some of them have been covered by road pavement or structures and no longer utilized for maintenance. Such maintenance holes should be improved in order to recover their proper functions. Otherwise, it is really difficult to conduct ordinary O&M works.

(6) Necessity of Additional Works

Dredging of esteros/creeks and declogging of drainage mains are significantly effective to recover the original function of drainage system in the core area. However, some additional works will be required to improve the inundation condition, especially in severely inundated areas. There are two notable regional inundation areas, one in Aviles - Sampaloc area in North Manila, and the other, San Isidro, San Antonio and Pio del Pilar area in South Manila.

4.2.2 Basic Conditions for Formulating Drainage Facility Improvement Plan

(1) Objective Drainage Channels and Facilities

The drainage improvement master plan is formulated basically based on the existing drainage networks and drainage facilities in the core area, in which 11 drainage blocks are identified. *Table 4.2.1* shows the objective drainage channels and facilities, which include large pumping stations, esteros/creeks, drainage mains and major outfalls. Although there are numerous laterals and 8 small pumping stations, they are not included in the Master Plan and are to be rehabilitated separately through the ordinary maintenance activities.

Table 4.2.1 Objective Drainage Channels and Facilities

North Manila: 5 drainage blocks (28.8 km^2)	*South Manila: 6 drainage blocks (43.8 km^2)*
7 Large pumping stations	*8 Large pumping stations*
20 Esteros/Creeks: 27.8 km	*22 Esteros/Creeks: 45.7 km*
19 Drainage mains: 17.8 km	*18 Drainage mains: 17.0 km*
Related major laterals	*Related major laterals*

(2) Categorization of Drainage Channels

The existing drainage channels: esteros/creeks, drainage mains, outfalls and laterals, are categorized due to their drainage functions or roles. The 15 large drainage pumping stations

drain storm water from about 70% of the core area. The esteros, which are directly connected to the pumping stations, are essential for the pump drainage system. These channels act not only as channels for discharging stormwater to pumping stations but also as regulating ponds of pumping stations. Therefore, they should be categorized as the trunk channels. The open and closed channels connecting to trunk channels are also important and categorized as the secondary channels. The rest of drainage channels except laterals are categorized as the tertiary channels. *Table 4.2.2* summarizes the definition of the category of drainage channels, and the categorized channels are shown in *Figure 4.2.1.*

Table 4.2.2 Definition of Category of Drainage Channels

Trunk Channel	*Esteros/Creeks which are directly connected to large drainage pumping stations and jointly functions as common retarding pond for smooth pump operation*
Secondary Channel	*Other minor Esteros/Creeks and drainage mains/outfalls/interceptors which are connected to trunk channel*
Tertiary Channel	*Other channels except for above trunk and secondary channels and laterals*
Lateral	*Drainage pipes and gutters*

(3) Target of Rehabilitation and Design Scale for Additional Works

According to the 1952 Plan for the Drainage of Manila and Suburbs, major drainage channels were designed for a 10-year return period, whereas local channels had no prepared action. On the other hand, the 1984 Metro Manila Integrated Urban Drainage and Flood Control Plan proposed a 10-year return period for design discharge for major channels and drainage pumping stations, and a 2-year return period for local channels. It should be noted that drainage capacities of the pumping stations have been designed for a 10-year return period with a 20-cm allowable inundation depth in the catchments.

The present channels and facilities have been basically constructed and improved according to the above-mentioned design scales. However, those original functions and safety level have been considerably decreased due to illegal social activities of encroachment of informal settlers and accumulated bottom deposits, but in some drainage basin runoff is increasing due to the rapid urbanization, etc.

Ideally, it is supposed in the core area of Metropolitan Manila that drastic drainage improvement be desired in view of maintaining and improving the capital city's functions and the citizen's social and public welfare. However, it is not practical considering the present and potential drainage capacities of the existing channels, various constraints of limited channel easement, encroachment of numerous informal settlers in the channels, financial capacity for improvement works, etc.

Objective works in the drainage improvement consist of rehabilitation works and additional works for the drainage channels including box culverts and pumping stations.

Main purpose of the rehabilitation works is to revive the original cross-sectional area of drainage channels and box culverts, and to sustain the original functions of drainage pumping stations so as to operate properly. Accordingly, the rehabilitation target is to remove the accumulated bottom deposits in the channels and culverts by means of dredging or declogging including related remedial works of construction of stop logs and improvement of covered maintenance holes (or manholes) and to repair and replace damaged pump equipment and appurtenant facilities of the pumping stations.

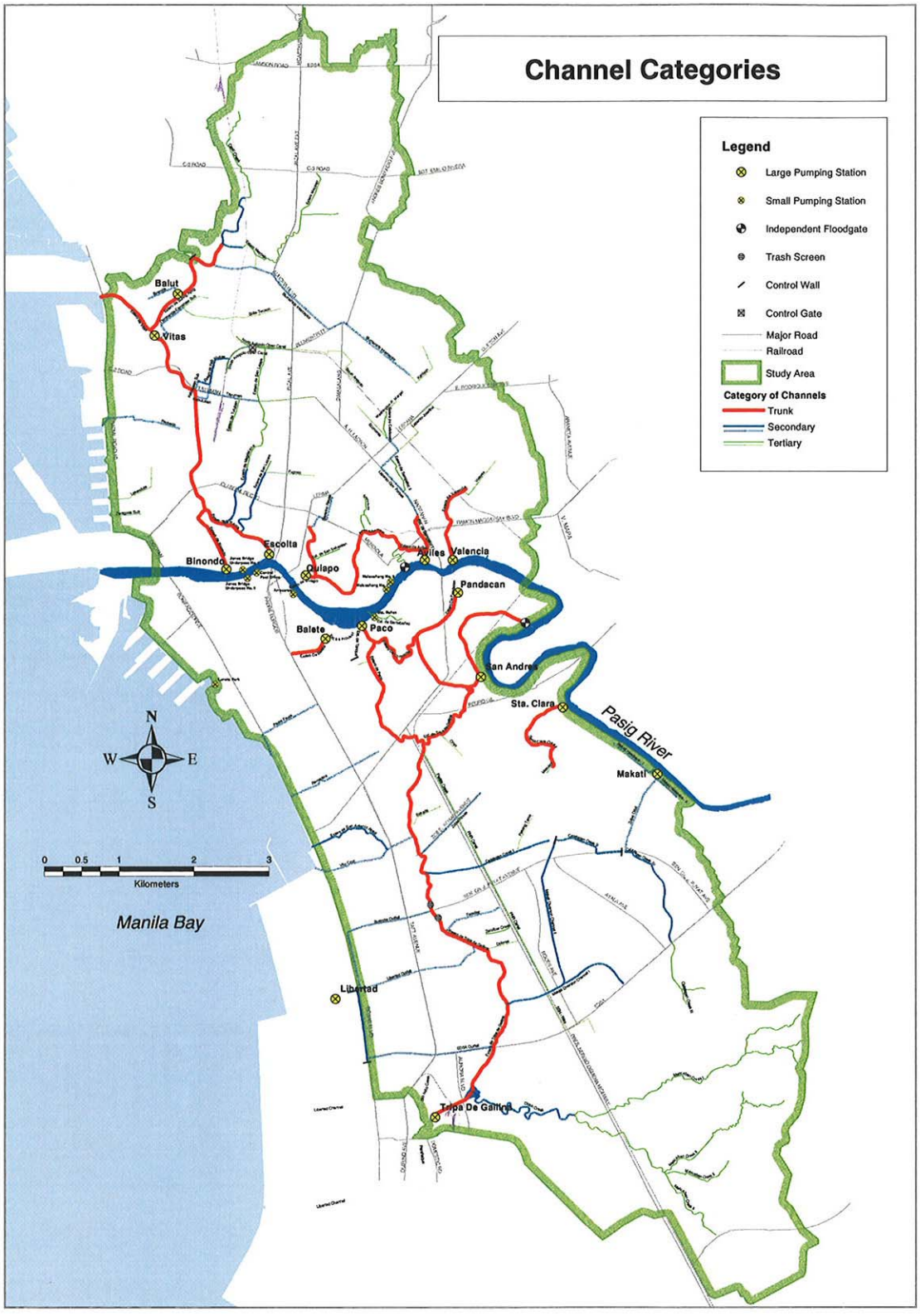


Figure 4.2.1 Channel Categories

Aside from the above, that of the additional works is to construct new box culverts for further improvement of the present poor drainage situation. For Blumentritt Interceptor, construction of inlets for road surface flow and widening of narrow sections are planned as remedial works. The design scale for additional works is a safety level against a certain rainfall amount evaluated by occurrence probability to design and construct new drainage channels, generally called as "design scale".

The design scale for additional works is summarized in *Table 4.2.3*.

Table 4.2.3 Design Scale for Additional Works

Drainage pumping Stations (15 large pumping stations)	*10 years return period (269 mm/24 hours)*
Trunk Channel	*10 years return period (80 mm/hour)*
Secondary Channel Interceptor to be proposed	*3 years return period (60 mm/hour)*
Tertiary Channel Lateral Small Pumping Station	*To recover original capacity, not specified*

(4) Other Conditions

1) Topography

- The most recent available topographic information based on 1:5,000 topographic map prepared in 2004, with low-lying areas modified using the result of manhole survey in 2000, is utilized for formulation of the Master Plan.
- Primary benchmark is BM-ML3 located in Quezon City.
- Elevation above DPWH datum of 10.475 m is equivalent to Mean Sea Level (MSL).
- Cross-sectional and longitudinal shape of the channels surveyed in the present study and in SEDLMM (2000) is used as basis to evaluate the existing condition.

2) Design Rainfall

- The probable rainfall intensity for Port Area station evaluated in the Study is employed. The average rainfall intensity for one hour against a 10-year return period is 81 mm/ hour.
- The design hyetograph has been proposed considering mass-curves, and it is applied in the Study. The detail of the design hyetograph is described in *Supporting Report B*.

3) Design High Water Levels at Surroundings

- Mean Spring High Tide Level (El. 11.34 m) is applied for design high water level on Manila Bay.
- As for design high water level along the Pasig River and the Parañaque River, water level for a 30-year return period event is applied. For the detail, please refer to *Chapter 2.1* or *Supporting Report B*.

4) Improvement of the Pasig River

- Completion of on-going Pasig-Marikina River Improvement Project is assumed.
- The design high water level along the Pasig River is thereby determined using that in

the said project.

- Also, it is assumed that outlet of drainage along the Pasig River will be improved so that reverse flow from the Pasig River into the study area will be minimum, even if the water level along the Pasig River rises. The concept of improvement plan of drainage along the Pasig River, which is proposed in the on-going Pasig-Marikina River Improvement Project, is described in *Supporting Report E.*

5) Hydrologic and Hydraulic Analysis

- For the design purpose, the rational method to estimate probable peak discharge is applied.
- Discharge capacity is then estimated using conventional uniform or non-uniform calculation.
- Manning's coefficient for channel roughness is assumed at 0.025 for esteros/creeks and 0.015 for drainage mains.
- After necessary dimension of the drainage channel is determined, a more sophisticated, unsteady, hydrodynamic simulation by MOUSE is executed to confirm its validity.

(5) Proposed Drainage Scheme

It is proposed that the uppermost sub-basin of the existing Blumentritt Interceptor is to be transferred to Quiapo-Aviles drainage block. Furthermore, some additional works for drainage channels are to be proposed in the Master Plan. Accordingly, some adjustments of sub-basin and block in North Manila are necessary. *Table 4.2.4* shows the areas for the proposed drainage blocks. The adjusted drainage block and sub-basin are also shown in *Figure 4.2.2.*

Table 4.2.4 Proposed Drainage Blocks

ID	*Name of Drainage Block*	*Existing Area (km^2)*	*Proposed Area (km^2)*	*Remarks*
N01	*Vitas-Binondo-Escolta*	*8.55*	*8.26*	*-0.29 km^2*
N02	*Quiapo-Aviles*	*5.58*	*6.19*	*+0.61 km^2*
N03	*Valencia*	*2.37*	*2.37*	*No change*
N04	*Maypajo-Blumentritt-Balut*	*9.91*	*9.59*	*-0.32 km^2*
N05	*North Harbor*	*2.37*	*2.37*	*No change*
S01	*Libertad-Tripa de Gallina*	*25.96*	*25.96*	*No change*
S02	*Balete*	*0.94*	*0.94*	*No change*
S03	*Paco-Pandacan-San Andres*	*6.12*	*6.12*	*No change*
S04	*Sta. Clara*	*1.57*	*1.57*	*No change*
S05	*Makati*	*4.31*	*4.31*	*No change*
S06	*South Harbor and Others*	*4.90*	*4.90*	*No change*

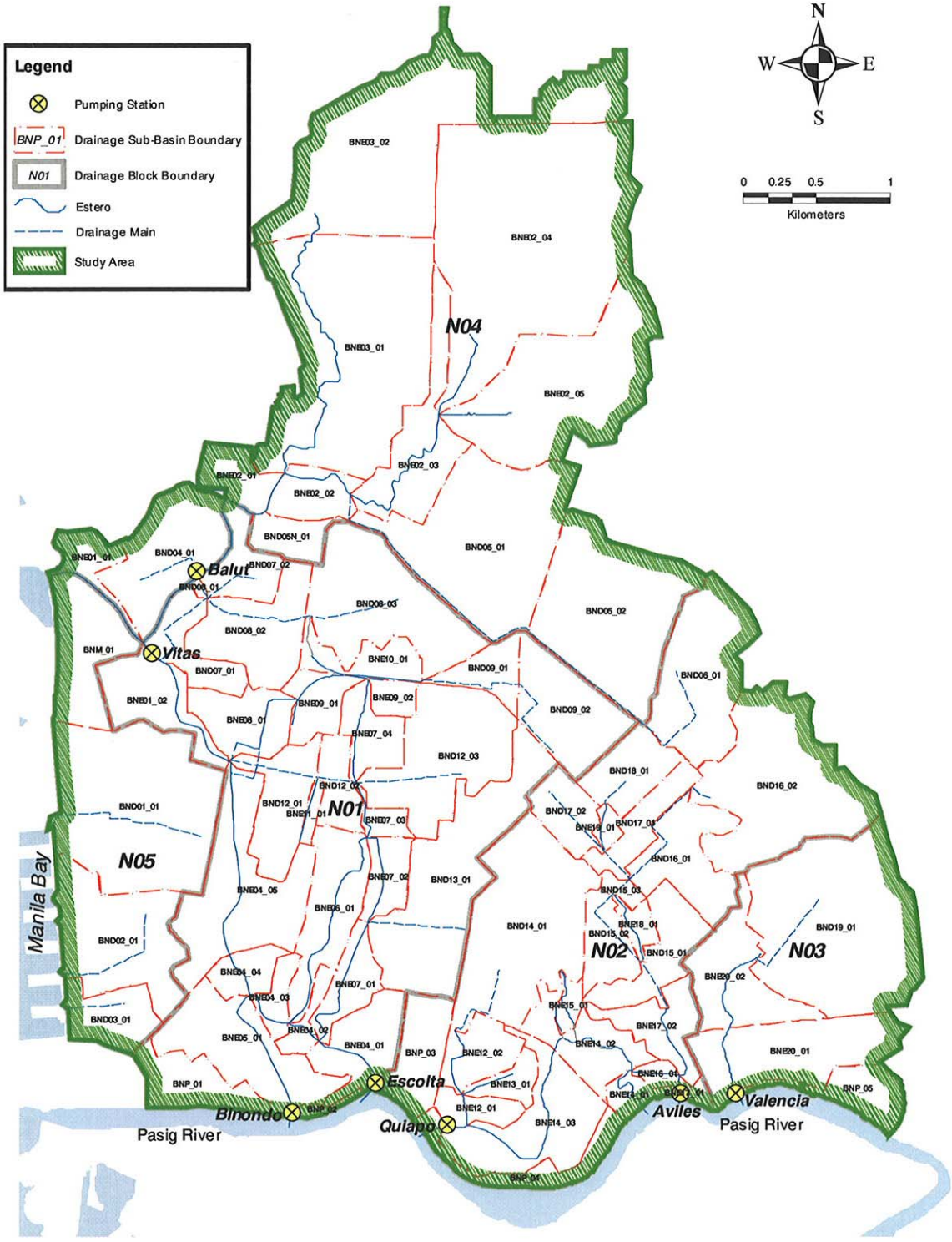


Figure 4.2.2 Drainage Block and Sub-Basin for Proposed Drainage Scheme (1/2)

Figure E4.2.2 Drainage Block and Sub-Basin for Proposed Drainage Scheme (2/2)

4.2.3 IMPROVEMENT AND REHABILITATION PLAN FOR DRAINAGE CHANNELS

(1) Rehabilitation Works for Drainage Channels

The present drainage channels mostly have lost the original cross-section areas planned and constructed. In order to recover the original cross-sectional areas, the following are proposed:

- Dredging of trunk channels:
  Dredging to be done for the channels to recover the estimated original bed elevations/cross-sections.
- Dredging and declogging of secondary and tertiary channels:
  Secondary and tertiary channels to be dredged and declogged to recover the estimated original bed elevations/cross-sections.
- Related Works
  1) Rehabilitation of maintenance holes (or manholes)
     Maintenance holes covered by road pavement are raised to recover those functions.
  2) Installation of stop log gate for drainage mains
     Stop log is installed depending on water level at the box culvert that is rehabilitated. The criterion of installation of stop log gate is as follows.
     - For box culvert discharging through pumping stations:
       Culvert with more than 50 cm water depth of box culvert when water level of outlet is pump operation stop level
     - For box culvert discharging directly to Manila Bay:
       All culverts

Table 4.2.5 presents a summary of dredging and declogging volume of the drainage channels. The drainage mains in which the stop log gate should be installed are shown in *Table 4.2.6.*

Table 4.2.5 Summary of Dredging and Declogging Volumes

Unit of volume: 1,000 m^3

Location	*Works*	*Trunk channel*		*Secondary channel*		*Tertiary channel*		*Total volume*
		No.of channels	*Volume*	*No. of channels*	*Volume*	*No. of channels*	*Volume*	
North Manila	*Dredging*	*9*	*314*	*5*	*71*	*7*	*31*	*416*
	Declogging	*-*	*-*	*9*	*28*	*13*	*21*	*49*
	Sub total	*9*	*314*	*14*	*99*	*20*	*52*	*465*
South Manila	*Dredging*	*6*	*316*	*4*	*98*	*2*	*10*	*424*
	Declogging	*-*	*-*	*11*	*30*	*4*	*2*	*32*
	Sub total	*6*	*316*	*15*	*128*	*6*	*12*	*456*
Total	*-*	*18*	*630*	*29*	*227*	*26*	*64*	*921*

Before implementing the dredging works, the informal settlers within esteros will have to be relocated. Affected by these measures are families living in about 1,900 house buildings within esteros. When it is assumed that the conversion rate from number of buildings to number of families that live there is 2.8, the number of the families to be resettled is about 5,500.

Table 4.2.6 Drainage Mains in Which Stop Log Gate Should be Installed

Code	Name	Code	Name
ND07	Pampanga-Earnshaw Sub	SD14	Buendia Outfall
ND08	Solis-Tecson	SD15	Libertad Outfall
ND09	South Antipolo	SD16	EDSA Outfall
ND10	Kabulusan Sub	SD13	Vito Cruz
ND11	Kabulusan	SD04	Makati Headrace-I
ND12	Tayuman	SD05	Makati Headrace-II
ND13	Fugoso	SD01	Padre Faura
ND14	Severino Reyes	SD02	Remedios
ND15	Lepanto-Gov. Forbes		
ND16	Lepanto-Josefina		
ND17	Economia		
ND18	Washington-P. Margal		
ND19	Visayas		
ND05	Blumentritt Interceptor		
ND04	Buendia		
ND01	Pacheco		
ND02	Lakandula		

(2) Additional Works for Drainage Channels

The additional works for drainage channels are proposed as follows.

Vitas-Binondo-Escolta drainage block

- Additional works of South Antipolo area

Quiapo-Aviles drainage block

- Additional works of channels to Quiapo Pumping Station
- Additional works for Aviles drainage area

Maypajo-Blumentritt-Balut drainage block

- Additional works of Estero de Vitas
- Additional works of Blumentritt Interceptor

Libertad-Tripa de Gallina drainage block

- Additional works for severe inundation area in South Manila
- Additional works of Libertad pond
- Additional works of Dilain/Maricaban Creek area

Balete drainage block

- Additional works in Estero de Balete

The tentative dimensions by preliminary design are shown in *Table 4.2.7.* For the detail explanation of additional works, please refer to *Supporting Report E.*

Table 4.2.7 Proposed Additional Works for Drainage Channels (1/2)

Drainage Block	Drainage Block	Item	Sub-Item	Purpose	Location	Length	Dimension	Remarks
N01	**Vitas-Binondo-Escolta**	**Additional works of South Antipolo area**	Replacement of existing Kubulusan Sub Outfall	To drain stormwater in the uppermost area of Vitas-Binondo-Esclota drainage block	Kabulusan Sub D.M.	140m	W3.8mxH2.7m	
			Additional B.C. along South Antipolo Open Canal	To drain stormwater in the uppermost area of Vitas-Binondo-Esclota drainage block	Beside the existing South Antipolo Canal	400m	W3.3mxH2.7m	The dimension is determined by assuming that the dredging of South and North Antipolo Open Canals are not possible considering the existing condition of encroachment of informal settelers. If dredgings are possible, the dimension will be able to be downsized.
					Beside the existing South Antipolo Canal	500m	W2.6mxH2.7m	
			Additional B.C. along Solis Tescon D.M.	To prevent local inundation along Solis Tecson D.M.	Beside the existing Soilis Tescon D.M.	1400m	W3.0mxH1.5m	
N02	**Quiapo-Aviles**	**Additional works of channel to Quiapo Pumping Station**	Additional B.C. of Severino Reyes D.M.	To introduce more stormwater to Quiapo P.S.	Beside the existing Severino Reyes D.M.	700m	W2.8mxH2.5m	
			Extension of B.C.along Espana Street	To introduce more stormwater to Quiapo P.S.	Along Espana Street	800m	W2.8mxH2.5m	
		Additional works for Aviles drainage area	Additional B.C. along Margal	To drain the stromwater in the uppermost area of the existing Blumentritt Interceptor through Quiapo-Aviles drainage block efficiently	P.Margal to Kanloan	630m	W3.8mxH2.1m	
					P.Margal to Economia	700m	W3.8mxH2.1m	
			Imrpovement of a Bridge along Estero de Sampaloc I	To improve flow capacity of the channels to Aviles P.S.	Est. de Sampaloc I			
			Improvement of Est. de Samaploc II and Lepanto-Gov.Forbes D.M.	To increase flow capacity of the channels to Aviles P.S. to cope with increase of drainage area of Quiapo-Aviles drainage block	Est. de Sampaloc II and Lepanto-Gov.Forbes D.M.			It is assumed that Est. de Samaploc II is available to utilize. Improvement of inlet & outlet of the Est. de Sampaloc II to Lepanto-Gov.Forbes D.M., improvement of culverts are included. If Est. de Samaploc II is not available, additional box culvert is necessary.
N04	**Maypajo-Blumentritt-Balut**	**Additional works of Estero de Vitas**	Hightenning of river wall in the lower estro de Vitas	To prevent possible overtopping of seawater into the nearby urban area	Estero de Vitas	Rightbank 700m Leftbank 900m	DL+13.0m	
					Estero de Sunog Apog/Maypajo	Rightbank 1200m Leftbank 800m	DL+13.0m	
		Additional works of Blumentritt Interceptor	Remedial works of existing Blumentritt Interceptor	To prevent overflow from hilliy area to Quiapo-Aviles drainage block	Blumentritt Interceptor			
			Construction of Additional Interceptor	To prevent overflow from hilliy area to Quiapo-Aviles drainage block	Extension of the existing Blumentritt Interceptor	560m	2xW2.5mxH3.3m	The route of the additional interceptor is tentatively set besides the existing Blumentritt interceptor. More detailed study will be required for setting more technically, economically and enviornmentally sound route.
					Beside the existing Blumentritt Interceptor	1100m	W3.2mxH3.3m	
					Beside the existing Blumentritt Interceptor	1600m	W2.3mxH2.4m	

Table 4.2.7 Proposed Additional Works for Drainage Channels (2/2)

Drainage Block	Drainage Block	Item	Sub-Item	Purpose	Location	Length	Dimension	Remarks
S01	**Libertad-Tripa de Gallina**	**Additional works for severe inundation area in South Manila**	Additional B.C. along Zobel Roxas D.M.	To improve flow capacity along Zobel Roxas D.M. To improve flow capacity of crossing point with South Super Highway in Zobel Roxas D.M.	Zobel Roxas D.M. (upper area of South Super Highway)	650m	2xW1.8mxH1.4m	
					Zobel Roxas D.M. (under the South Super Highway)	65m	3xW1.5mxH1.4m	
			Additional B.C. along Faraday D.M.	To improve flow capacity along Faraday D.M. To improve flow capacity of crossing point with South Super Highway in Faraday D.M.	Finlandia Street (Tripa to Faraday D.M.)	800m	2xW2.2mxH1.7m	
					Faraday D.M. (Under the South Super Highway)	65m	2xW1.5mxH1.4m	
			Additional B.C. along Makati Diversion Channel	To improve flow capacity along Makati Diversion Channel I	Beside the Makati diversion Channel I	550m	2xW2.2mxH2.1m	The dimension is determined by assuming that widening of the existing Makati Diversion Channel I is not possible considering the existing condition of river banks with many residents.
		Additional works of Libertad pond	Expansion of the exsiting Libertad pond	To regain the original capacity of retarding pond of Libertad-Tripa de Gallina systsem	Libertad channel		100mx1700m	The original capacity of 100m x 1700m or its equivalent should be regained.
		Additional works of Dilain/Maricaban Creek area	Construction of Maricaban Interceptor	To reduce flood risk caused by future urbanization in upper Maricaban Creek Basin	Libertad Channel to Paranaque River	500m	2xW3.5mxH3.3m	
					Maricaban Creek II to Paranaque River	2350m	W3.7mxH3.3m	
					Maricaban Creek II to Paranaque River	1800m	W4.0mxH4.0m	
			Improvement of Dilain Pond	To prevent reverse flow from Est. de Tripa de Gallina to the surroundings	Left Bank of Dilain Pond			
S02	**Balete**	**Additional works in Estero de Balete**	Improvement of Padre Burgos B.C.	To improve a bottleneck point	Padre Burgos			
			Improvement of bridge cross San Maecelino St.	To improve a bottleneck point	San Maecelino St.			

4.2.4 NON-STRUCTURAL MEASURES

To support and sustain proposed structural measures, the following non-structural measures are recommended.

(1) Countermeasures for Rapid Urbanization

Urbanization in the core area, especially in Makati and Taguig areas, has been largely in progress. Open and green space is being converted into commercial and business complexes. Due to the urbanization, stormwater retention capacity in the catchment area is decreasing. Also, infiltration capacity to underground is decreasing because of asphalting of ground surface. As a result, runoff coefficient of storm water is expected to increase remarkably. Against such negative impacts, some countermeasures to lower runoff coefficient or to retard storm water temporarily are recommended in collaboration with urban development planning in view of effective utilization of improved drainage systems and sustainable floodplain management in the core area.

(2) Application of Existing Floodplain Management System

Existing systems of EFCOS and Inter-Agencies Floodplain Management are available for flood forecasting and warning, and floodplain management in the core area of Metropolitan Manila. Also, Disaster Management System for disaster preparedness is undertaken by Disaster Coordination Committees at national and regional levels as well as at city, municipality and barangay levels, and special arrangement system of funding allotment is available in case of emergency. These existing systems under government services are applicable to floodplain management as non-structural measures in the core area of Metropolitan Manila.

4.2.5 MAIN WORKS COST

Based on the preliminary cost estimation, main works cost for improvement and rehabilitation works for drainage channels are estimated as shown in *Table 4.2.8*.

Table 4.2.8 Main Works Cost for Improvement and Rehabilitation Works for Drainage Channels

Item			Amount (Million Peso)
Rehabilitation works of drainage channels			1,140.5
N01	Vitas-Binondo-Escolta	Additional works of South Antipolo area	503.0
N02	Quiapo-Aviles	Additional works of channel to Quiapo Pumping Station	307.5
		Additional works for Aviles drainage area	539.2
N04	Maypajo-Blumentritt-Balut	Additional works of Estero de Vitas	18.0
		Additional works of Blumentritt Interceptor	723.2
S01	Libertad-Tripa de Gallina	Additional works for severe inundation area in South Manila	460.1
		Additional works of Libertad pond	522.0
		Additional Works of Dilain/Maricaban Creek area	1,380.8
S02	Balete	Additional works in Estero de Balete	29.1
Total			5,623.4

4.2.6 PHASING OF IMPROVEMENT AND REHABILITATION PLAN FOR DRAINAGE CHANNELS

(1) Basic Idea for Phasing

Rehabilitation works such as dredging and declogging are most effective to reduce the inundation depth and duration for the entire study area. However, the existence of the informal settlers within esteros will make it difficult to implement in earlier phase because the well-considered relocation will take time to implement in general. Declogging of drainage mains is effective after dredging of esteros, because without improving the downstream part of a drainage main, which is usually esteros, storm water cannot be drained effectively. It is more effective to implement dredging and declogging for same drainage area simultaneously. Therefore, the rehabilitation works should be limited in the most critical area for mitigating inundation condition in earlier phase.

Additional works can be started in earlier phase, because it will not be accompanied by severe relocation problem. However, it should be noted that additional works usually require higher cost than rehabilitation work.

(2) Phasing

The proposed phasing for rehabilitation works is as follows.

1st Phase:

- Dredging 139,000 m^3
- Declogging 20,000 m^3
- Related Works
- Relocation 825 families (15% of 5,500 families)

2nd Phase:

- Dredging 360,000 m^3
- Declogging 50,000 m^3
- Related Works
- Relocation 1,925 families (35% of 5,500 families)

3rd Phase:

- Dredging 340,000 m^3
- Declogging 11,000 m^3
- Related Works
- Relocation 2,750 families (50% of 5,500 families)

The location to be rehabilitated for each phase is shown in *Figure 4.2.3*. *Table 4.2.9* and *4.2.10* show the work quantities of the rehabilitation works for esteros/creeks and drainage mains, respectively.

Table 4.2.11 shows the phasing of the additional works.

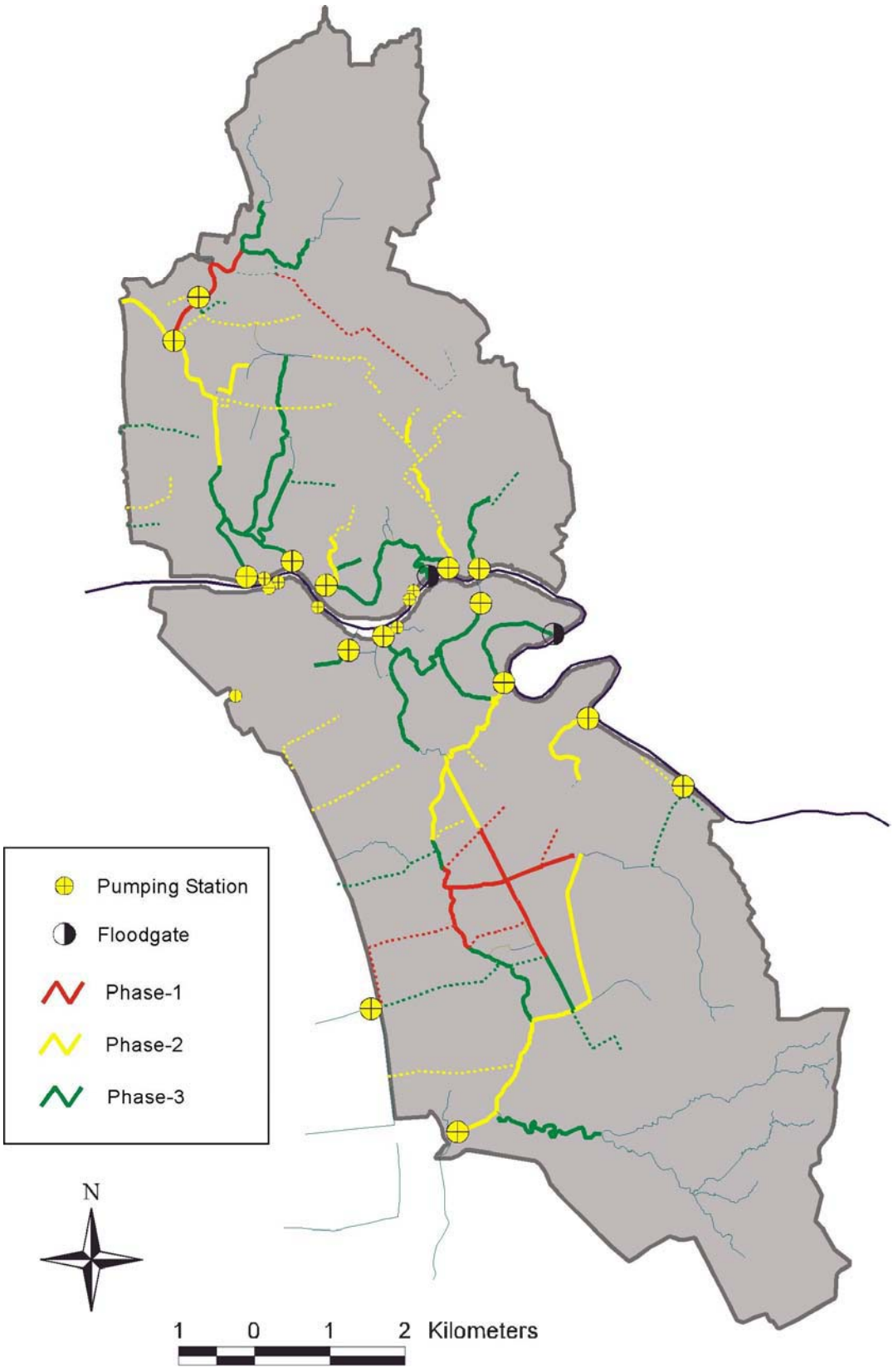


Figure 4.2.3 Phasing of Rehabilitation Works for Drainage Channels

Table 4.2.9 Phasing of Rehabilitation Works for Esteros/Creeks

Code	Name of Estero	Total Dredging Length (m)	Total Dredging Volume (m^3)	Portion	Dredging Length (m)	Dredging Volume (m^3)	Phase 1	Phase 2	Phase 3	Number of Buildings
NE01	Estero De Vitas	1,992	109,547		1,992	109,547		x		51
NE02	Estero De Sunog Apog/ Maypajo	3,172	111,401	1	1,827	91,475	x			37
				2	1,345	19,925			x	67
NE03	Casili Creek	901	6,025		901	6,025			x	0
NE04	Estero Dela Reina	2,843	31,254	1	1,946	20,515			x	15
				2	897	10,739		x		97
NE05	Estero De Binondo	922	7,310		922	7,310			x	0
NE06	Estero De Magdalena	1,512	18,895		1,512	18,895			x	35
NE07	Estero De San Lazaro	2,324	34,983		2,324	34,983			x	31
NE08	Estero De Kabulusan	690	8,371		690	8,371		x		5
NE12	Estero De Quiapo	903	14,064		903	14,064		x		19
NE13	Estero De San Sebastian	379	1,685		379	1,685			x	5
NE14	Estero De San Miguel/ Uli Uli	2,674	36,008		2,674	36,008			x	46
NE16	Estero De Aviles	345	1,783		345	1,783			x	0
NE17	Estero De Sampaloc I	659	9,397		659	9,397		x		0
NE18	Estero De Sampaloc II	506	4,786		506	4,786		x		1
NE19	Estero De Calubcob	337	1,136		337	1,136		x		4
NE20	Estero De Valencia	1,128	18,923		1,128	18,923			x	130
SE03	Estero De Balete	550	4,601		550	4,601			x	11
SE05	Santa Clara Creek	1,392	16,116		1,392	16,116		x		10
SE06	Estero De Paco	1,771	17,397		1,771	17,397			x	210
SE07	Estero De Concordia	1,070	24,702		1,070	24,702			x	0
SE08	Estero De Pandacan	3,878	27,629	1	1,929	18,036			x	51
				2	292	2,446		x		0
				3	1,657	7,148			x	1
SE09	Estero de Tripa de Gallina	7,538	224,912	1	1,929	115,819		x		315
				2	1,515	48,384			x	204
				3	1,247	28,882	x			230
				4	419	6,580			x	17
				5	2,428	25,246		x		92
SE10	Perlita Creek	922	3,264		922	3,264		x		12
SE11	PNR Canal	2,654	6,468	1	1,883	4,969	x			9
				2	771	1,499			x	105
SE12	Calatagan Creek I	1,711	13,162		1,711	13,162	x			6
SE16	Makati Diversion Channel I	814	11,167		814	11,167		x		43
SE17	Makati Diverson Channel II	1,993	28,302		1,993	28,302		x		0
SE18	Dilain Creek/ Maricaban Creek I	2,151	45,823		2,151	45,823			x	9
Total		47,733	839,110		47,733	839,110	138,489	360,400	340,222	1,868

Table 4.2.10 Phasing of Rehabilitation Works for Drainage Main

Code	Name of Drainage Main	Total Length (m)	Total Volume (m^3)	Portion	Length (m)	Volume (m^3)	Phase 1	Phase 2	Phase 3	Stop Log Gate
ND01	Pacheco	1157	1879		1157	1879			x	x
ND02	Lakandula	873	3520		873	3520		x		x
ND03	Zaragosa Sub	429	279		429	279			x	
ND04	Buendia	511	594		511	594		x		x
ND05	Blumentritt Interceptor	2775	10574	1	183	861			x	x
				2	2592	9713	x			x
ND07	Pampanga-Earnshaw Sub	1040	1624	1	653	606		x		x
				2	386	1017			x	x
ND08	Solis-Tecson	1424	2303	1	61	47			x	x
				2	1363	2256		x		x
ND09	South Antipolo	1379	7619		1379	7619		x		x
ND11	Kabulusan	366	1935		366	1935		x		x
ND12	Tayuman	1598	3755		1598	3755		x		x
ND13	Fugoso	669	1266		669	1266			x	x
ND14	Severino Reyes	646	319		646	319		x		x
ND15	Lepanto-Gov. Forbes	1160	7817		1160	7817		x		x
ND16	Lepanto-Josefina	1063	1434		1063	1434		x		x
ND17	Economia	824	2031		824	2031		x		x
ND18	Washington-P. Margal	212	485		212	485		x		x
ND19	Visayas	674	1103		674	1103			x	x
SD01	Padre Faura	1159	901		1159	901		x		x
SD02	Remedios	1348	3192		1348	3192		x		x
SD04	Makati Headrace-I	626	2280		626	2280		x		x
SD05	Makati Headrace-II	393	374		393	374			x	x
SD06	Zobel Orbit	1219	505		1219	505			x	
SD07	Onyx	414	456		414	456		x		
SD08	Estrada	518	682		518	682		x		
SD09	Zobel Roxas	1155	2120		1155	2120	x			
SD10	Faraday	817	99		817	99	x			
SD11	Pasong Tamo	543	911		543	911	x			
SD12	SSH-Way	1108	311		1108	311			x	
SD13	Vito Cruz	1450	521		1450	521			x	x
SD14	Buendia Outfall	1992	7152		1992	7152	x			x
SD15	Libertad Outfall	1796	2816		1796	2816			x	x
SD16	EDSA Outfall	1731	10142		1731	10142		x		x
SD17	Dolores	434	-		434	-			x	
Total		33502	80997		33502	80997	19995	50023	50023	

Table 4.2.11 Phasing of Additional Works for Drainage Channels

Item			Sub-Item	Phase 1	Phase 2	Phase 3
N01	**Vitas-Binondo-Escolta**	**Additional works of South Antipolo area**	Replacement of existing Kubulusan Sub Outfall		x	
			Additional B.C. along South Antipolo Open Canal		x	
			Additional B.C. along Solis Tescon D.M.			x
N02	**Quiapo-Aviles**	**Additional works of channel to Quiapo Pumping Station**	Additional B.C. of Severino Reyes D.M.		x	
			Extension of B.C.along Espana Street		x	
		Additional works for Aviles drainage area	Additional B.C. along Margal		x	
			Imrpovement of a Bridge along Estero de Sampaloc I		x	
			Improvement of Est. de Samaploc II and Lepanto-Gov.Forbes D.M.		x	
N04	**Maypajo-Blumentritt-Balut**	**Additional works of Estero de Vitas**	Hightenning of river wall in the lower estero de Vitas			x
		Additional works of Blumentritt Interceptor	Remedial works of existing Blumentritt Interceptor	x		
			Construction of Additional Interceptor	x		
S01	**Libertad-Tripa de Gallina**	**Additional works for severe inundation area in South Manila**	Additional B.C. along Zobel Roxas D.M.	x		
			Additional B.C. along Faraday D.M.	x		
			Additional B.C. along Makati Diversion Channel		x	
		Additional works of Libertad pond	Expansion of the exsiting Libertad pond		x	
		Additional Works of Dilain/Maricaban Creek area	Construction of Maricaban Interceptor			x
			Improvement of Dilain Pond			x
S02	**Balete**	**Additional works in Estero de Balete**	Improvement of Padre Burgos B.C.			x
			Improvement of bridge cross San Maecelino St.			x

4.3 IMPROVEMENT AND REHABILITATION PLAN FOR DRAINAGE PUMPING STATIONS

4.3.1 DESIGN DISCHARGE CAPACITY OF PUMPING STATIONS

The drainage capacities of the existing pumping stations are principally kept by means of repair and/or replacement of pump equipment and appurtenant facilities complying with the extent of mechanical and electrical service life. The existing and proposed drainage capacities of the pumping stations are shown in *Table 4.3.1*. Some adjustment of the capacities will be made.

Table 4.3.1 Discharge Capacity of Pumping Stations

Pumping station	*Existing discharge capacity*	*Proposed discharge capacity*	*Remarks*
Aviles	*15.6 m^3/s*	*18.6 m^3/s*	*+ 3 m^3/s*
(Pump Gates at existing Uli-Uli Independent Floodgate)	-	*2.0 m^3/s*	*New*
Quiapo	*10.8 m^3/s*	*10.8 m^3/s*	*No change*
Valencia	*11.8 m^3/s*	*11.8 m^3/s*	*No change*
Binondo	*11.6 m^3/s*	*11.6 m^3/s*	*No change*
Escolta	*1.5 m^3/s*	*1.5 m^3/s*	*No change*
Vitas	*32.0 m^3/s*	*32.0 m^3/s*	*No change*
Balut	*2.0 m^3/s*	*2.0 m^3/s*	*No change*
Pandacan	*4.4 m^3/s*	*4.4 m^3/s*	*No change*
Tripa de Gallina	*57.0 m^3/s*	*57.0 m^3/s*	*No change*
Sta. Clara	*5.3 m^3/s*	*5.3 m^3/s*	*No change*
(Pump Gates in existing Sta. Clara Drainage Basin)	-	*2.0 m^3/s*	*New*
Paco	*7.6 m^3/s*	*7.6 m^3/s*	*No change*
Libertad	*42.0 m^3/s*	*42.0 m^3/s*	*No change*
Makati	*7.0 m^3/s*	*7.0 m^3/s*	*No change*
Balete	*3.0 m^3/s*	*3.0 m^3/s*	*No change*
San Andres	*19.0 m^3/s*	*19.0 m^3/s*	*No change*
(Pump Gates at outlet of Perlita Creek)	-	*2.0 m^3/s*	*New*

4.3.2 REHABILITATION WORKS FOR DRAINAGE PUMPING STATIONS

Detailed overall technical checking of the service lives for drainage pump equipment and appurtenant facilities has been made from the mechanical and electrical viewpoints, based on the survey by the Flood Control Management Services of MMDA in the period from May to June 2004. The technical checking and diagnosis have been made in accordance with the criteria that are applied in the irrigation pumping stations by the Ministry of Agriculture, Fisheries and Forest, Japan. The checking consists of the following two steps:

- 1st step is overall checking of mechanical and electrical parts, and
- 2nd step is repair or replacement of mechanical parts that received a score above 10 points during the 1st step checking.

In the Study, 1st step checking was made mainly by visual observation, trial pump operation and diagnosis without disassembly of the pump equipment. Checking results, and rehabilitation items and priorities are described below.

(1) Criteria on Technical Checking and Diagnosis

It is generally reported that the lifespan for drainage pump equipment and appurtenant facilities and for electrical apparatus is around 20 and 10 years, respectively. It would be required for pump equipment and appurtenant facilities, used for more than 20 years, to be repaired or replaced in order to operate a pumping station in good condition from the mechanical, electrical and economic viewpoints. The electrical apparatus should also be replaced in general. The concept of degradation and timing of repair/replacement is shown in *Figure 4.3.1.*

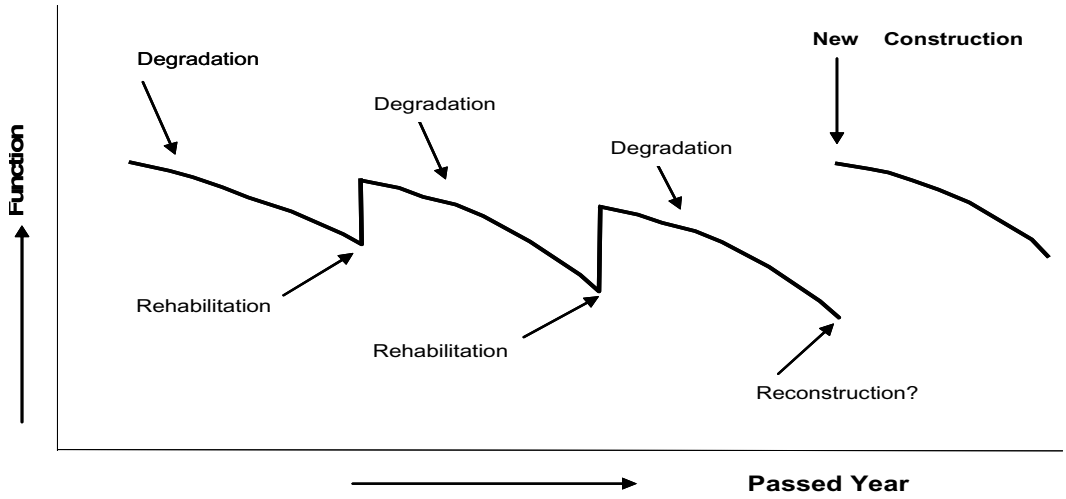


Figure 4.3.1 Concept of Degradation of Pumping Equipment and Appurtenant Facilities

The criteria consist of two categories of mechanical and electrical aspects as shown in *Tables 4.3.2* and *4.3.3*. Mechanical checking by scoring is divided into two factors of aged ratio and fault ratio, while electrical checking is divided into age, maintenance history, etc. Higher scoring means higher degree in need of repair/replacement. For mechanical parts scored above 10 points, 2nd step checking will be needed for detailed programming of repair/replacement; for electrical parts scored above 10 points, replacement or renewal is recommended.

Table 4.3.2 Criteria for Mechanical Checking and Diagnosis

Pump Equipment	*Scoring for Aged Ratio*				*Scoring for Fault Ratio*		
	2.5	*2.0*	*1.5*	*1.0*	*2.0*	*1.5*	*1.0*
Main Pump	*Passed years; More than 35*	*Passed years; 35 to 25*	*Passed years; 20 to 10*	*Passed years; Less than 10*	*Fault times; More than 3*	*Fault times; 2 to 1*	*Fault times; No fault*
Diesel Engine	*More than 27*	*27 to 15*	*15 to 5*	*Less than 5*	*More than 3*	*2 to 1*	*No fault*
Gear Box/ Butterfly Valve	*More than 30*	*30 to 20*	*20 to 10*	*Less than 10*	*More than 3*	*2 to 1*	*No fault*
Non-Return Valve/ Auto screen/ Conveyor/ Flap Valve	*More than 25*	*25 to 20*	*20 to 10*	*Less than 10*	*More than 3*	*2 to 1*	*No fault*
Auxiliary Pump	-	*More than 15*	*15 to 10*	*Less than 10*	*More than 3*	*2 to 1*	*No fault*

Table 4.3.3 Criteria for Electrical Checking and Diagnosis

Item	*Condition*		*Scoring*
Aged	*15 to 10 years*		*6*
	20 to 15 years		*12*
	More than 20 years		*20*
Ordinary Condition	*Daily average ambient temperature abovE.30º C*		*6*
	Anuual average humidity above 85%		*6*
	Outdoor type		*6*
Maintenance Record	*Trace of short circuit*		*9*
	Water penetration or condensation		*3*
	Repair work on conductive part in the past		*6*
	Replacement of main equipment (less than 10%)		*6*
	Replacement of main equipment (more than 10%)		*9*
Deterioration	*Enclosure*	*Peeling of paint, rust, damage*	*3*
		Water penetration or condensation	*3*
		Damage of packing	*3*
		Losing of door, damage of handle	*3*
	Conductive part	*Change in color due to overheating on busbar or termination*	*6*
		Crack, damage or deformation of busbar support	*3*
		Change in color due to overheating on terminal block	*3*
		Crack, damage or deformation of terminal block	*3*

(2) Results of Technical Checking and Diagnosis

In accordance with the above criteria, checking has been made as shown in *Table 4.3.4.*

Table 4.3.4 Technical Checking Results for Mechanical and Electrical Parts

Pumping Station	Completion Year	Operation Hours	Mechanical Parts								Total Scoring of Electrical Parts
			Main Pump	Engine	Gearbox	Discharge Valve	Flap Valve	Screen, Hori. and Inclined Conveyors	Auxi. Pump	Total Scoring	
Aviles	1976	14,650	80	72	48	55	70	196	118	639	40
Quiapo	1976	15,830	220	176	124	164	84	444	256	1,468	39
Valencia	1976	10,790	72	58	36	34	10	618	87	471	34
Pandacan	1976	10,890	30	23	16	10	18	116	30	243	43
Paco	1977	16,630	15	12	23	6	5	78	151	290	41
Sta. Clara	1977	7,420	29	55	22	8	6	54	34	208	41
Tripa de Gallina	1977	8,010	125	171	100	143	38	467	0	1,044	43
Libertad	1977	12,880	58	50	32	38	0	118	80	376	39
Makati	1984	4,030	11	12	6	6	10	52	41	138	38
Binondo	1985	8,220	33	38	11	25	40	95	49	291	43
Balete	1988	140	59	0	-	-	-	-	-	59	37
Escolta	1982	360	24	35	-	-	-	-	-	59	42
Vitas	1997	4,080	5	12	0	0	0	24	12	51	14
Balut	1997	3,700	4	11	-	0	0	30	11	56	15
San Andres	1997	1,150	0	2	0	2	0	20	14	38	14

Based on the results shown in *Table 4.3.4* and the previous study report made by Japan Consulting Institute in 1999, the existing pumping stations are concluded as follows:

For mechanical parts

The pump equipment and appurtenant facilities of three pumping stations: Vitas, Balut and San Andres, are still in good condition and able to function for the coming 20 years with periodical inspection and maintenance works including overhauling.

However, the other 12 pumping stations are required further checking and overhauling for detailed programming of repair and replacement, and especially of 12 pumping stations, the four pumping stations of Aviles, Quiapo, Valencia and Tripa de Gallina, require urgent rehabilitation works.

The present pump equipment at Escolta (total capacity: 1.5 m^3/s) and Balete (total capacity: 3.0 m^3/s) are submergible type with discharge pipes installed over or nearby the existing gate and their operation efficiencies are assumed quite low, and proposed to be converted into ordinary fixed type pumps or gate pumps.

The present additional submergible pump installed over drainage gates is recommended to convert into ordinary fixed type in connection with rehabilitation works.

For electrical parts

The electrical parts of Vitas, Balut and San Andres stations are presently in good condition because they are still relatively new. It is proposed that performance characteristics of

electrical apparatus be kept through the ordinary maintenance activities in the future.

For the other 12 pumping stations, scorings largely exceeded 20 points, which is a critical mark for repair or replacement. Evaluated scores clarify that it is required for all parts to be urgently replaced. It also can be said that tentative repair or partial replacement of a chain of electrical apparatus to improve its performance characteristics is costly and not recommendable. Therefore, it is concluded that electrical apparatus at the 12 pumping stations should be replaced urgently.

(3) Rehabilitation Works

Based on the above technical checking and diagnosis results and detailed discussion and consultation with the Flood Control Management Services of MMDA, the following rehabilitation program is proposed in the Master Plan.

Overhauling is proposed principally for all pumping stations prior to rehabilitation works. Based on the overhauling results, detailed rehabilitation programs are to be formulated in the implementation stage. The rehabilitation program for the drainage pumping stations is proposed as follows:

For 4 stations of Quiapo, Aviles, Valencia and Tripa de Gallina

- List up supply of spare parts and consumables required
- Repair and replacement of pump equipment
- Replacement of electrical apparatus

For 6 stations of Pandacan, Binondo, Paco, Sta. Clara, Makati and Libertad

- List up supply of spare parts and consumables required
- Repair of damaged pump equipment
- Replacement of electrical apparatus

For 2 stations of Balete and Escolta

- Replacement of pump equipment by pump gate

For 3 stations of Vitas, Balut and San Andres

- List up supply of spare parts and consumables required

4.3.3 ADDITIONAL WORKS FOR DRAINAGE PUMPING STATIONS

(1) Aviles-Quiapo Drainage Block

- ***Increase of pump capacity (3 m³/s) at Aviles pumping station***

- ***Installation of pump gates (2 m³/s) at the existing Uli-Uli floodgate***

The planned drainage area of Aviles pumping station is increased and it is proposed to increase the pump capacity (5 m^3/s). 3 m^3/s is added by increase of the capacity of the existing Aviles pumping station, by replacing mechanical parts of pump equipment through its rehabilitation, and 2 m^3/s is to be achieved by new installation of pump gates at the existing Uli-Uli independent floodgate.

(2) Sta. Clara Drainage Block

- ***Installation of pump gates in Sta. Clara drainage basin***

The existing Sta. Clara pumping station does not have enough capacity for the drainage area. Also, additional drainage area is expected in the future due to the on-going road and drainage construction in the upper Zobel-Roxas area, although how big the area is still unknown. It is tentatively proposed that the drainage area of 0.3 km^2 within the drainage basin of Sta. Clara pumping station be drained by some newly installed pump gates at drainage outlet along the Pasig River. Although the location of the new pump gates needs to be investigated further, total capacity would be about 2 m^3/s considering specific discharge of the existing pumping stations in the core area.

(3) Paco-Pandacan-San Andres Drainage Block

- ***Installation of pump gates on Perlita Creek***

The drainage sub-basin covered by Perlita Creek is also frequently inundated. To mitigate such inundation condition, installation of a small pump gate is proposed to accelerate draining of storm water when the water level of Estero de Tripa de Gallina rises. The capacity is tentatively set at about 2 m^3/s. However, before implementing this, a detailed investigation should be conducted to maximize its efficiency.

4.3.4 MAIN WORKS COST

Based on the preliminary cost estimation, main works cost for improvement and rehabilitation works for drainage pumping stations are estimated as shown in *Table 4.3.5*.

Table 4.3.5 Main Works Cost for Improvement and Rehabilitation Works for Drainage Pumping Stations

Item			Amount (Million Peso)
Rehabilitation works of drainage pumping stations			2,129.0
N02	Quiapo-Aviles	Additional works for Aviles drainage area	160.0
S03	Paco-Pandacan-San Andres	Additional works on Perita Creek	160.0
S04	Sta. Clara	Additional works in Sta. Clara drainage basin	160.0
Total			2,609.0

Note: The Cost for additional work at Aviles P.S. is included in the cost for rehabilitation works.

4.3.5 PHASING OF IMPROVEMENT AND REHABILITATION PLAN FOR DRAINAGE PUMPING STATIONS

(1) Basic Idea for Phasing

Twelve of the 15 large pumping stations are very old. It should be rehabilitated as soon as possible.

(2) Phasing

It is proposed to execute the rehabilitation and additional works for drainage pumping stations as follows.

1st Phase:

- Rehabilitation of 12 Pumping Stations

  Quiapo, Aviles, Valencia, Tripa de Gallina, Pandacan, Binondo, Paco, Sta. Clara, Makati, Libertad, Balete and Escolta

- Increase of Pump Capacity at Aviles Pumping Station (together with Rehabilitation work)

2nd Phase:

- Rehabilitation of 3 Pumping Stations

  Vitas, Balut, San Andres

- Installation of pump gates at existing Uli-Uli Floodgate

- Installation of pump gates in Sta. Clara drainage basin

- Installation of pump gates on Perlita Creek

4.4 SOLID WASTE MANAGEMENT PLAN

4.4.1 PLANNING FRAMEWORK

(1) Goals and Objectives of Solid Waste Management

Based on the field survey, questionnaire survey, and data collection analysis, it can be said that there are two major problems regarding operation and maintenance of drainage system. They are:

- refuse thrown into esteros; and
- informal settlers who are encroaching drainage right-of-way, i.e. esteros.

It could be presumed that the culprits of the first problem are the residents living along esteros. These residents, formal and informal settlers, throw refuse into esteros. Industrial waste and other waste are also dumped there. The above problems give rise to not only deterioration of scenery, water pollution, generation of odor but also increase risk of flooding. Waterways are clogged by thrown refuse and constructed structures. Increasing danger caused by flood affects the safety of people.

It can be found easily that refuse is thrown in especially high-density building and narrow street areas. From viewpoint of solid waste management, the causes for throwing refuse into esteros are as follows:

- Some areas are not covered by collection service because their streets are too narrow for a collection vehicle to enter.
- Solid waste collection service is not regular or there is no solid waste collection service at all.
- There is lack of refuse storage space individually, especially in high-density area.

There are areas where collection is done twice a day. On the other hand, some areas covered have irregular service or no collection service. Especially high-density area has solid waste collection problem. Solid waste collection vehicle cannot enter in narrow street areas. It is necessary that residents bring refuse to solid waste collection stations in these areas.

There is not enough space for refuse storage at individual houses in high-density area. These residents would not store refuse in their houses not only because of the odor and flies it will generate but also because of dislike of seeing an accumulation of refuse in their houses.

Solid waste management plan aims to reduce the amount of solid waste thrown through improvement of solid waste management along esteros.

In order to reduce the amount of solid waste thrown, a community-initiative solid waste management or community-based solid waste management should be promoted in order to increase social acceptability and sustainability.

(2) Planning Target

According to Local Government Code No. 7160, 1990, LGUs shall be primary responsible for implementation and enforcement of solid waste management. In general, solid waste management follows a process from solid waste generation to disposal (see *Figure 4.4.1*). In general, the process of solid waste collection to disposal is implemented by LGUs and MMDA.

On the other hand, barangays have responsibility for solid waste generation and collection process. Therefore, according to Republic Act No. 9003, named the Ecological Solid Waste Management (2000), solid waste generation and collection will be dealt with in this master plan

Collection activities include:

- collection of solid waste at household, and
- transportation of solid waste from household to solid waste collection stations.

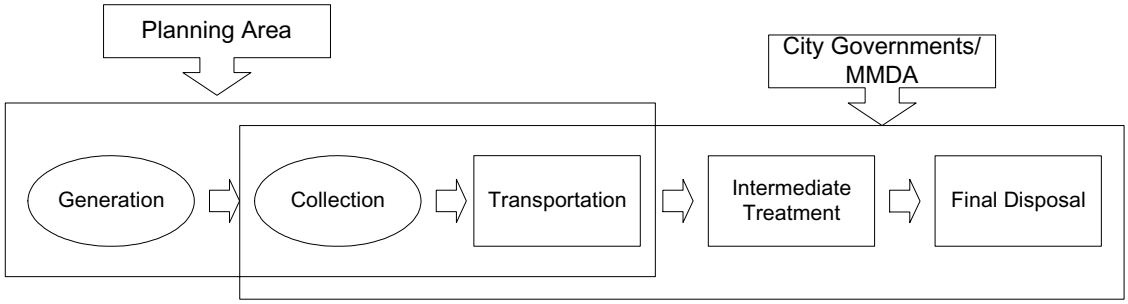


Figure 4.4.1 Planning Area of Solid Waste Management

(3) Planning Issues

The following planning issues for promotion of community involvement in order to implement solid waste management from viewpoint of social acceptability and sustainability are taken up in the Master Plan:

- to make clear roles and functions in solid waste management;
- to develop capability of community and barangay administration in solid waste management;
- to develop linkage between community and barangay administration in solid waste management;
- to develop appropriate methods of solid waste management based on local situations;
- to promote people's awareness (see IEC) for involvement in solid waste management.

(4) Approaches and Strategies for Solid Waste Management

The following approaches shall be adopted for formulation of a Master Plan:

1) Sharing responsibility with community

People generate refuse and throw refuse into esteros. According to Republic Act No. 9003 of 2000 (Ecological Solid Waste Management Act), barangay administration is largely responsible for solid waste management. Furthermore, it is expected that residents have a responsibility for their generated refuse. It is required that solid waste generators who are residents should be involved in solid waste management. Therefore, the cooperation of barangay residents is indispensable for the effective implementation of solid waste management.

2) Solid waste management suitable to the local situations for increasing social acceptability and sustainability through establishment of community group

There are various types of communities in the core area taking into account the land use,

road network and social situations, so that a unified solid waste management does not work. Especially, the collection system should be suited to local situations in order to increase social acceptability and sustainability.

In order to achieve the objectives of community involvement for solid waste management, the following strategies should be taken for a socially acceptable and sustainable master plan:

- to make each stakeholder shoulder responsibility regarding solid waste management;
- to build capability and awareness of barangay leaders;
- to promote a community-initiative solid waste management planning in order to increase ownership by barangay people;
- to develop solid waste collection models for narrow street areas.

4.4.2 INSTITUTIONAL ARRANGEMENT FOR SOLID WASTE MANAGEMENT

(1) Problems and Planning Issues for Institutional Arrangement

Basically related agencies such as city/municipality governments and barangay administration have potentialities for solid waste management. It can be said that government agencies do not work well for solid waste management. There are several examples to indicate this: no-collection or no regular collection, no pick up of refuse at household, scattering refuse around waste stations and others. The following reasons are given for this prevailing situation:

- information on problems of barangay regarding solid waste are not transferred to LGUs and MMDA; and
- residents do not cooperate for solid waste generation and collection.

In order to solve the above problems, the following issues should be addressed:

- to make government agencies be responsible for one another's actions; and
- to coordinate among related government agencies and community in order to clarify their roles in solid waste management.

(2) Strategic Approaches to institutional Arrangement

The above issues will be addressed focusing on the institutional aspect and following the strategic approaches given below.

- to be well informed of the responsibilities of related agencies based on Republic Act No. 9003 of 2000, or the Ecological Waste Management Act;
- to make sure that related agencies take up their responsibility on solid waste management;
- to establish opportunity of coordination among related agencies.

(3) Proposed Demarcation of Related Agencies for Solid Waste Management

Republic Act No. 9003 of 2000, or the Ecological Solid Waste Management Act, stipulates roles of city/municipality government and barangay administration as follows:

> *Segregation and collection of solid waste shall be conducted at the barangay level specifically for biodegradable, compostable and reusable wastes:*
> *Collection of non-recyclable materials and special wastes shall be the responsibility of the municipality and city.*

Sec. 10 of Republic Act No. 9003, 2000

According to the above act, LGUs have a responsibility of non-recyclable waste collection. On the other hand, barangay administration covers recyclable waste collection. However, if barangay administration should have responsibility for collection of recyclable and non-recyclable wastes as primary collection, more meticulous waste collection service should be provided to community. And then, LGUs take charge from secondary collection, if area is densely populated or has narrow streets. Roles of LGUs and barangay administration are as follows:

LGUs

- to collect un-recyclable wastes at solid waste collection stations
- to transport collected solid wastes to disposal sites
- to support barangay administration in technical aspect regarding solid waste management

Barangay Administration

- to promote segregation of generated refuse at household level
- to collect un-recyclable wastes from household, and at barangay waste bins and containers and bring them to secondary waste stations and/or city/municipality collection vehicle
- to collect recyclable wastes from households
- to manage recycling centers and/or material recovery facilities
- to mobilize barangay people for proper solid waste management

(4) Establishment of Regular Coordination Meeting

Communication between LGU and barangay is indispensable in order to achieve an effective solid waste management. Problems arise regarding management aspect such as solid waste collection location, frequency, timing and methods. Therefore, barangay administration serves as interface between LGUs and residents side so that barangay captain can show actual situations of barangay including problems and idea of effective solid waste management. It is recommended, therefore, to hold a Monthly Solid Waste Management Coordination Meeting with LGUs and barangay captains in order to strengthen relationship of LGUs and barangay administrations. Relationship between LGU and barangay administration is shown in *Figure 4.4.2*, and example of meeting agenda is as follows:

- solution of solid waste management
- dissemination of solid waste management plan to community

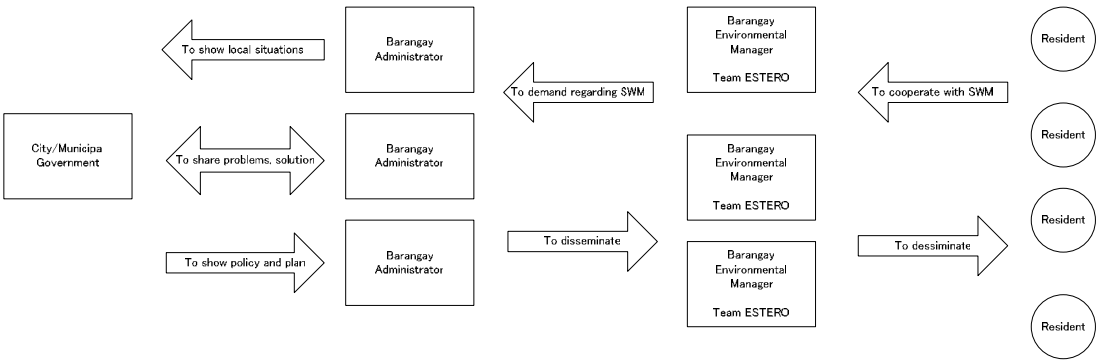


Figure 4.4.2 Relationship Among City/Municipality Government, BEM/Team Estero and Residents

4.4.3 CAPABILITY BUILDING FOR SOLID WASTE MANAGEMENT ADMINISTRATION

(1) Problems and Planning Issues for Capability Building

Because of insufficient collection condition、residents would throw refuse into esteros. On the other hand the behavior of throwing garbage into esteros comes from low awareness for environment.

And insufficient collection conditions come from lack of solid waste management capability of LGUs. Moreover, in large part, barangays are able to contribute toward the environmental improvement of local areas, however, every place needs capability improvement for solid waste management.

In order to solve the need to improve capability for solid waste management, efforts should be directed toward achieving the following objectives:

- To build skill and to improve capability for the LGUs' officers related to solid waste management.
- To strengthen the leadership for Barangay office environmental and sanitation management capability.

(2) Strategic Approaches to Capability Building

LGUs and Barangay offices play an important part in the solid waste collection and should promote strengthening the capability of officials related to solid waste collection.

In order to improve the capability for solid waste management, efforts should be made toward fulfilling the following objectives:

- To develop a training program designed for officials related to solid waste collection.
- To develop barangay office capability to realize Local Government Code of 1990.
- To develop barangay office capability to point out problems on solid waste collection and solve them by own capability.

(3) Development of Resources (Training Program)

To improve collection service and to block refuse dumping to esteros, the following items should be decided:

- Person in charge of training
- Training objectives
- Training method
- Monitoring items

Proposed training program is shown in *Table 4.4.1*.

Table 4.4.1 Training Program for Capacity Building of City/Municipality Governments and Barangay Offices

Government Units	Target	Necessary knowledge, skill	Method	Monitoring method
City /Municipality	Administrative Division	1. Collection method, 2. Separate collection, 3. Cooperation with residents	Lecture On-the-job training	Activities reporting
	Collection Division	3.Cooperation with residents	Discussion with residents	Activities reporting
Barangay	BEM	Refer to 4.4.2 Institutional Arrangement for Solid Waste Management		Activities reporting
	Team ESTEROS	Refer to 4.4.2 Institutional Arrangement for Solid Waste Management		Activities reporting
	Community	1.Recycling activities for community 2.Waste reduction at source 3.Household storage	Discussion on meeting	Activities reporting

4.4.4 COMMUNITY INVOLVEMENT FOR SOLID WASTE MANAGEMENT

(1) Problems and Planning Issues for Community Involvement

Compared to other public services such as water supply and electricity, solid waste management requires strong interaction between service provider and service recipient. If people do not cooperate, solid waste management does not work well. It is easy to find scattered refuse even if city government provides solid waste collection service twice a day. It can be said that people do not cooperate with solid waste collection service well. Community people should be involved in solid waste management for ensuring social acceptability, sustainability and effectiveness.

In order to solve the above problems, the following issues are identified for promotion of community involvement in solid waste management:

- to make clear roles of community in solid waste management;
- to develop a mechanism of community and residents involvement for solid waste management including planning and implementation;
- to provide opportunities for community participation for solid waste management to community people;
- to promote increasing people's awareness for participation in solid waste management.

(2) Strategic Approaches to Community Involvement

In order to successfully address the above issues for community involvement in solid waste management, the following strategic approaches should be taken in solid waste management plan.

- to strengthen institutional system at community level in order to increase community participation;
- to establish community group as representative of residents for solid waste management at community level in order to assist barangay administration;
- to involve community people in planning and implementation of solid waste management in order to increase people's ownership of plan.

(3) Roles of Community in Solid Waste Management

LGUs have limited resources, technical capability and financial capability. It is not expected that LGUs provide fully the solid waste collection system. Responsibility of solid waste management should be shared not only with LGUs but also solid waste generators including residents. LGUs cannot make their solid waste management system work without people's cooperation. Therefore, roles of community are indispensable for effective solid waste management.

According to Republic Act No. 9003 of 2000, barangay administration has responsibility of segregation and collection of solid waste specially biodegradable, compostable and reusable wastes. At the same time, LGUs have a responsibility for collection of non-recyclable materials and specific waste so that barangay administration should provide assistance for LGUs. Residents and community as a whole should take a responsibility at generation and primary collection phases. Therefore, a community has the following responsibility for supporting barangay administration:

- to reduce generation of solid waste at household;
- to cooperate for promotion of recycling with barangay administration;
- to bring refuse to solid waste collection stations or solid waste collection vehicle appropriately;
- to manage solid waste collection stations;
- to be on the look out for persons throwing/dumping solid waste.

(4) Establishment of Barangay Solid Waste Management Group

The Implementing Rules and Regulations of Ecological Solid Waste Management Act (DENR Administrative Order No. 2001-34) state that Barangay Solid Waste Management Committee shall be established and chaired by Barangay Captain. This Committee has the following responsibilities (Section 6):

- formulate solid waste management program consistent with city municipality plan;
- segregate and collect biodegradable, compostable, reusable wastes;
- establish materials recovery facilities;
- allocate barangay funds, and look for sources of funds;
- organize core coordinators;
- submit monthly report to city or municipality.

Republic Act No. 9003, 2003, named Ecological Solid Waste Management Act, stipulates that segregation and collection of solid waste shall be conducted at barangay level. Therefore, the barangay administrator should be involved in solid waste management. However, barangays

do not perform their duty regarding solid waste management. It is necessary to strengthen the administrative capacity of barangays in order to perform their duty. Proposed Barangay Solid Waste Management Group can support this responsibility of the barangay administration.

In order to successfully address the above issues for community involvement in solid waste management, an institutional system for solid waste management at community level shall be established. Therefore, appointment and formation respectively of the following are proposed:

- Barangay Environmental Manager (BEM)
- Team Environmental Strategic Task for Estero Renewal Organization (Team ESTERO)

This institutional system provides a workable, sustainable and effective organizational structure at community level that is socially accepted.

Proposed institutional system will deal with issues on not only solid waste management but also the broad area of environmental improvement and development. It is possible that only solid waste management will not attract people's interest.

1) Status of Barangay Environmental Manager and Team ESTERO

Organizational chart of experimental research is shown in *Figure 4.4.3*. BEM and Team ESTERO are volunteers for improvement of living environment as a community group. BEM and Team ESTERO facilitate the need for community people to formulate a living environmental plan and to implement the plan in cooperation with barangay administration. BEM recommends Barangay Environmental Plan including solid waste management to Barangay Captain. Barangay Captain instructs to deliberate on the environmental management plan to Barangay Council. And then, Environmental Management Plan is authorized by Barangay Council. From community side, ownership of solid waste management plan at barangay level can be created through activities of BEM and Team ESTERO.

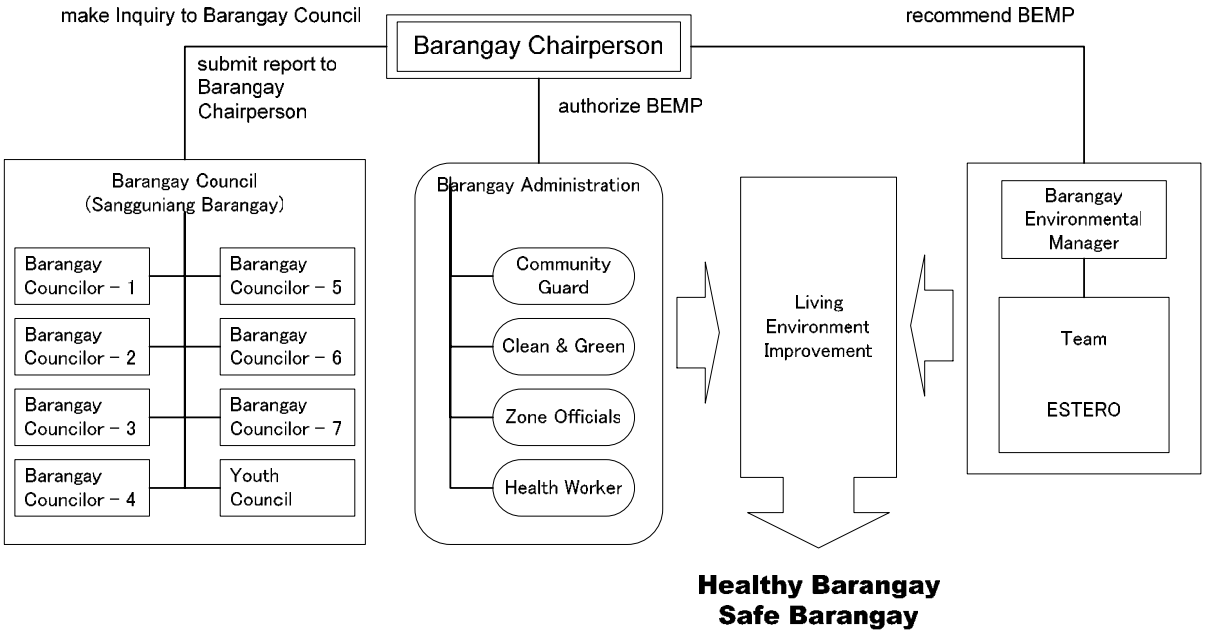


Figure 4.4.3 Proposed Organizational Chart of Barangay Administration

2) Roles of Barangay Environmental Manager and Team ESTERO

Proposed roles of BEM and Team ESTERO are as follows:

Barangay Environmental Manager (BEM)

- facilitate pollution control, public health improvement and beautification of barangay
- coordinate between barangay captain and barangay residents in order to formulate, implement and monitor Barangay Environmental Management Plan
- facilitate and monitor activities of Team ESTERO
- disseminate information to barangay residents for improvement and development of barangay environment

Team Environmental Strategic Task for Estero Renewal Organization (Team ESTERO)

- support BEM in order to improve and develop barangay environment
- organize barangay residents in order to improve and develop their environment
- facilitate pollution control, public health improvement and beautification of barangay

(3) Development for Barangay Environmental Manager and Team ESTERO

There are 1,191 barangays in the study area, i.e. the core area. It is required that, in the future, barangay institutional strengthening should be expanded to the whole study area and Metro Manila from viewpoint of urban environmental improvement. However, barangays that are located along esteros should be priority for introduction of the system. There are 376 barangays located along esteros. Therefore, it is required that this institutional system should be introduced to 376 barangays until year 2020, phase by phase, as shown in *Tables 4.4.2* and *4.4.3*. This phasing is based on level of seriousness caused by thrown refuse and drainage network system.

Table 4.4.2 Number of Priority Barangays for Introduction of Barangay Environmental Management

Target Year	No. of Barangays for introduction of the System
Short-term 2005 – 2010	137 barangays
Mid-term 2011 to 2015	140 barangays
Long-term 2016 - 2020	99 barangays

Table 4.4.3 Priority Barangays for Introduction of Barangay Environmental Management System

Block_ID	Code	Name of Estero	Number of Related Barangays		Short-term 2005-2010	Mid-term 2011-2015	Long-term 2016-2020
N01	NE01	Estero de Vitas (*1)	12			12	
	NE04	Estero dela Reina	23			23	
	NE05	Estero de Binondo	5			5	
	NE06	Estero de Magdalena	5			5	
	NE07	Estero de San Lazaro	16			16	
	NE08	Estero de Kabulusan	6			6	
	NE09	South Antipolo Open Canal	6			6	
	NE10	North Antipolo Open Canal	4			4	
	NE11	Estero de Tutuban	4	81			4
N02	NE12	Estero de Quiapo	8				8
	NE13	Estero de San Sebastian	3				3
	NE14	Estero de San Miguel / Uli Uli	17				17
	NE15	Estero de Alix	2				2
	NE16	Estero de Aviles	2				2
	NE17	Estero de Sampaloc I	8				8
	NE18	Estero de Sampaloc II	4				4
	NE19	Estero de Calubcob	3	47			3
N03	NE20	Estero de Valencia	12	12			12
N04	NE02	Estero de Sunog Apog / Maypajo	36		36		
	NE03	Casili Creek	14	50	14		
S01	SE09	Estero de Tripa de Gallina (*2)	64		64		
	SE11	PNR canal	3		3		
	SE12	Calatagan Creek I	2		2		
	SE13	Calatagan Creek II	1			1	
	SE15	Zanzibar Creek	2		2		
	SE16	Makati Diversion Channel I	2			2	
	SE17	Makati Diversion Channel II	2			2	
	SE18	Dilain Creek / Maricaban Creek I	14				14
	SE19	Maricaban Creek II	2				2
	SE20	Estero de San Antonio Abad	5				5
	SE21	Libertad Channel	1	98			1
S02	SE03	Estero de Balete	4	4		4	
S03	SE01	Estero de Provisor	4			4	
	SE02	Estero de Tanque	1			1	
	SE04	Estero de Santebanez	3			3	
	SE06	Estero de Paco	16		16		
	SE07	Estero de Concordia	5			5	
	SE08	Estero de Pandacan	36			36	
	SE10	Perlita Creek	5	70		5	
S04	SE05	Santa Clara Creek	7	7			7
S05	SE14	Calatagan Creek III	4	4			4
S06	SE22	Sto Nino Creek	3	3			3
Total			376		137	140	99

Note : *1: This is included also in N04. *2: This is included also in S02.
Source : a: JICA Study Team, b: SEDLMM database (2000)

4.4.5 SOLID WASTE SOURCE CONTROL PLAN

(1) Problems and Planning Issues for Waste Sources Control Plan

As mentioned in the previous section, major problems for drainage system is thrown refuse into esteros. It is easy to see why residents would do this. One reason is that residents do not like to store generated solid waste in their houses because it would take up space. Houses located along esteros have very small spaces and most, if not all, would probably not give up space for solid waste storage. Moreover, the often hot and very humid weather in Metro Manila is not good for storing solid waste as odors, flies, and dirt will be generated.

It is required that amount of generated solid waste be reduced, and in so doing, generated solid waste would be well managed. It would also cause thrown solid waste to decrease comparatively. Therefore, the issues to address are as follows.

- To store refuse properly.
- To reduce the amount of generated refuse.

(2) Strategic Approaches to Solid Waste Sources Control

Solid waste source reduction—recycling activities by community—is effective to avoid illegal refuse dumping to esteros.

In order to achieve an effective solid waste control plan, the following objectives should be taken up:

- To convey knowledge and skill of solid waste reduction at source to community.
- To support recycling activity done by community on its own and to create incentive for this activity.
- To store solid waste inside of the house under sanitary condition through solid waste segregation.

(3) Solid Waste Reduction at Community Level

In accordance with strategic approaches to waste sources control, community should learn knowledge and skill of solid waste reduction at source.

Waste reduction is done this way. Basically solid waste reduction activity is an individual effort such as “To select long life goods”, “To repair damaged goods”, and “To use second-hand goods and recycling goods”.

And source reduction activity is effective when done by each material. *Table 4.4.4* shows source reduction way at source for each item.

Table 4.4.4 Source Reduction Activity

	Action plan
Stage of using goods	- To select long life goods - To repair damaged goods
Stage of daily life	- To cooperate with local garbage reduction groups - To use second-hand goods and recycling goods
Garbage reduction plan for each items	
Soft plastics	- To bring your shopping bag and refuse plastic bag at shopping - To purchase recyclable goods - To purchase recycled goods with priority. - To support /join group of recycling activity - To buy good with only simple packaged.
Hard plastics	- To choose goods that can be used for a long time - To purchase recyclable goods - To purchase recycled goods with priority - To support /join group of recycling activity - To avoid using one-time-use pet bottle
Kitchen/Food waste	- To bury kitchen waste in own backyard - To make compost from kitchen waste. - To discharge kitchen/food waste after drying it up - To take natural food using organic fertilizer
Paper	- To use simple packaging - To segregate newspaper, magazine paper and board to recycle - To use recyclable paper.
Steel and aluminum cans	- To segregate cans for recycling
Textile and clothes	- To buy long life clothing materials - To repair torn clothes
Furniture	- To buy long life furniture - To repair damaged furniture
Home appliance	- To buy long life home appliance - To repair damaged home appliance - To use recycled home appliance - To select home appliance with guarantee
Dry battery	- To use rechargeable battery

(4) Solid Waste Storage at Household

In between collections, waste is stored inside of house at least for one day, sometimes more than one day. Usually kitchen/food waste generates a bad, sour smell during the time of storage. Inorganic waste occupies some room for storage time. Solid waste storage is inevitable. Here are some ideas on storage.

- Use plastic buckets for storage.
- Plastic buckets come with a cap and has a capacity of around 50 l. At collection time the plastic bucket (inside waste is kept) is brought to collection point, and after garbage inside is discharged, the plastic bucket should be washed each time.
- Set a community storage stations.
- Several houses are using same place together for storing solid waste outside of their houses. Some person brings the plastic bucket to the collection point.

- Segregate solid waste into organic waste and inorganic waste for storage.
- Organic waste generates a bad, sour smell, and inorganic waste occupies space for storage time. Store organic waste and inorganic waste into separate buckets.
- Discharge kitchen/food waste after drying it up.
- Kitchen/food waste is usually wet, and this makes the waste dirtier and more foul-smelling. Keep kitchen/food waste in mesh bowl until it dries up, and then put into the bucket.

(5) Community based Recycling Activities

Barangays have coordinated community-based recycling activities in Metro Manila. Many successful community-based recycling teams have been established.

The Makati City Government introduced the MRF (Material Recovery Facility) based on a proposal from the "Study on Solid Waste Management Study in Metro Manila" by JICA. The concept of recycling center by the JICA Study on Solid Waste Management has been conveyed to UNDP and ADB followed suit on the recycling activities. In this scheme, the Makati City Government provides a Barangay office with an MRF, and then the Barangay office shall manage this facility. MRFs of Makati City are successful from the environmental and financial aspects. Moreover, these activities are profitable.

Proposed Community-Based Recycling Activity is as follows:

1) Collection

MRF's collectors collect refuse from each house by pushcart

Residents bring refuse to MRF by themselves

2) Segregation

MRF's staff segregates at MRF

3) Selling of Recyclable waste

MRF sells recyclable waste to contracted junkshop regularly

4.4.6 SOLID WASTE COLLECTION PLAN

(1) Problems and Planning Issues for Solid Waste Collection

In areas located along esteros, there are very narrow streets that are inaccessible to solid waste collection vehicles. And in some areas, collection service is not regular. Primary collection by barangay offices and secondary collection by LGUs are not coordinated, that is why when collection vehicles start work there is garbage left behind at collection stations.

In order to solve the above problems, the following issues should be addressed:

- to develop an effective collection system based on local situations;
- to mobilize community to assist in solid waste collection;
- to establish a linkage between LGUs and barangay offices regarding solid waste management.

(2) Strategic Approaches to Solid Waste Collection

In order to successfully address the above issues for good solid waste collection system, the following strategic approaches should be taken in solid waste management plan:

- to increase people's ownership in solid waste management;
- to develop a model for collection based on road network;
- to synchronize primary collection by Barangay administration and secondary collection by LGUs.

The first strategy is discussed in *Chapter 4.4.4*.

(3) Collection Systems for Insufficient Collection Service Area

There are very narrow streets mostly found along esteros, so that it is difficult to collect solid waste by pushcart. At present, pushcarts are very popular in Metro Manila, in high density areas. However, there is still more narrow street area where even pushcarts cannot go. Collection system should match a town's structure. The recommended collection method is shown in *Table 4.4.5* and *Figure 4.4.4*.

Table 4.4.5 Recommended Collection System along Esteros

Types of Area	Equipment	Methods
Main Street (more than 2 lanes)	Truck or compaction vehicle	The existing method. Trucks or compaction vehicles collect waste at collection points and/or households directly.
Narrow streets (1 lane street or 2 to 3 m wide)	Pushcart	The existing method. Pushcart collects waste from households, and brings to secondary waste collection points.
Very narrow streets (1.5 to 2 m wide)	Trolley	Trolley collects waste at households and/ or waste container boxes.
Waste Container Box	Small container	Waste Container will be set at strategic points in high-density population area. Residents bring waste to Waste Container. And then trolley and pushcart collect waste to bring to secondary waste collection points.

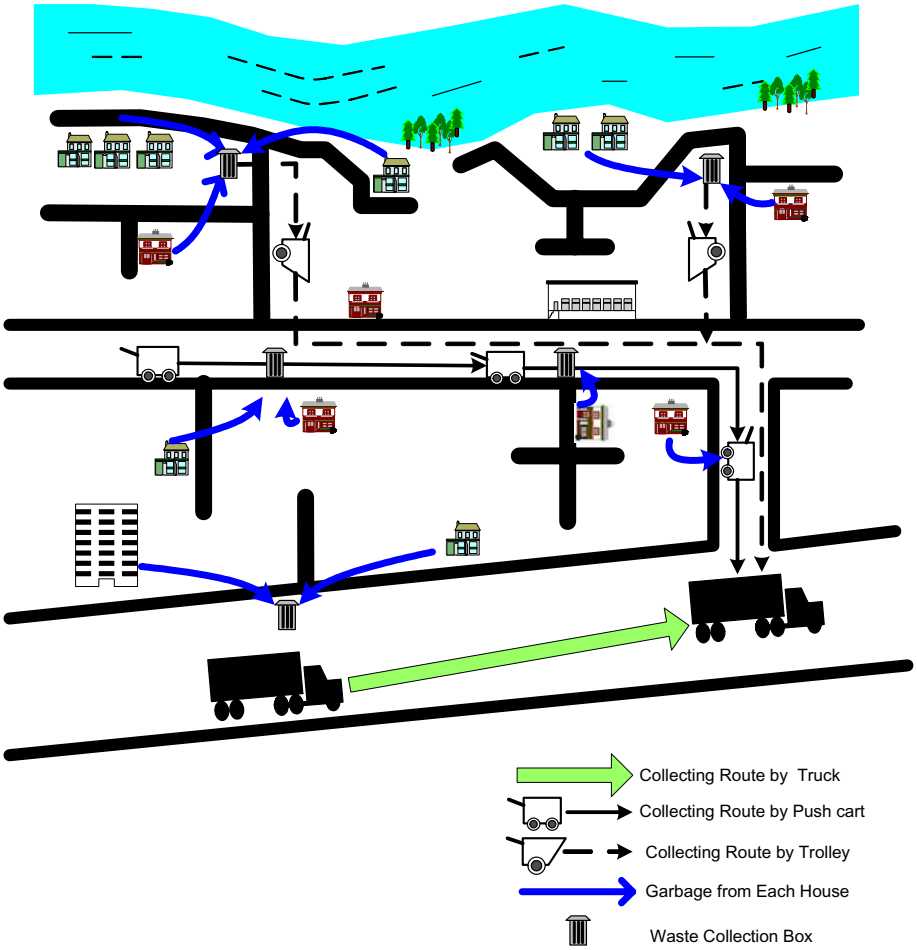


Figure 4.4.4 Solid Waste Collection System

(4) Synchronization between Primary Collection and Secondary Collection

Primary and secondary collection should be synchronized in order that collection proceeds smoothly with no left refuse at collection stations and scattered refuse around collection stations. The following should be coordinated between LGUs and barangay offices:

- timing for primary collection and secondary collection;
- types of collected solid waste by barangay offices and LGUs;
- volume of solid waste by secondary collection based on volume of solid waste by primary collection.

Information on collection day, time and place should be informed to residents by proposed Barangay Environmental Manager and Team ESTERO.

4.4.7 INFORMATION, EDUCATION AND COMMUNICATION AGAINST SOLID WASTE DUMPING INTO ESTEROS

(1) Problems and Planning Issues for IEC

One of the reasons for thrown and scattered solid waste is inappropriate solid waste collection. However, thrown and scattered solid waste would still be visible even if LGUs were to provide solid waste collection service twice a day. There is a strong disconnect between people who throw solid waste and solid waste collection system. This can be attributed to the following major reasons:

- insufficient people's awareness;
- inappropriate public manner;
- lack of knowledge of the existing regulation in relation to illegal activities.

Information, Education and Communication (IEC) campaign plan aims to minimize influence on drainage system and ensure the existing functions by influencing people in a positive manner. In order to solve the above problems, the following issues should be addressed:

- to promote proper knowledge, and changes in lifestyle and behavior

(2) Strategic Approaches to Improvement of Awareness

In order to successfully address the above issues for improvement of people's awareness and manner, the following strategic approaches should be taken in solid waste management plan:

- to establish an institutional system at barangay level in order to increase involvement of community in solid waste management and its ownership of plan;
- to enhance people's knowledge about conditions and problems related to solid waste management;
- to improve the quality of communication.

In general, targets of IEC for solid waste management are various such as resident, school, commercial establishment, industrial sector and market. However, this IEC campaign plan aims to put an end to throwing solid waste in esteros and other improper use of esteros. Therefore, targets in this plan cover residents, young generation and barangay administration. The first strategy, institutional system establishment at barangay level, is dealt with in *Chapter 4.4.4*. For barangay administration, it is covered in *Chapter 4.4.3*.

(3) Strengthening of Environmental Education for Young Generation

It is difficult to change attitudes and behavior of grown-up persons. It is therefore necessary to start educating the youth early about proper solid waste disposal. This plan covers primary school and high school in Metro Manila.

The school curriculum should cover the following aspects:

- daily activities and solid waste;
- problems of solid waste management;
- system and process of solid waste management;
- recycling and environmental conservation.

In order to strengthen school curriculum for solid waste management, the following are required:

1) Development of training kit

Effective environmental education should be developed. Education kit includes textbook and video program that support environmental education effectively. Video/DVD material is a good teaching tool that can help students to understand the importance of solid waste management. Example of video/DVD program is shown below:

Table 4.4.6 Development of Training Kit for School Students

Proposed Title	Daily activities and Solid Waste Problems
Target Audience	High school students
Message	Daily activities generate refuse. And a cycle is started thus: Man throws refuse into esteros, road sides, vacant spaces and other areas, and these casual activities give rise to deterioration of natural environment and living and health environment. Then, Environment retaliates by increasing risk of flood, generating flies and mosquitoes. Going about the business of daily living in an appropriate manner is important to secure man's health and safety.
Playing Time	20 minutes
Production	560 copies of DVD for private high schools (428) and public high schools (132)

2) Teachers Training

Most teachers do not have a clear understanding of solid waste management process including collection, recycling and disposal. Therefore, MMDA should support to give lecture to school teachers. Contents of teacher's training are shown in *Table 4.4.7*.

Table 4.4.7 Contents of Teacher's Training

Aims	Contents
• to understand the current situations of solid waste management in Metro Manila • to understand improper solid waste management impacting living environment and people's health • to recognize people's responsibility and the need for them to cooperate	■ existing solid waste management and its facilities ■ current status and solid waste management problems in Metro Manila ■ solid waste and people's safety ■ community-based solid waste management including collection and recycling ■ roles of stakeholders in solid waste management

3) Development of Extra-curricular Activities

Although written materials and video/DVD are good teaching materials, they are not enough to educate students. It is recommended that students be brought to field to see actual facilities and situations in order to get a clearer image and better understand what they have read in the materials, seen on video and heard from lectures. High school students should be assigned to join a study tour of solid waste management at least one time.

The Department of Education should organize extra-curricular activities. MMDA and city/municipality Governments should develop a tour of facilities for observation at sites and distribution of educational materials. MMDA, on the other hand, could provide tour guides. Cooperation on solid waste management could be achieved through these activities.

The following roles on extra-curricular activities are proposed below:

Table 4.4.8 Roles of Related Organizations for Implementation of Extra Curricular Activities

Related Organizations	Roles
DECS	• Promotion of and organizing extra-curricular activities
DENR	• Providing pamphlet/brochure
MMDA	• Arrangement of field observation • Construction of observation facilities at MMDA disposal sites • Providing guides
City/Municipal Governments	• Construction of observation facilities at city government's disposal sites • Arrangement of observation for waste collection and recycling facilities

(4) Strengthening of Enlightenment for Barangay People

Major targets of enlightenment are people who live along esteros and drainage facilities. A program of enlightenment is expected to help people realize the importance of proper solid waste disposal and to gain their cooperation for proper operation and maintenance of drainage system and solid waste management.

It is very important that enlightenment tools are based on targets and objectives, at the same time recognizing their strong point and weak point. *Table 4.4.9* shows feature of enlightenment tool for solid waste management. The enlightenment tools and how they could best be used are shown in *Table 4.4.10*.

Table 4.4.9 Enlightenment Tools for Solid Waste Management

Enlightenment Tools	Features
Consultation • regular meeting • group discussion	Consultations as a communication strategy is effective as it creates an environment of face-to face encounter wherein the participants and the facilitators go through the process of sharing information and experiences towards the resolution of issues.
Print media • primer • pamphlet/brochure • comics	Primer as a communication strategy is effective in explaining, illustrating and discussing major issues of the project. The media use graphical illustrations and the language of the people to deepen their understanding and thus influence their behavior.
Posters and Wall Comics	These media forms, as communication strategies, are effective to catch the attention of people and influence their behavior. Posters are presented in short and catchy illustrations, which attract the audience's visual and sensual sensitivities thus influencing their behavior. Likewise, comics are scripted visual illustrations of familiar community experiences with messages that purposively focus on the benefits of the project.
Mass Media • radio • TV	This media is effective to send a message to a wide area. However, viewers and audiences cannot be selected so that message should be general and not deep for various viewers and audiences.

Table 4.4.10 Enlightenment Tools and Massage for Solid Waste Management

Media Frequency	Targets	Message	Implementing Organizations
Consultation Frequency: every 3 months	Residents	• Using the interpersonal approach DPWH/ MMDA Community Relations maintain regular consultations with the affected households for an open dialogue on the issues, problems and concerns related to the implementation and sustainability of the project.	DPWH MMDA BEM and Team ESTERO
Primer Frequency: every year	Residents	• The project description, a graphic illustration about the present situation of the drainage and esteros and the factors, i.e. solid waste, siltation etc., that have contributed to the flooding and the project design that will mitigate the problem. • Answers to questions frequently asked about the project. – The identified impacts and mitigations written in Filipino – On the Health and Safety measures related to solid waste management – On their role in maintaining and sustaining solid waste management	DPWH MMDA City/Municipality Governments
Comics Frequency: every year	Children	It is easy to understand the necessity of cooperation with people starting with children, in order to promote increase of people's awareness. Example of story: Hero and heroine did not know and understand actual solid waste problems so that they throw refuse anywhere. However, they are getting actual knowledge such as causes of solid waste problems, problems caused by people's daily activities, solution of solid waste management by people gradually.	DPWH MMDA
Poster Frequency: every half year	Residents Children	A graphic illustration of the rationale of solid waste management in the context of their experiences in relation to the dirty and smelly environment they are in due to the filthy esteros and the flooding due to clogged drainage. In like manner, the positive effect of the dredged and garbage-free esteros and the de-clogged drainage, showing the improvement of the residents' lives and the future of their children.	DPWH MMDA City/Municipality Governments
Mass Media Frequency: 30 seconds spot, every week	Residents	Capitalizing on the negative impacts of the refuse in the esteros and the flooding due to clogged drainage in Filipino. In like manner, the positive effect of the dredged and garbage-free esteros and the de-clogged drainage, showing the improvement of the residents' lives and the future of their children.	DPWH MMDA

4.4.8 COST

The cost for barangay activities including BEM and Team ESTERO activities and information, education and communication campaign has been preliminarily estimated. The results are shown in *Tables 4.4.11* and *4.4.12*.

Table 4.4.11 Cost for BEM and Team ESTERO Activities

		2005	2006	2007	2008	2009	2010	ShotTerm	
Establishment of BEM		40,000	40,000	44,000	50,000	50,000	50,000	274,000	
Establishment of Team ESTERO		280,000	280,000	308,000	350,000	350,000	350,000	1,918,000	
Training	P 30,000/Brgy	600,000	600,000	660,000	750,000	750,000	750,000	4,110,000	
Allowance									
	P 1,000 x 1person	20,000	40,000	62,000	87,000	112,000	137,000	458,000	
	P 500 x 7persons	70,000	140,000	217,000	304,500	392,000	479,500	1,603,000	
Implementation Cost	P 12000/Bargy	2,400,000	4,800,000	7,440,000	10,440,000	13,440,000	16,440,000	54,960,000	
Total		**3,410,000**	**5,900,000**	**8,731,000**	**11,981,500**	**15,094,000**	**18,206,500**	***63,323,000***	
			2011	**2012**	**2013**	**2014**	**2015**	**Mid Term**	
Establishment of BEM			56,000	56,000	56,000	56,000	56,000	280,000	
Establishment of Team ESTERO			392,000	392,000	392,000	392,000	392,000	1,960,000	
Training	P 30,000/Brgy		840,000	840,000	840,000	840,000	840,000	4,200,000	
Allowance									
	P 1,000 x 1person		161,000	189,000	217,000	245,000	273,000	1,085,000	
	P 500 x 7persons		563,500	661,500	759,500	857,500	955,500	3,797,500	
Implementation Cost	P 12000/Bargy		19,320,000	22,680,000	26,040,000	29,400,000	32,760,000	130,200,000	
Total			**21,332,500**	**24,818,500**	**28,304,500**	**31,790,500**	**35,276,500**	***141,522,500***	
			2016	**2017**	**2018**	**2019**	**2020**	**Long Term**	**Total**
Establishment of BEM			40,000	40,000	40,000	40,000	38,000	198,000	752,000
Establishment of Team ESTERO			280,000	280,000	280,000	280,000	266,000	1,386,000	5,264,000
Training	P 30,000/Brgy		600,000	600,000	600,000	600,000	570,000	2,970,000	11,280,000
Allowance									
	P 1,000 x 1person		295,000	315,000	335,000	355,000	374,000	1,674,000	3,217,000
	P 500 x 7persons		1,032,500	1,102,500	1,172,500	1,242,500	1,309,000	5,859,000	11,259,500
Implementation Cost	P 12000/Bargy		35,400,000	37,800,000	40,200,000	42,600,000	44,880,000	200,880,000	386,040,000
Total			**37,647,500**	**40,137,500**	**42,627,500**	**45,117,500**	**47,437,000**	***212,967,000***	***417,812,500***

Table 4.4.12 Cost for Information, Education and Communication Campaign

		2005	2006	2007	2008	2009	2010	Shot Term	
1. Development of training kit									
Produce of Program		1,000,000			1,000,000			2,000,000	
Copy of DVD (600 copies)		90,000			90,000			180,000	
2. Extra Curriculum (560 schools/5y	P 35,000/school	3,325,000	3,325,000	3,325,000	3,325,000	3,150,000	3,150,000	19,600,000	
3. Preparation and printing of prime	P 50,000/primer	50,000	50,000	50,000	50,000	50,000	50,000	300,000	
4. Preparation and Printing of Comi	P 70,000/poster	70,000	70,000	70,000	70,000	70,000	70,000	420,000	
3. Poster design and printing	P 120,000/poster X 2 times	240,000	240,000	240,000	240,000	240,000	240,000	1,440,000	
Total		**4,775,000**	**3,685,000**	**3,685,000**	**4,775,000**	**3,510,000**	**3,510,000**	***23,940,000***	
			2011	**2012**	**2013**	**2014**	**2015**	**Mid Term**	
1. Development of training kit									
Produce of Program			1,000,000			1,000,000		2,000,000	
Copy of DVD (600 copies)			90,000			90,000		180,000	
								0	
2. Extra Curriculum (560 schools/5y	P 35,000/school		3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	19,600,000	
								0	
3. Preparation and printing of prime	P 50,000/primer		50,000	50,000	50,000	50,000	50,000	250,000	
								0	
4. Preparation and Printing of Comi	P 70,000/poster		70,000	70,000	70,000	70,000	70,000	350,000	
								0	
3. Poster design and printing	P 120,000/poster X 2 times		240,000	240,000	240,000	240,000	240,000	1,200,000	
								0	
Total			**5,370,000**	**4,280,000**	**4,280,000**	**5,370,000**	**4,280,000**	***23,580,000***	
			2016	**2017**	**2018**	**2019**	**2020**	**Long Term**	**Total**
1. Development of training kit									
Produce of Program				1,000,000			1,000,000	2,000,000	**6,000,000**
Copy of DVD (600 copies)				90,000			90,000	180,000	**540,000**
2. Extra Curriculum (560 schools/5y	P 35,000/school		3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	19,600,000	**58,800,000**
3. Preparation and printing of prime	P 50,000/primer		50,000	50,000	50,000	50,000	50,000	250,000	**800,000**
4. Preparation and Printing of Comi	P 70,000/poster		70,000	70,000	70,000	70,000	70,000	350,000	**1,120,000**
3. Poster design and printing	P 120,000/poster X 2 times		240,000	240,000	240,000	240,000	240,000	1,200,000	**3,840,000**
Total			**4,280,000**	**5,370,000**	**4,280,000**	**4,280,000**	**5,370,000**	***23,580,000***	***71,100,000***

4.5 IMPROVEMENT OF OPERATION AND MAINTENANCE SYSTEM

4.5.1 KEY ISSUES FOR IMPROVEMENT OF OPERATION AND MAINTENANCE SYSTEM

The existing condition of operation and maintenance activities in MMDA and LGUs are discussed in *Chapter 2.7.* The key issues for each operation and maintenance (O & M) organization, daily activities, etc., are summarized below.

(1) Issues for Pumping Station and Floodgates Operation (PSFO)

O & M activities PSFO are mainly composed of operation of pumping station, periodic overhauling, solid waste collection and staff training. The problems and constraints are summarized as follows:

- Aged Pumping Stations
- Increasing operation hours because of solid waste, reversed inflow from the Pasig River, and stormwater flow from other drainage areas
- Sudden shutdown of Pumping Station (PS)
- Increasing solid waste flowed into PS
- Bad odor from solid waste temporarily stocked at PS
- Insufficient budget for material and spare parts (5% of annual expenditures)
- Decreasing qualified engineers & skilled labors
- Insufficient opportunities for improving technology and getting advanced technology

(2) Key Issues for Drainage and Waterways Operation (DWO)

O&M activities of DWO are mainly composed of dredging, desilting, declogging, repair and rehabilitation of channels. The problem and constraints are summarized as follows:

- Activity inhibition by encroachment, and increasing informal settlers
- Insufficient Budget $\Rightarrow$ Low late of activity accomplishment
- Required suitable equipment allocation to sub-divisions
- Independent management of equipment (DWO, PSFO, LGUs)
- Transportation of dredged materials to dumping sites
- Solid waste thrown into waterways

(3) Key Issues for Maintenance Section, LGUs

The Six Local Government Units (Manila, Makati, Pasay, Quezon, Caloocan and Taguig) have O & M works of dredging, desilting, declogging of minor channels except the channels under MMDA in the study area. Also the cleaning of laterals and gutters is covered by O & M activities of LGUs. The problems and constraints are summarized as follows:

- Insufficient budget
- Insufficient manpower resources
- Small scale of organization
- Scarce maintenance equipment

4.5.2 IMPROVEMENT OF OPERATION AND MAINTENANCE (O & M) ORGANIZATION

(1) General

In order to sustain the recovered drainage system in the core area of Metropolitan Manila, O & M system is to be strengthened. It is proposed to set up an overall O & M system with the following principle:

- To organize a coordination committee consisting of MMDA, LGUs and DPWH in MMDA.
- To establish an overall O & M system in MMDA integrating various fields: drainage channels, pumping stations, community-involved maintenance of drainage channels and solid waste management, reduction of illegal social activities, and information/ education campaign.

(2) Organization and Responsibility

Under the flood control management service of MMDA, two major operations: Pumping Station and Floodgates Operation (PSFO), Drainage and Waterways Operation (DWO) are responsible for O & M activities for the drainage facilities.

PSFO manages the pumping stations and floodgates, including solid waste removal at the pumping stations. Structures of the O & M organization are divided into four groups of the pumping stations and one maintenance workshop.

On the other hand, DWO manages directly the activity of dredging, desilting, declogging, repairing and rehabilitation of drainage waterway, and construction of additional drainage inlets/manholes. Territory of management area covers 17 LGUs area. The existing management area is divided into 11 districts (*Figure 4.5.1*). The study area covers only 12% of the territory. The study area is covered by major four districts: North Manila, Central Manila, South Manila and First South Metro Manila. Reorganization of the O & M management shall be discussed widely including 17 LGUs. For this study, the management area shall be discussed focusing on the core area of Metropolitan Manila.

Basic concepts summarized through the discussion are as follows:

- PSFO and DWO are to be managed under one operation.
- The drainage facilities and pumping stations in the core area of Metropolitan Manila are to be divided into two divisions by the Pasig River and managed accordingly.
- Two pumping stations of KAMANAVA and West Mangahan are respectively one group (division)
- Accordingly, PSFO has four groups of KAMANAVA, West Mangahan, North Manila, and South Manila.
- Outside of the study area is divided into four divisions based on the existing territory and the administration boundary of LGUs.

The responsibility for O & M in the respective members is proposed as follows.

MMDA:

- Trunk channel, secondary and tertiary channels
- Laterals along major road
- Drainage pumping stations
- Solid waste management along drainage channel
- Control of illegal activity
- Information and education campaign

LGUs

- Laterals along local road
- Solid waste management along drainage channel
- Information and education campaign
- Resettlement

As a result of these discussions, the territory of Metro Manila for DWO is divided into six divisions and the pumping station groups under PSFO are divided into four groups. Two divisions, Division 2 and Division 6, do not include pumping station groups as summarized in *Table 4.5.1*. Divisions 3 & 4 shall cover the study area.

Table 4.5.1 Proposed Reorganization of Operation and Maintenance Activities by MMDA

Flood Control Divisions	Existing Division Structure of PSFO and DWO
Division 1	Kamanava PS Group, First North M.M, Second North M.M
Division 2	Quezon City First, Quezon City Second, East M.M
Division 3	North Manila PS Group, North Manila, Central Manila
Division 4	South Manila PS Group, South Manila, First South M.M
Division 5	West Mangahan PS Group, First East M.M, Second East M.M
Division 6	Second South M.M

Based on the basic concepts, the divisions and their territories of operation are proposed in *Figures 4.5.1* and *4.5.2*.

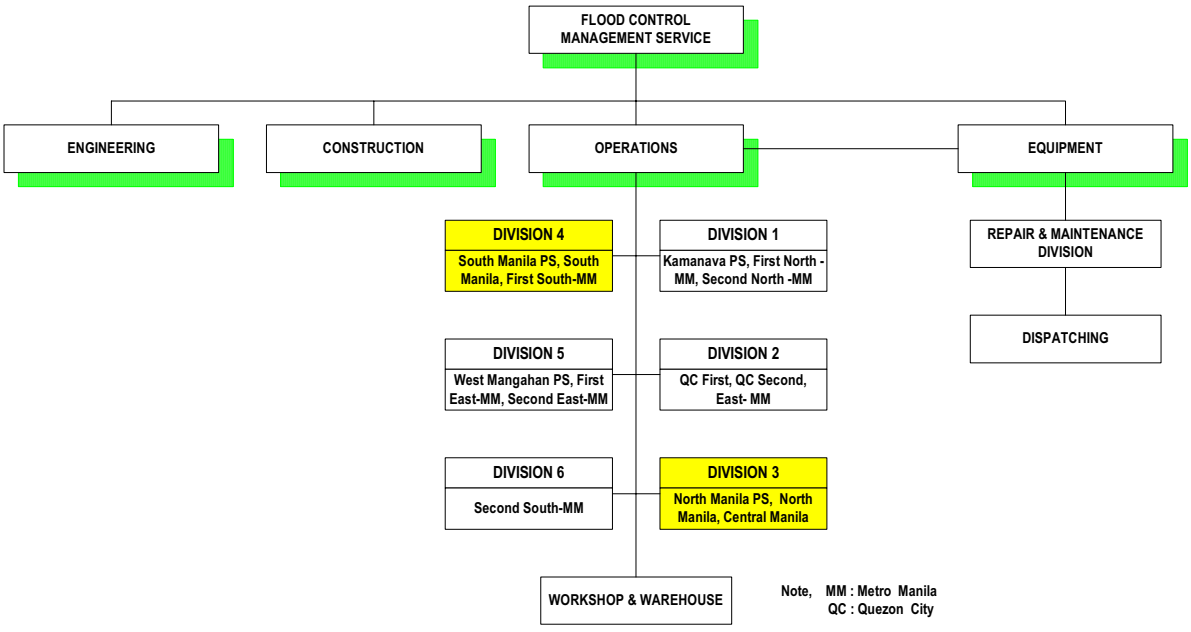


Figure 4.5.1 Proposed Reorganization Chart of Operation and Maintenance Activities

Figure 4.5.2 Proposed Management Districts for Operation and Maintenance, MMDA

In the control division office, close coordination should be required for the integrated management of waterways and pumping stations. For the easy operation and maintenance management, the IT management system of the document management system and the pumping station management system proposed in the following section will be required.

4.5.3 PERSONNEL

The total manpower of the flood control management service is 1,385 persons as of February 2004 and composed of the following:

- Technical personnel: 168 persons
- Office personnel: 147 persons
- Skilled workers: 347 persons
- Laborers 723 persons

Employment status of the manpower is categorized into permanent, job order, and casual.

In line with activity of operation and maintenance in flood control management service, the existing manpower of PSFO and DWO has been surveyed through interview. In addition, the manpower requirements of PSFO and DWO were roughly estimated on the installed capacity and pump units of pumping stations, management area of districts, total drainage length, etc., and summarized in *Tables 4.5.2* and *4.5.3*.

Survey result indicates an increasing rate of manpower requirement estimated at about 10% as against that of the existing one.

Table 4.5.2 PSFO's Existing Personnel and Its Manpower Requirements

Pumping Stations	Existing		Requirement	
Structure	Operator / Tech.	Laborer	Operator / Tech.	Laborer
Major Pumping Stations				
Pandacan	5	5	5	5
Aviles	9	8	9	9
Quiapo	9	8	9	9
Valencia	8	8	9	9
Tripa de Gallina	15	15	16	16
Sta. Clara	5	4	5	5
Paco	9	7	9	9
Libertad	14	11	12	12
Makati	5	5	5	5
Binondo	8	9	9	9
Balete	7	5	5	5
Escolta	5	7	5	5
Vitas	10	10	12	12
Balut	5	2	5	5
San Andres	12	7	12	12
Sub-Total	126	111	127	127
Small Pumping Stations (7)				
Sub-Total	20	7	32	10
Independent Floodgate (1)				
Sub-Tptal	3	3	5	
Grand Total	149	121	164	137

Table 4.5.3 DWO's Existing Personnel and Its Manpower Requirements

Flood Control Operation	Existing		Requirement	
Districts	Operator / Tech.	Laborer	Operator / Tech.	Laborer
North Manila	29	31	32	34
Central Manila	30	34	33	37
South Manila	23	49	26	52
First South Metro Manila	17	25	18	26
Second South Metro Manila	18	31	19	33
First Quezon City	10	21	12	23
Second Quezon City	25	29	28	32
First North Metro Manila	20	38	22	42
Second North Metro Manila	29	34	32	38
First East Metro Manila	18	37	20	39
Second East Metro Manila	28	39	30	41
Grand Total	247	368	272	397

4.5.4 COMMUNITY-INVOLVED OPERATION AND MAINTENANCE

It is fundamental to monitor/inspect drainage channels and facilities and to maintain those normal functions. Because illegal solid waste dumping is one of the main factors of deteriorating functions of drainage channels and facilities, it is very difficult for MMDA to maintain the drainage function well without community cooperation. The draft model of community participation for solid waste management in the drainage system has been tested as experimental activities proposed and conducted in the Study. In the Study, it is proposed to apply those activities proposed in the experiment at pilot barangays to operation and maintenance activities of drainage system, which can be called as community-involved operation and maintenance.

4.5.5 REQUIRED BUDGET FOR ANNUAL OPERATION AND MAINTENANCE ACTIVITIES

The revenue of MMDA is mainly composed of IRA and other subsidies from Central Government, internal revenue, and 5% contribution from LGUs as shown in *Table 4.5.4*.

Table 4.5.4 MMDA Revenues

	2002 (Actual)	2003 (Estimate)	2004 (Projection)
Revenue (Php Million)	2,295	2,693	2,739
Share	100%	100%	100%
IRA* from Central Government	13%	12%	12%
Other Subsidy from Central Gov.	30%	32%	32%
Internal Revenue	9%	12%	24%
5% Contribution from LGUs *	29%	32%	32%
Inappropriate Surplus	19%	11%	0%

Sources: Data as of March 2004 provided by Budget and Financial Section, MMDA

For the budget requirements in next budget year, each section of flood control management service of MMDA shall estimate cost until March. Secondly, Planning and Design Section shall request total budget to MMDA's Budget and Financial Division until May. MMDA's Budget and Financial Division shall adjust all budgets from each division of MMDA and submit MMDA's budget requirement to the Department of Budget and Management (DBM). Budget proposal shall be discussed in Congress of the Philippines and should be approved by the President. The steps in budget preparation described here are illustrated in *Figure 4.5.3*.

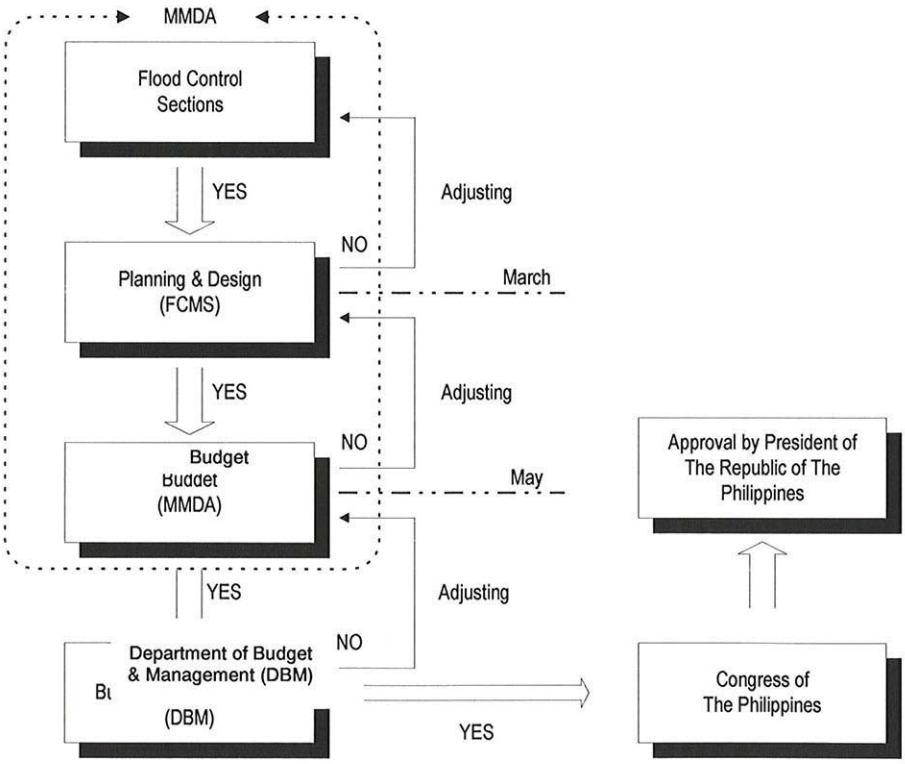


Figure 4.5.3 Steps in Preparing MMDA's Budget

For the budget of O & M under the flood control management service, the Regular Flood Control Maintenance Fund and Quick Response Fund (QRF) as Calamity Fund are available.

This QRF is an urgent financial burden from DPWH of Central Government. Urgent solid waste collection at the pumping stations after a serious flood has been at times covered by QRF so far.

Number of O & M experts, which decreases due to low wage level and insufficient budget allocation, is one of primary key issues for O & M activities by PSFO and DWO.

Annual expenditure of Flood Control Management Service MMDA in 2003 was Php314,845,000 in total including the capital outlays and the O & M expenditure for personnel and maintenance of Php217,845,000 as shown in *Table 4.5.5*.

As already discussed in the above manpower requirement, the rate of increase is 10%. The O & M cost for Flood Control Management Service will be roughly estimated by applying this rate wholly.

Accordingly, O & M cost is estimated at Php241,000,000 multiplying personnel and O & M equipment cost by 10% in Year 2003.

Table 4.5.5 Required Budget for O& M, MMDA

(Unit: Php '000)

	2003	Required
Total	**217,845**	**241,000**
Personnel Cost	108,450	127,000
Maintenance & Other Operating	109,395	114,000
(Capital Outlays)	(101,000)	-

4.5.6 OTHER COUNTERMEASURES FOR EFFECTIVE OPERATION AND MAINTENANCE ACTIVITIES

Further, to sustain the integrated O & M system, the following countermeasures for improvement of O & M activities are proposed as follows;

- Document management system,
- Empowerment of pump diagnosis system,
- Development of manpower resources,
- Installation of additional rain and water level measuring equipment,
- Introduction of maintenance equipment for emergency case etc.

A description of the countermeasures and concepts is provided below.

(1) Document Management System

The current condition of the document management in the head office, district offices and pumping stations is as follows:

- Paper technical documents (Manual, Drawing, Guideline, B/T)
- Paper records of measurements and data in pumping stations
- Paper notices, reports and other communications

- Stock in the desk and boxes
- Private stock of document distributed in seminar or workshop

The documents and records happen to be easily missing and the notices are weak in crosscheck. The development of document management system and disclosure of technical document shall help in the capacity developments of MMDA staffs for management, planning, and coordination. Through the system, as shown in *Table 4.5.6* and *Figure 4.5.4*, staffs can access technical documents at any time and also take easy training at the pumping stations and district offices through the Internet. Knowledge management (Information and knowledge sharing) through the system can transfer technology to young staff from senior staff.

Table 4.5.6 System Component

OS	Server, MMDA	Windows NT4.0+SP6/XP Windows 2000/2000 server Windows 95/98
	PC : District Office, PS of MMDA	Windows NT4.0/XP Windows 2000/2000 server Windows 95/98
Network	TCP/IP Communication	Server :IP Fix Bucket Communication
Memory	Server PC	Over 256MB (Minimum) Over 32MB (Minimum)

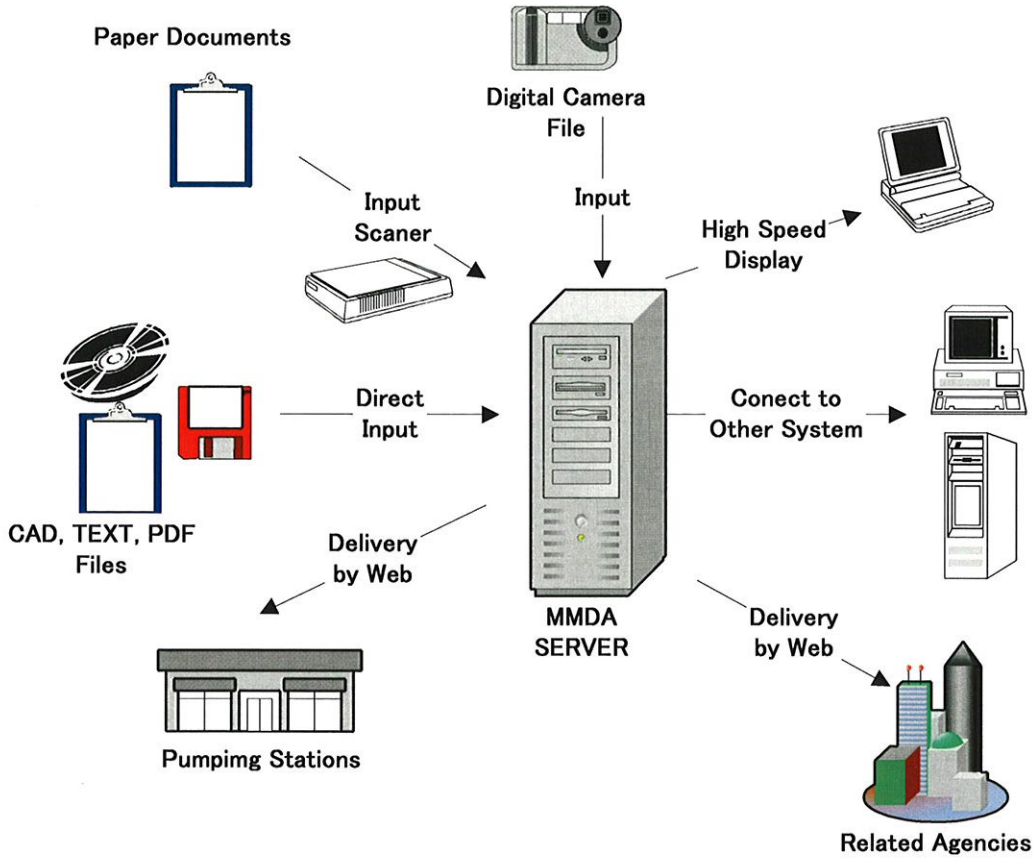


Figure 4.5.4 Image of Document Management System

(2) Pumping Stations Management System

At present, the operation condition can be monitored on only machine panel at the pumping stations, and the fault record of the equipment and diagnostics record of the pump are stocked at site or in the staff's brains. Paper technical documents (O&M Manual, Drawing, Records) at PS and operation record (Daily, Monthly, Annual) may be delivered behind time to the Head Office at MMDA.

In addition, the individual operation by each pumping station is still done and exchanging information from/to other PS is not conducted currently.

To sustain efficient management of pumping stations, the system can support for operation and data management using the Internet, radio and transmission. Main functions of the system are as follows:

- Monitoring & Control Support Function displays profile, equipment network, condition of various equipments.
- Operation Support Function displays current hydrological condition, operation guidance, simulation and assists for judgments of start/stop timing.
- Information & Management Support Function displays various record (annual/monthly/daily operation, water level, operation history, fault history) and produces printouts.
- Fault Support Function displays current faults from experienced fault list and fault causes.

Equipment component of the system is illustrated in *Figure 4.5.5* and the support function diagram of the system is illustrated in *Figure 4.5.6*.

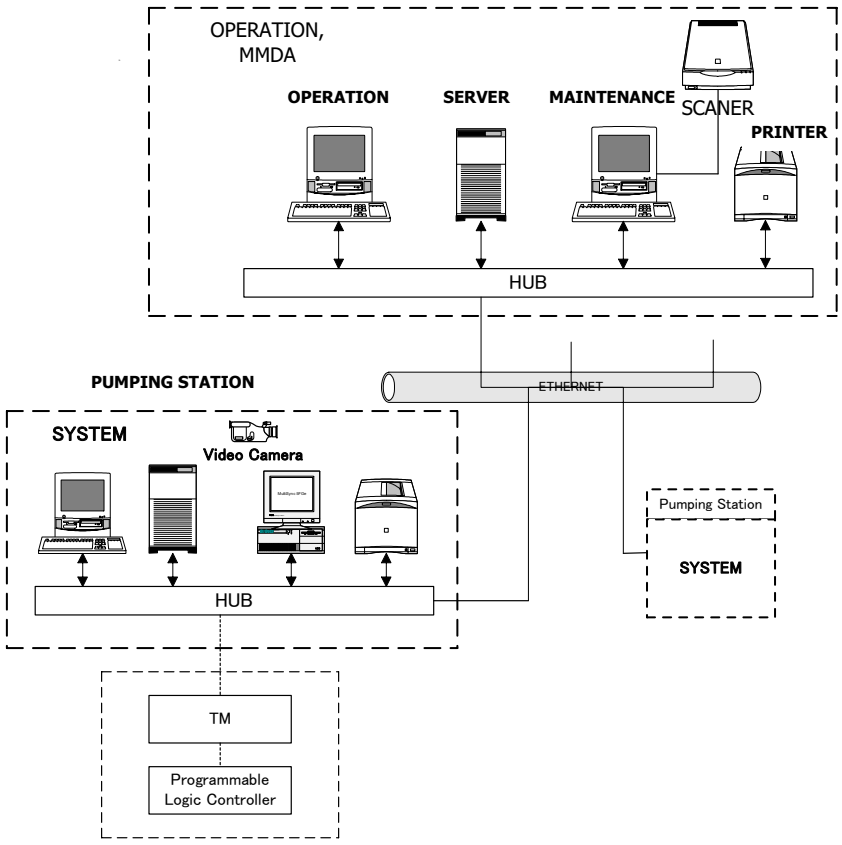


Figure 4.5.5 Equipment Component of Pumping Station Management System

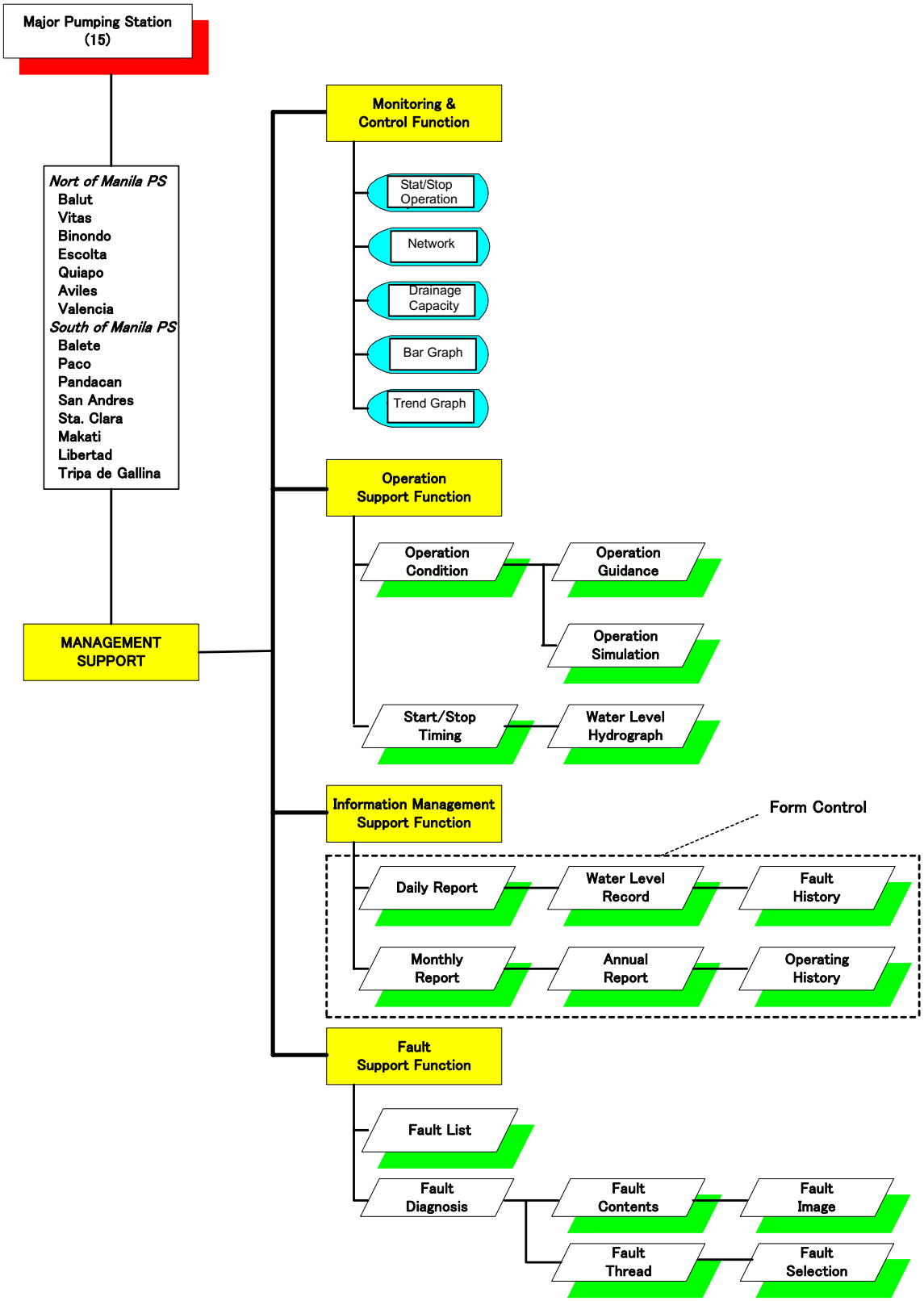


Figure 4.5.6 Support Function Diagram of the System

(3) Solid Waste Transportation Supporting System

For avoiding the temporary stocking of solid waste and traffic delay of hauling dredged material, the supporting system for efficient hauling to dumping site is required.

The system using mobile phones with GPS function indicates the location of hauling truck, time distance to dumping site and trucks near-by collection site on the monitor. The system supports communication from / to truck drivers, district offices, PS and MMDA head office. The system automatically sends the information to district office, when the hauling truck moves to collection site.

The GPS (Global Information System) service is required for structuring this system as presented in *Table 4.5.7* and *Figure 4.5.7*. At present, it is not available in Manila but is coming soon.

Table 4.5.7 System Component

PC, MMDA	OS	Windows Me/XP Windows 2000/2000 server Windows 98
	CPU	Intel Celeron, Pentium R3
	TCP/IP Communication	Server :IP Fix Bucket Communication
	Memory	256MB (Minimum)
	Browsing	Over Internet Explorer 5.5
Mobile Phone (PDA)	Communication Memory	Bucket Contract 32 MB (Minimum)

(4) Empowerment of Pump Diagnostic System

The diagnosis of pump degradation has been done by periodic maintenance with the disassembly. The disassembly takes up much manpower and time. As there are more than 53 units of pumps under PS of MMDA, the pump diagnostic system shall be required for rapid and accurate evaluation of the degradation.

Pump Diagnostic System is an accurate system of determining pump performance through the use of electronic sensors. Test data obtained from this method are highly reliable and suitable for an effective inspection of pumps for its preventive maintenance as well as its present performance. The features of this system are described below:

- Five sensors are installed on the pump. All sensors are placed in different strategic spots on pump's outer casing located above floor level. Deterioration of impeller and submerged bearing can be diagnosed without the need of dismantling the pump.
- Diagnosis can be done using the obtained test data even without the knowledge of pump's technical specifications. This system will be very useful when inspecting old pumps, especially those that are operating for the past 20 to 30 years where there are no available technical data.

The Pump Diagnostics employs the use of a laptop computer that can provide a semi-automatic quick response. *Figure 4.5.7* illustrates the diagnostic items and how they work.

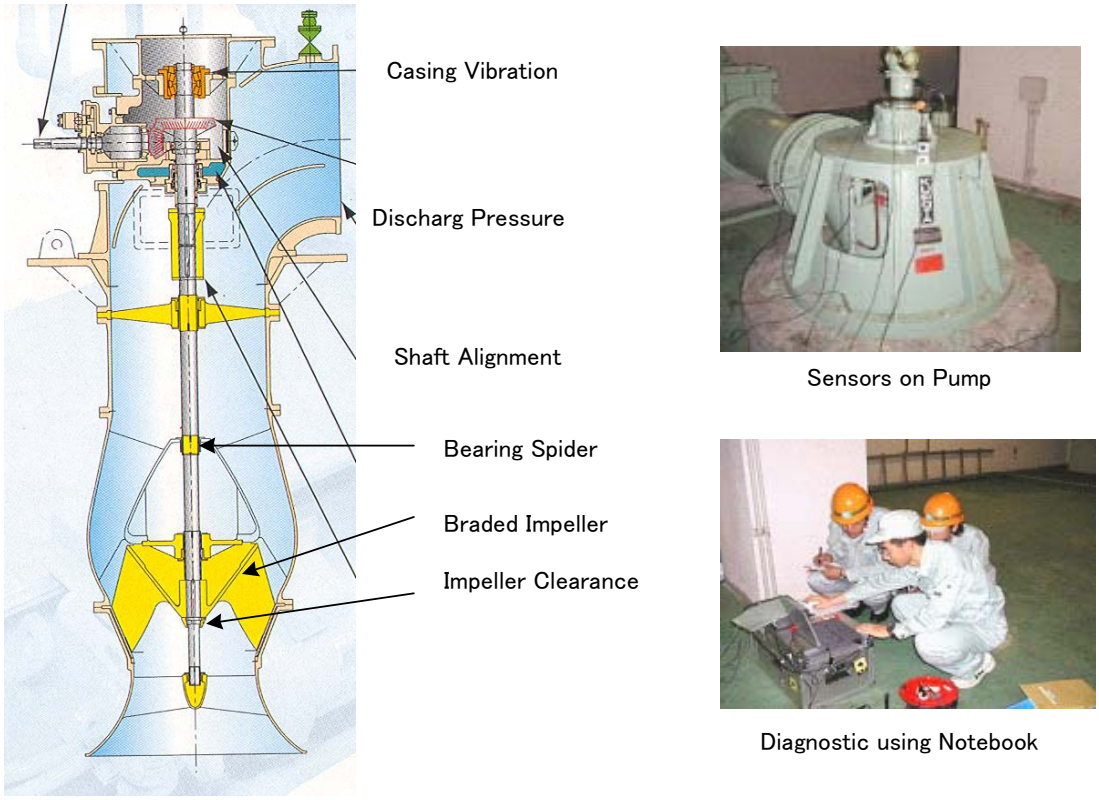


Figure 4.5.7 Pump Diagnostics System

(5) Manpower Resources Development

At present, total staff is approximately 350 broken down as follows: 53 permanent, 202 daily/casual, 95 for job order. PSFO has continued the periodic training twice in a year. Numbers of staff in pumping stations are decreasing some having retired and others having left due to low salary.

Manpower resources development is primarily required for sustainable operation and maintenance of pumping station in the core of drainage facilities in Metro Manila.

Although the training by PSFO senior engineers is available, the overseas training is also available by a partnership of JICA and Pump Companies. On the other hand, the training on terminal using the Internet or proposed document management system is easy without time constraints for the staff. And so, PSFO shall prepare the educational materials picked up from the manual or documents prepared by traders and foreign experts in the past.

(6) Installation of Additional Hydrological Equipment

PAGASA has only one rainfall station in Metro Manila. Its gauging equipment is damaged and the accuracy of rainfall gauging is suspicious. Rainfall gauging and runoff estimation is primarily important for the improvement of drainage at pumping stations.

With consideration of location and the drainage magnitude of the pumping stations, the additional rainfall gauging equipment are proposed to set for four pumping stations at Tripa de Gallina, Pandacan, Vitas, and Aviles. For the selection of equipment, a similar type with the equipment of PAGASA is recommendable due to easy maintenance and automatic 3 months recording. *Table 4.5.8* lists the specification of automatic rain gauge.

Table 4.5.8 Specification of Rain Gauge

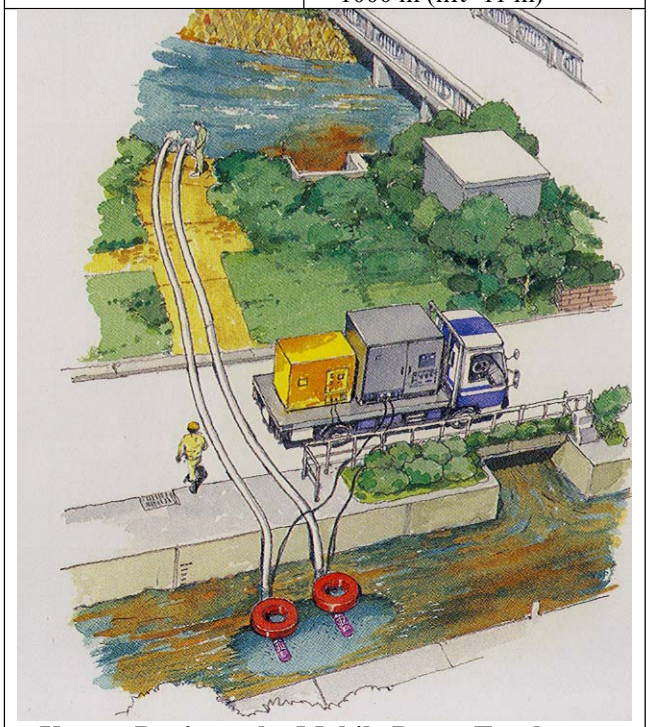
Automatic Rain Gauge
Installation Site: 4 Pumping Stations
Tipping Bucket Rain-Gauge
Receiver: 200 mm Diameter
Sensitivity: One tip at 0.5 mm
Accuracy: +/- 3%
Measuring range: 0-500 mm
Record Style: Arc writing by Pen
Record Paper: 50 mm roll paper
Contact Speed: 6mm (for 3 months)
Watch: Quarts
Power Source: DC 3VDC for Contact
DC 1.5VDC for Watch
Weight: 26 Kg

(7) Introduction of Emergency Operation and Maintenance Equipment

During torrential rainstorm, there are small-scale inundations in the road, local depression area, and low-lying area. These inundations may frequently cause stalled traffic in Metro Manila. The emergency mobile pumps are recommendable for urgent drainage. For shortening of time and labor hour of placement, the pumps and equipment with weight saved and downsized are installed in the vehicle. The specification and image of the mobile pump truck is listed in *Table 4.5.9*.

Table 4.5.9 Specification and Image of Mobile Pump Truck

Pump Type	Submersible
Total Capacity	5 - 10 m^3/min
Equipment Set	2 set
Lift	10-20 m
Power	12 KW
Drainage Length	50 m (lift<18 m) 1000 m (lift<11 m)



Urgent Drainage by Mobile Pump Truck

4.5.7 REQUIRED COST FOR IMPROVEMENT OF OPERATION AND MAINTENANCE

For the above-mentioned countermeasures, a preliminary cost estimate is made based on the information of local procurement and imported equipment. The input volume of equipment or machine is assumed only for the study area as summarized in *Table 4.5.10*.

Table 4.5.10 Preliminary Cost of Countermeasures

Countermeasures		Cost (Million Pesos)
Annual Operation and Maintenance Activities	(1) O&M for Flood Control Management Service Personnel Cost, O&M Equipment	241.0 per annum
Other Countermeasures for Effective Operation and Maintenance	(1) Document Management System Server, Software, PC, Printer, Scanner, Ethernet etc.	6.2
	(2) Pumping Stations Management System Server, Software, Scanner, Video, Interface, Ethernet	116.1
	(3) Solid Waste Transportation Supporting System Server, Software, PDA (with GPS), Ethernet etc.	7.8
	(4) Empowerment of Diagnostic System Diagnostic Machine, Notebook Computer, Sensor, Amplifier etc	4.1
	(5) Manpower Resources Development Workshop, Site Training etc	4.3
	(6) Installation of Additional Hydrological Equipment Rain Gauge, O&M Equipment	1.5
	(7) Introduction of Emergency Operation and Maintenance Equipment Trailer Type Mobile Pump, O&M Equipment	37.6
	(8) Total	177.6

4.5.8 PHASING FOR IMPROVEMENT OF OPERATION AND MAINTENANCE

It is recommended that the improvement plan for operation and maintenance organizations and activities be implemented as soon as possible. Establishment of community-involved operation and maintenance would be gradually achieved by target year of the Master Plan, together with the expansion of the community-involved solid waste management.

Other countermeasures for effective operation and maintenance require installation of equipment and facilities. Phasing of installation of such equipment and facilities is proposed as follows.

Phase 1

- Installation of Additional Hydrological Equipment
- Introduction of Emergency Operation and Maintenance Equipment

Phase 2

- Installation of Document Management System
- Installation of Pumping Stations Management System
- Installation of Solid Waste Transportation Supporting System
- Empowerment of Diagnostic System
- Development of Manpower Resources

4.6 SOCIAL FRAMEWORK OF RESETTLEMENT

The social framework of resettlement focusing on the social framework surrounding resettlement rather than on resettlement itself has been prepared as follows. The social framework including legal, institutional and procedural settings and requirements is discussed.

4.6.1 LEGAL FRAMEWORK

The most important legal framework of resettlement of the affected people by the projects is Republic Act No. 7279, Urban Development and Housing Act of 1992 (UDHA). All resettlement arrangements and operations have to be carried out according to the stipulations of the Act. This Act also determines all the necessary procedures, the government agencies that have to be involved and their responsibilities, LGUs' responsibilities on informal settlers and their relocation, NGOs' roles, and the responsibilities of the people who are required to move as well.

A summary of the above is shown in *Table 4.6.1*.

4.6.2 INSTITUTIONAL FRAMEWORK

In the process of resettlement of the affected people of a project, various government agencies, local governments and NGOs have to be involved and have to play each role according to the stipulations of RA No. 7279.

(1) Roles of Government Agencies

The Inter-Agency Committee plays a key role as a coordinating body in the operation of resettlement of project affected people. The detailed committee structure and the responsibilities of the committee members are explained in *Supporting Report I.*

Summarized responsibilities of the major government agencies are explained below.

1) Implementing/Executing Body

DPWH/MMDA

Involves almost all stages of resettlement throughout resettlement operation by forming a Task Force Team from its initiation and works to the end of project life. Has to play major role as a project proponent/implementing body/executing body.

2) Other Government Agencies

National Housing Authority (NHA)

Very wide responsibilities and important for resettlement activities. In cooperation with the Implementing Body, Proponent LGU, Recipient LGU, NHA shall find a resettlement site, may develop the site, and construct socialized housing. Throughout operation stages, NHA assists the resettlement as a member of the Inter-Agency Committee. Further assists census evaluation, confirms qualification for provision of socialized housing, consultation, document preparation, dismantling of the illegally occupied houses, actual relocation of affected families. In addition, the responsibilities are to provide assistance for post-relocation livelihood programs such as skill training and income generation activities and monitoring of all resettlement processes.

Table 4.6.1 Responsibilities for Resettlement Operation

Resettlement Operation Flow	Implementing Body DPWH/MMDA	Concerned Government Agencies													
		HUDCC	NHA	NAPC	PCUP	DSWD	DOH	DECS	PNP	(Rec) LGU	(Sed) LGU	NGO	HLURB	Barangay	Affected Families
I. Pre-Relocation Phase															
1. Identification of Resettlement Site	○		○							○	○		○		
2. Pre-census	○										○			○	
a. Completion of data requirements	○		○								○			○	
b. Community relation operation	○		○		○						○			○	
3. Census	○		○								○			○	
a. Physical survey	○										○			○	
b. Tagging	○										○			○	
c. Mappping and Household Listing	○										○			○	
d. Actual census	○										○			○	
e. Census data evaluation/masterlist preparation	○		○								○			○	
f. Census Committee	○		○								○			○	
g. Information drive on resettlement site	○		○							○	○			○	
4. Issuance of 30-day Notice	○				○						○				
a. Notice placing	○										○			○	
5. Consultation Proper	○	○	○	○	○	○	○	○	○	○	○	○		○	○
a. Consulting meetings with affected families on demolition, their option of moving etc.					○						○				
b. Needs assessment and agree/disagreed points															
6. Inter-agency Meetings/Coordination	○	○	○	○	○	○	○	○	○		○	○		○	
a. Resettlement site	○		○		○					○	○			○	
b. Relocation/demolition team	○		○		○									○	
c. Logistic requirements	○										○			○	
d. Security									○					○	
e. Food subsidy/back to province policy						○									
f. Medical assistance							○								
g. Relocation documentation	○		○								○				
7. Completion of Relocation Documentation	○		○								○				
8. Voluntary Relocation and Resettlement	○										○				○
II. Relocation Phase															
1. Preparation before the Dismantling of Structure	○		○							○	○				
2. Dismantling of Structure/Movement of Families	○										○			✲ ○ △	
a. Actual dismantling and requirement	○		○							○	○			✲ ○ △	
b. PNP's role									○						
c. Presence of government agencies	○		○	○	○	○	○	○	○		○	○		○	
3. Issuance of Entry Passes	○		○												
4. Loading and Transporting families/belongings	○										○			○	
5. Monitoring and Documentation			○							○					
6. Processing of Documents and Lot Assignment	✲ ○ △		○												
7. Transfer of Assigned Lot	✲ ○ △		○												
III. Post Relocation Phase													✲ △ indicates		
1. Resettlement site													occasional cases		
a. Strengthening of organized community based structures			○			○	○	○		○		○			
b. Promote general well-being of resettled families			○			○	○	○		○		○			
c. Generate employment and income opportunities			○			○				○		○			

Presidential Commission for Urban Poor (PCUP)

Is basically a coordination body in assisting the affected people. Their assistance starts with the pre-relocation phase at community or people's level. PCUP also assists in informing of 30-day notice, giving consultation; joins the Inter-Agency Committee, and importantly, acts as witness at the demolition operation.

National Anti-Poverty Commission (NAPC)

While the assistance of PCUP covers only urban, NAPC is responsible for assisting poor people of nationwide rural areas. The assistance of those who are relocated to outside the Metro Manila area shall be provided by the NAPC.

Department of Social Welfare and Development (DSWD)

Major duties of the DSWD are to participate as a member of the Inter-Agency Committee and provide consultation to the affected people. Two most important mandates of DSWD are to provide food assistance to the resettled people and assist in post-relocation livelihood activities such as provisions of skill trainings or to create job opportunities.

Department of Health (DOH)

This Department is also a member of the Inter-Agency Committee. Besides consultation, the DOH provides medical assistance to the affected people. Their services have to continue to the post-relocation phase.

Department of Education, Culture, and Sports (DECS)

The Department is responsible for the education of the resettled children. It must make sure, along with its regional office at LGU, that the education of the resettled children is duly maintained.

Philippine National Police (PNP)

PNP keeps peace and order in LGU or barangay, particularly at the time of demolition PNP has to be present at the demolition site.

(2) Local Government Units (LGUs)

Proponent LGU (Sending LGU)

Proponent LGU has to be involved in almost all stages of resettlement operation starting from the acquisition of resettlement site in cooperation with NHA and Implementing /Executing Body. It has to inform the project affected people of the need for relocation, to assist in the census conduct, tagging, preparation of various required documents, and preparation of a masterlist in cooperation with the responsible government agencies, up to the point of actual moving of the project affected people/families. Further, the LGU has to give confirmation along with the government agencies authorized to demolish, clear the original places, and has to witness the demolition.

Recipient LGU

Recipient LGU is required to assist in the identification of resettlement site, and to provide information on the site, monitoring of resettlement documentation, and post relocation assistance of various kinds. The responsibilities of the recipient LGU are quite heavy. They have to provide, or have to ascertain that the settled families are provided with various kinds of social services such as health service, education and livelihood programs through regional offices of each agency.

4.6.3 RESETTLEMENT PROCEDURES

(1) Procedures Described by Guidelines for Implementation under RA No.7279

As mentioned earlier, RA No. 7279, Urban Development and Housing Act of 1992 (UDHA), is "the Bible for Resettlement Operation". Section 3, "Guidelines for Implementation", describes the arrangements and procedure of resettlement as follows starting from the pre-relocation phase:

I. Pre-Relocation Phase

a. Identification of Resettlement Site (Preparation of the site)
b. Pre-Census (Identify affected structures/families)
c. Census (Conduct census on all affected families)
d. Issuance of 30-Day Notice (Issue the notice 30 days prior to the actual relocation to all affected families to clear the area)
e. Consultation Proper (The families are consulted by various groups)
f. Inter-Agency Meetings/Coordination (Meetings to support relocation)
g. Completion of Relocation Documents/Requirements (The affected families need to prepare required documents for qualification of award for socialized housing)

II.	**Relocation Phase** a. Preparation Before the Dismantling of Structures (Various documents are required for dismantling) b. Dismantling of Structures/Movement of Families (Demolition of structures being monitored/observed by various agencies) c. Issuance of Entry Passes (Entry passes to relocation site are issued) d. Loading and Transporting (Those qualified families are provided with transportation services and moved to relocation site/back to province) e. Monitoring and Documentation (LGU or government agencies observe the operation and confirm the documents) f. Welcome and Reception (Resettlers are welcomed by the new site) g. Processing of Documents and Lot Assignment (Upon arrival, a lot shall be assigned to each family) h. Transfer to Assigned Lot (Families can move in to the assigned lot)
III.	**Post Relocation Phase** a. Place of Origin (The areas where cleared have to be immediately safeguarded from occupation by informal settlers again) b. Resettlement Site (Recipient LGU has to provide appropriate social services; livelihood assistance must be made available)

(2) Assisting Organizations

The above resettlement operation shall be carried out with the assistance of various government agencies and organizations as well. The organizations that shall be formed to assist the operation are: Inter-Agency Committee, a coordinating body; Task Force on Relocation and Resettlement, and under this Task Force, an Action Team.

1) Inter-Agency Committee

This Committee normally consists of:

- Implementing/Executing body – DPWH / MMDA
- Housing and Urban Development Coordinating Council (HUDCC)
- National Housing Authority (NHA)
- Presidential Commission for the Urban Poor (PCUP)
- National Anti-Poverty Commission (NAPC)
- Department of Social Welfare and Development (DSWD)
- Department of Health (DOH)
- Department of Education, Culture and Sports (DECS)
- Commission on Human Rights (CHR)
- Local Government Units (LGUs)

2) Task Force on Relocation and Resettlement

Section 5, "Organization", of the same "Implementing Rules and Regulations…" of RA No. 7279 stipulates the formation of organizations to ensure the smooth and effective implementation of all relocation and resettlement operations.

The structure and composition of the Task Force shall be as follows.

- Chairman - City/Municipality Mayor or duly designated representative of the concerned government agency authorized to demolish
- Legal services group

- Security group
- Dismantling and relocation group
- Community relation group
- Census and tagging group
- Surveillance group

3) Action Team

Further, an Action Team shall be created to oversee or undertake actual eviction/relocation of the affected families and dismantling of the structures.

The Action Team may be composed of:

- City/municipality engineer/building official
- Medical/health personnel
- Dismantling crew/relocation officer
- Social worker
- Barangay chairman
- NGO representative

4.6.4 PROBLEM POINTS

The problem points of the Social Framework of Resettlement may be seen in its institutional framework mostly in the application of RA No. 7279. The stipulations of the Act are carefully prepared even into details. However, when it comes to implementation, there are too many variations, and the application is different project by project depending on the policies of the implementing/executing body, concerned government agencies, or availability of financial resources. The result is unequal treatment of the affected people and families.

Some of the major problems are pointed out below.

(1) Whereabouts of the Political Will and Responsibility

Had the stipulation of RA No. 7279 been properly carried out in the past by each responsible LGU, the informal settlers of this magnitude would not have settled in public lands as can be seen today. The Act specifies that "*when person or entities occupy danger areas such as esteros …eviction or demolition may be allowed"* and clarifies the responsibility of LGUs as that, "*the barangay, municipal or city government units shall prevent the construction of any kind of illegal dwelling units or structures within their respective localities."*

However, responsible officials of LGUs in the study area expressed that the relocation of informal settlers in and along esteros is the responsibility of national governments such as MMDA or DPWH because the management of esteros is their responsibility.

On the other hand, MMDA or DPWH considers the relocation of informal settlers on the danger areas or public lands is the responsibility of each LGU as stipulated by the Act.

The growing number of informal settlers seems to be largely left alone by the reluctant attitude of LGUs to enforce the Act.

(2) Lack of National Standards

Due to lack of rigid national standards on application or implementation of the above Act, the assistance given to the affected people in various projects, at the time of relocation and resettlement, have been considerably different. Some groups of families were given better assistance than some others who were not lucky enough to enjoy the same degree and types of assistance.

Examples:

- There are cases in which many informal settlers have been removed without any government assistance for the reason that they were violators of laws.
- There are cases in which the affected families received the disturbance fee of "minimum salary x 60 days".
- There are cases in which the affected families can receive the disturbance fee of "minimum salary x 30 days".
- Many informal settlers have received socialized housing, but many others have not received it simply because the houses were not available.

  (The basic policy of the government for relocating informal settlers by a project is to provide them with socialized housing.)
- In various cases many affected families have been disqualified for provision of socialized housing or denied any government assistance for the reason that their structures had been constructed after March 1992.
- Some informal settlers who had been relocated have received thorough livelihood skill training and even provided with job opportunity, but many others were not provided at all.
- There is a recent case in which each affected family is reportedly receiving Php50,000 for the reason that those families have to be moved by a presidential order, but NHA has no time to find a site.

(3) Lack of Resettlement Sites

The policy of NHA who is basically responsible for providing socialized housing to the poorest 30% of the families who do not own a house is to award socialized houses, particularly in cases that informal settlers have to be relocated by projects. All concerned agencies are well aware of the necessity of resettlement sites. Lack of resettlement sites has created the situations in the past wherein the government resorted to the payment in lump sum instead of providing a lot and low cost socialized housing.

(4) Ineffective Solutions

As explained in the previous section, in many cases affected people were simply given a lump sum, say, minimum salary x 30 or 60 days, and they had to move out, or had been evicted without any kind of assistance because those people were occupying public lands or danger areas without express consent. Also, there are cases of those who agreed to go back to their original places accepting the policy of "back to province", as an option for relocation.

This method may be much easier and economical for the government because many government agencies do not have to work long and hard hours preparing various matters requiring a large amount of financial resources. With lump sum payment, government may be able to save time and money for; looking for resettlement sites, developing land, construction of socialized housing, and for provision of post-relocation training and livelihood programs, etc.

What will be possible outcome of these cases? Have they successfully settled down in houses

in legal land as formal settlers?

It is not proven how effective the above methods are. Most likely, those who were given money but had not been given any assistance may have settled down on public lands elsewhere. Also, there are no reports to tell what is happening to those who went back to province.

(5) Insufficient Social Preparation

The most important component of resettlement is understood as social preparation. This means that, on the part of resettlers, the people receive thorough public consultation and hearing so that they well understand the meaning of relocation, the anticipated problems and difficulties they might face, and they have time to be ready them to move. Preparedness of the proponent LGU means that the LGU provides a full explanation to the project affected people POP), why they have to move, or along with NHA and project proponent prepare resettlement site, and assist conduct of census and in other various tasks for preparation of relocation. The accepting LGU, on the other hand, is to prepare to support the incoming settlers, assisting them with post-relocation livelihood or for improvement of their living conditions.

In many cases, although some officials of LGUs and barangays were informed and consulted, the people who are directly affected were not sufficiently informed and they have no idea where they stand. In some other cases, the affected people thus interrupt project activities.

4.6.5 GUIDELINES FOR SOCIAL FRAMEWORK OF RESETTLEMENT

In consideration of RA No. 7279, the guidelines for its implementation and standards of JICA and international funding agencies, some suggestions are presented below as guidelines for the preparation and operation of resettlement for the project affected people who have to be relocated from the present location by the projects.

Points of discussion are focused mainly on:

- Clarification of application of RA No. 7279,
- Standardization of the policy and application of procedure among government agencies, and
- Intensification of communication and assistance to the people for resettlement.

(1) Definition of "Informal Settlers"

"Informal Settlers" who have been formerly called "squatters" are the individuals or groups who occupy land without the express consent of the landowner. In this particular Study the "informal settlers" are mainly the individuals or groups who occupy public lands, specifically in and along esteros where construction of any structures is prohibited by laws.

(2) Land Acquisition and Resettlement Site

In acquiring the land and developing it, the concerned government agencies have to clearly explain the purpose of the land use not only to some group of LGUs, but more importantly, have to thoroughly explain and obtain the acceptance of the people and communities surrounding the intended resettlement site. This is essential for the resettlers who come in to unfamiliar neighborhood and environment, and who may need assistance of the neighboring people for many reasons.

It is basically the responsibility of NHA to acquire and develop the land for underprivileged families of the lowest 30% of income level that includes many of informal settlers, and prepare socialized housing in coordination with LGUs, or LGUs in coordination with NHA. However, in some cases, it is the task of implementing bodies to find the land and develop it in coordination with NHA, LGUs and the concerned government agencies.

All concerned agencies and LGUs must make utmost efforts to prepare relocation sites for the project affected people, and have to avoid the payment of lump sum money for the reason that there are no appropriate relocation sites.

(3) Upon Project Decision

Immediately after the implementation of a project is decided, it is required that the implementing body informs various agencies concerned.

1) Formation of Task Force Team

In the case that the Task Force Team has to perform the part of public communication with the project affected families, sufficient manpower must be assigned, because the Team members are basically assigned to work for the civil construction sector of the project, and because the public relations require extra time and painstaking energy.

2) Notification to Concerned Government Agencies and Others

There are suggestions among project implementing bodies that the Committee should play a more active role in assisting the affected people.

Also, establishment of a permanent organization that is neutral and that is accessible for everyone besides the Project Task Force field office is recommended for the reason that an inter-agency committee is not easily accessible to the project affected people.

As soon as a project implementation is decided, the Task Force Team is required to inform of the project to the concerned government agencies if the project requires the assistance of these agencies, and set up an inter-agency committee. The information is sent to the sending LGU of the project affected people by the project as well.

The inter-agency committee is, however, basically a coordination, monitoring or supervisory organization.

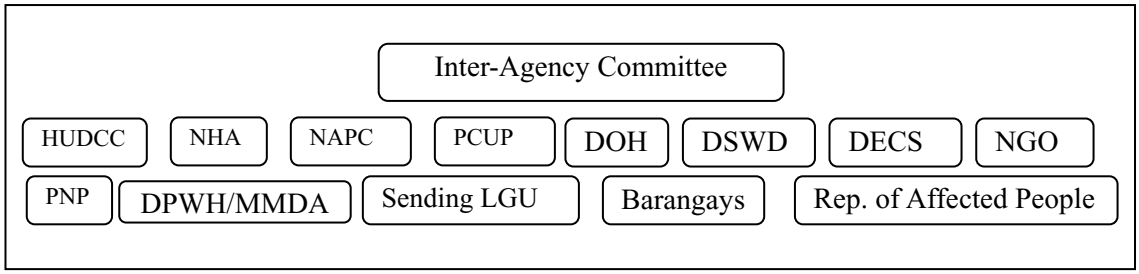


Figure 4.6.1 Inter-Agency Committee

(4) Tagging and Pre-Census

If government agencies are concerned about the increase of informal settlers, it is suggested that after a project decision, the resettlement operation action has to be hastened in order not to allow the encroachment of the area by "professional squatters" and "squatter syndicates".

It is also recommended that once the area has been firmly decided, the tagging operation must be immediately started, and **only one tagging** must be done in the area by allocating sufficient manpower. The implementing body has to carefully plan the way to maintain one time tagging.

Further, the implementing body and sending LGU with the concerned government agencies have to clearly announce and stress to the public the one tagging to be done, and that there will be no more tagging for the project afterward.

In the past, tagging has been done multiple times in various cases, segment by segment, as the project progressed due to the magnitude of the project area. If it is known that more than one tagging will go on, the chances for "professional squatters" and "squatter syndicates" to encroach will be great.

(5) Notification, Explanation and Consultation

The communication with and consultation for the affected people must be more intensive and frequent than existing level in order that the people truly understand the purposes of the project, the reasons they have to move, what assistance they are eligible for, who will assist, what will happen in the resettlement site, what are the conditions required to be qualified for awarding of a socialized house, what are the obligations of the people, etc.

RA No. 7279 requires the LGU or concerned agency to undertake the establishment of communication and rapport with recognized resident community leaders. It is important that the implementing body communicate with the affected people directly after the LGU is notified of the project, and after the LGU informed the affected barangays of the project.

The same organization that was suggested in the previous section to be established, a third party organization, may be able to play an important role in this regard.

Upon project decision, the LGU will be immediately notified. Only after the notification to the LGU reached barangay level will the implementing body or the concerned government agencies be able to directly talk with the project affected people.

The guidelines of JICA and international funding agencies are particularly concerned about all people including informal settlers being treated equally, and the conditions and requirements of all families to be well considered

(6) Preparation of Masterlist and Qualification Process

There must be rigid and clear national standards to qualify the affected families, or disqualify them. The policy of NHA to include the informal settler families whose structures were built after the year 1992 is well taken although this policy contradicts RA No. 7279 because exclusion of a great many families from the government assistance is not accepted by the guidelines of JICA as well as international funding agencies.

Also, suggested is a method to draw a line on the length of stay at the present location as part of

qualification, like a family must have stayed at the present structure more than 2 years, or 5 years, to be approved as qualified families.

If any families who happens to be residing in the project area before a cut-off date are qualified regardless of the period they have lived in the place, whether one week or ten years, accumulation of informal settlers to the project area is apparent.

However, some of the policies of NHA, such as, to include "professional squatters" and members of "squatter syndicates" for the awarding of socialized housing for the reason that it is difficult to validate such information, may require reconsideration. There are many ways to prove their status.

After the tagging a house-to-house census for the tagged houses is conducted, and based on the census, a master list shall be prepared by the affected barangay to be submitted to NHA for qualification decision.

The existing practice of the NHA's qualification/disqualification process is done by only referring to the registration list of NHA. The list of NHA contains the people who have been awarded socialized housing in the past. Regardless of the clause of RA No. 7279 to exclude the structures that have been built after 1992, NHA shall award the houses to the families who built their houses after 1992 as long as the families had not been awarded a socialized housing previously. Neither shall NHA exclude possible "professional squatters" or members of "squatter syndicates" for the reason that it is difficult to confirm such status of professionals or syndicate members.

Presently, awarding of houses and providing financial assistance depend on the availability of resources, but the standard is not laid out by a law.

This method casts a question of equality and fairness. Those who are lucky to be in a project with abundant budget are able to receive a lot with a low-cost house, or financial assistance by a project of the same agency, but those who are not lucky cannot receive any.

(7) Avoidance of Summary Eviction

In view of the on going Philippine law, the use of "Summary Eviction" is not illegal, but not accepted by international standards. Neither JICA, nor JBIC, ADB, the World Bank tolerates the summary eviction without any assistance. Every effort should be made to avoid executing "summary eviction".

(8) Relocation

Actual relocation must be carefully carried out. Preparation of the resettlement site must be confirmed before relocating the people by the implementing body, LGU and inter-agency committee. Infrastructure such as roads, sewerage, electricity or water systems must all be properly completed and serviceable; a school and health clinic has to be also available.

RA No. 7279, Article V – Socialized Housing, Section 21 stipulates that potable water, power and electricity, sewerage facilities, solid waste disposal system, access to primary roads, etc. shall be provided by the LGU or NHA in cooperation with the private developers and concerned agencies.

In the past, in many sites, the resettlers have been moved to the site where no appropriate preparation was made. Finding a half completed site, the resettlers tried to return to the place

where they came from in some cases. Lack of preparedness and lack of eagerness of the government make people feel they were betrayed.

(9) Post Relocation Services/Livelihood Programs

Widely understood, but still not sufficient yet, is the livelihood programs. There is no exceptionally effective ways to provide such programs but only patience and commitment are required together with schemes of different kinds.

Additional manpower should be assigned by all means, and more various programs should be tried. Some of the suggestions for livelihood program and projects are shown in *Supporting Report I*.

4.6.6 RECOMMENDATIONS

In consideration of the existing problems discussed in the previous section, recommendations shall be presented herewith as follows. Government agencies and LGUs are well aware of the problems pointed out here thus these recommendations are not necessarily new to concerned government agencies and LGUs or any other organizations, but these are still the suggestions that have to be seriously reconsidered once more and reconfirmed, and then attempts have to be made to improve the existing conditions.

(1) Avoidance of Unwilling Relocation

Every effort should be made to avoid unwilling relocation such as "summary eviction".

(2) Participation of Affected People

The consultation for the affected people through the entire process of the project and their participation on creating better solution for relocation should be ensured. The qualified person who can treat social aspect properly should be assigned to follow up the participation process through the entire process of the project.

(3) Clarification of the Responsibility to Avoid Increasing Informal Settlers

In spite of the clear stipulation of the Act, the attitudes of both the concerned government agencies and concerned LGUs to try to escape the responsibility and look the other away while blaming one another in between, is one of the causes of the growing number of informal settlers. While two sides are blaming one another and not taking strict enforcement of the Act, there are good chances for informal settlers to prevail wherever possible.

It is time that both sides, the LGUs that have clusters of informal settlers and the concerned government implementing agencies with project proponents, to discuss over the matter to clarify who are responsible for what, and who are to implement the necessary measures. The implementation requires a strong political will and determination by all concerned.

(4) Establishment of Uniformed Standards in Application

Inconsistent application of the Act is or has been creating considerably unfair and unequal situations in the past for resettlement of informal settlers who were affected by projects as explained in the previous section. .

The amount of disturbance fees or eligibility of fees and award of socialized housing should not be different by agency or by project. Although the situation surrounding each project may

vary and availability of financial resources may not be the same as well, a unified method of calculation should be applied. The differences, if any, should be based on the conditions surrounding PAP, for example, the number of family members, amount of income, occupational status, etc.

The way to confirm consistent application of RA No. 7279 and uniformed standards that are acceptable for international funding agencies has to be established by studying the past experiences of resettlement as to what is practical but the best application of the Act.

(5) Need of Resettlement Sites with Basic Infrastructure

One of the serious problems of relocation of informal settlers is lack of resettlement sites to relocate the project affected people.

Basically NHA is responsible for provision of low-cost housing. The "Resettlement Policy" of DPWH is also proposing the provision of relocation sites for project affected urban informal settlers on public lands. If public lands are not available, NHA or LGU and implementing body may have to study the way to acquire private lands, as it is known that provision of resettlement sites with basic infrastructure, and socialized housing, is the responsibility of both national and local governments.

(6) Necessity of Monitoring

A separate third-party multi-partite monitoring team that can monitor the entire resettlement operation throughout the project life must be established at the initial stage of the project. The detail is shown in Resettlement Action Plan (RAP) Guideline in *Chapter 5.6*.

(7) Use of Effective Methods

As discussed in the previous section, the policy of simply providing financial assistance instead of resettlement site and socialized housing, for the reason that they are not available, should be seriously reconsidered because:

1. Money can be consumed very quickly
2. If people come to know that financial assistance is provided, professional squatters and syndicates shall try to penetrate. Often it is difficult to detect or exclude them once they settle.

It seems that this method is creating more problems than solving the problems. The result is very clear as to what will happen if informal settlers are only asked to move from one place when they have no other place to go. Relocation of informal settlers must be looked from the viewpoint of how to resettle them to elsewhere so that they can stay in the place as normal citizens and maintain a decent life. It has to be a long-term or permanent solution.

In cases where no other method is available but have to resort to the payment of financial assistance, the concerned government agency (ies) must make sure with some document, such as a copy of contract, that the project affected families (PAFs) have a place to settle. Without such arrangement and assurance of a settling plan the government should not pay the financial assistance.

(8) Need for Follow-Up Studies

Should the government insist on applying the "back to province" policy, thorough follow-up studies are required as to what is happening to those who went back home to the province. If the outcomes are negative, they may have to find other policy, or improve the methods by

analyzing the problem points.

(9) Consider the People as Resources

If the government's measure is to chase the informal settlers from one place to another, it will create more problems than solve problems on informal settlers. It may be necessary for the concerned government agencies and all stakeholders to change their perception or understanding on informal settlers from one of being a liability to the government and society to one who could be resourceful assets and respectable citizens of society if properly treated, given opportunities and trained.

The above is a legitimate claim that has been proven by the experimental research of barangay environmental management activities, which were conducted during this Study by the Study Team (please refer to *Chapter 6* for details.).

The crucial point is the post-relocation livelihood programs and training. Place more emphasis on the livelihood programs and training that are aimed at self-reliance.

a. Communicate with the people by spending sufficient time and holding talks repeatedly
b. Organize them in appropriate sizes to make them manageable
c. Get ideas (dreams and goals of 3 years, 5 years or 10 years after) as to what they want to do with themselves and their community
d. Think and plan together how to achieve their desires and goals
e. Try to find the ways to finance such activities (hand out is not recommended except for special cases)
f. Do not terminate the program or training half way – few weeks of training only is not sufficient. The aim should be to enable them to increase their income and become independent.
g. Include the monitoring and follow ups in programs to examine the effects of the training.
h. Recognize the importance of follow-up studies and their analysis to make the experiences useful for other cases

The above suggestion requires the assistance of public communication specialists or various kinds of social scientists who are specialized for the tasks.

There are discussions regarding why informal settlers who are violating laws get preferential assistance when there are many more poor people who do not receive similar assistance.

Such claims are reasonable. However, if the governments (the national and local) are willing to reduce, if not totally eliminate, those informal settlers, it is suggested that the governments, in cooperation with each other, try the above with firm political will.

4.6.7 COST FOR RESETTLEMENT

The following items should be included in a resettlement cost.

Land acquisition and site development
Construction of house
Pre-relocation activities
Relocation (actual moving of the settlers)
Assistance coverage (financial/food assistance)
Livelihood assistance (pre /post relocation)
Project management
Site management and monitoring
External monitoring and evaluation

In the case of "Pasig River Environmental Management and Rehabilitation Sector Development Program", March 2000, the total cost requirement to relocate one family was estimated at about Php210,000. This amount was confirmed with the NHA as the required resettlement cost per family.

The above estimated cost includes a parcel of lot and a completed house, plus all other necessary costs of entire relocation operation of a family, such as, pre-relocation activities, actual relocation, disturbance fees when applicable, assistance coverage, pre- or post relocation livelihood and skill trainings, project management and monitoring. It should be noted that the cost for land acquisition is not included.

The calculation shall be: Php 210,000 x 5,500 = 1,155,000,000

Accordingly, the total cost of relocating 5,500 families shall be approximately Php 1.16 billion excluding the cost for land acquisition.

4.7 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

4.7.1 OBJECTIVES OF IEE

In general, environmental impact assessment (EIA) comprises the whole environmental elements. EIA is a very important management tool for development project. EIA provides not only evaluation of environmental impact caused by implementation of the project but also information on changes and modification of the project including design of structure, construction methods and others before implementation in order to minimize environmental negative impact.

An Initial Environmental Examination (IEE) is a form of EIA. In general, the IEE is carried out in the early stage of projects. On the other hand, the Philippine Government established "Philippine EIA Law" or Presidential Decree No. 1586 of 1978. As mentioned in *Chapter 2.9.3*, the Philippine Government established the Philippine Environmental Impact Statement (EIS) system. DENR Administrative Order (DAO) No. 30 of 2003, and its Implementing Rules and Regulations (IRR) for the Philippine Environmental Impact Statement System include IEE "as a document similar to EIS with reduced details and depth of assessment and discussion".

However, in the Philippines IEE is carried out during feasibility stage. The IEE in this study is carried out during the Master Plan stage. In this report, therefore, IEE is carried out by the Study Team based on JICA's Environmental and Social Consideration Guidelines, 2004.

IEE provides the following information through preparation of environmental impact matrix, screening, and scoping.

- To identify possible environmental impact caused by implementation of the proposed projects and programs based on available data and information and limited field reconnaissance.
- To recommend necessary preventive measures and modification of projects and programs, if necessary.
- To suggest necessary environmental impact study such as IEE and/or EIA (or EIS) at feasibility study stage.

4.7.2 FRAMEWORK OF IEE

(1) Targets of IEE

Target project for IEE consists of five sub-components including:

- Rehabilitation of pumping station
- Improvement of regional inundation problem in North Manila
- Improvement of regional inundation problem in South Manila
- Improvement of management facilities along esteros and drainage mains
- Dredging of other esteros and drainage mains

Contents of target sub-components are shown in *Table 4.7.1.*

Table 4.7.1 Target Sub-Components for IEE

1. Rehabilitation of pumping stations		
	(1) Balut Pumping Station (2) Vitas Pumping Station (3) Escolta Pumping Station (4) Binondo Pumping Station (5) Quiapo Pumping Station (6) Aviles Pumping Station (7) Valencia Pumping Station (8) Pandacan Pumping Station	(9) Balete Pumping Station (10) Paco Pumping Station (11) San Andres Pumping Station (12) Sta. Clara Pumping Station (13) Makati Pumping Station (14) Libertad Pumping Station (15)Tripa de Gallina Pumping Station
2. Improvement of regional inundation problem in North Manila		
	Improvement of the existing drainage facilities within the Aviles-Sampaloc drainage block and the Maypajo-Blumentritt-Balut Drainage block. Major activities are: (1) Improvement of Estero de Sunog Apog/Maypajo (mainly dredging) (2) Declogging of Blumentritt interceptor (3) Remedial works of Blumentritt interceptor (4) Construction of a new interceptor (5) Other remedial works related to the new interceptor	
3. Improvement of regional inundation problem in South Manila		
	Improvement of the Libertad-Tripa de Gallina drainage block. Major activities are: (1) Improvement of parts of Estero de Tripa de Gallina (bottlenecks) (2) Dredging and declogging of secondary channels (3) Construction of new drainage mains	
4. Improvement of management facilities along esteros and drainage mains		
	Construction of facilities intended to facilitate maintenance and management of the drainage systems including: (1) Roads and related facilities along esteros (2) Manholes along drainage mains (3) 42 esteros with a total length of 74 km (4) 37 drainage mains with a total length of 35 km	
5. Dredging of other esteros and drainage mains		
	Dredging of the following drainage channels: (1) 42 esteros with a total length of 74 km (2) 37 drainage mains with a total length of 35 km	

(2) Phasing of the Project

The project activities can be divided into three phases such as Pre-Construction Phase, Construction Phase and Operation and Maintenance phase. The solutions of environmental impact caused by the project will be evaluated at each phase. Major activities are as follows:

Pre-construction Phase

- Surveys
- Land acquisition
- Resettlement
- Employment of workers

C***onstruction Phase***

- Transporting of construction vehicles
- Operation of heavy equipment
- Other construction activities

Operation and Maintenance Phase

- Existence of structure
- Nature of raw materials to be utilized and their source
- Processes and operation procedures of the project
- Maintenance under normal conditions
- Employment for operation and maintenance

(3) Information sources for preparation of IEE

The following surveys were conducted in order to study IEE:

- water quality survey
- sediment quality survey
- encroached building survey
- structure survey
- other field reconnaissance survey and secondary data analysis

4.7.3 RESULT OF IEE

(1) Environmental Impact Matrix

An environmental impact matrix is used as a checklist of environmental impact. Environmental elements of impact matrix are based on DENR Form-2 named First Level Scoping. Other environmental elements were added into original element of DENR Format-2. Scoping (DPWH: Social and Environmental Management System Operations and Manual 2003). Environmental impact is evaluated including not only negative impact but also positive impact. Environmental evaluation elements are shown in *Table 4.7.2.*

(2) Screening

1) JICA Screening

In the context of the IEE, screening is the process of deciding upon the level of environmental review required. JICA formulated Guidelines for Environmental and Social Consideration in 2004. The JICA Screening Format is a tool used to screen whether the project would bring about negative impacts on the environment and social aspect. Result of screening which follows the format of JICA Guidelines is shown in *Supporting Report K*.

Table 4.7.2 Environmental Imapct Matrix

Project Details		Land Features and Uses				Species and Ecosystem				Air and Water					Socia-econoic Consideration								
		Land Use	Topography/Physiography	Geology /Soils	Aesthetics	Terrestrial fauna	Terrestrial Flora	Aquatic Fauna	Aquatic Flora	Air Quality	Surface Water Quality	Ground Water Quality	Noise	vibration	Population/ Sattlement	Employment /Livelihood	Health	Hazzardous Substance	Solid Waste	Transportation	Cultural and HistoricalValue	Resource use Competion	Accessibility
Rehabilitation of Pumping Stations																							
Balut Pumping Station	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
Vitas Pumping Station	Pre-construction															C+							
	Construction																						
	O & M																						
Escolta Pumping Statin	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
BaletePumping Station	Pre-construction															C+							
	Construction																		C-	C-			
	O & M																						
Paco Pumping Station	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
San Anderson Pumping Station	Pre-construction															C+							
	Construction												C-						C-				
	O & M																						
Binondo Pumping Station	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
Quiapo Pumping Station	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
Aviles Pumping Station	Pre-construction															C+							
	Construction												C-						C-				
	O & M																						
Valencia Pumping Station	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
Pandacan Pumping Station	Pre-construction															C+							
	Construction																		C-	C-			
	O & M																						
Sta Clara Pumping Station	Pre-construction															C+							
	Construction												C-						C-	C-			
	O & M																						
Makati Pumping Station	Pre-construction															C+							
	Construction																		C-				
	O & M																						
Libertad Pumping Station	Pre-construction															C+							
	Construction																		C-				
	O & M																						
Tripa de Gallina Pumping Station	Pre-construction															C+							
	Construction																		C-				
	O & M																						
Improvement of regional inundation problem in North Manila																							
Improvement of Esterode Maypajo (mainly dredging)	Pre-construction														B-	C+							
	Construction			?						C-	?		C-						C-	C-			
	O & M	C+													C+								
Remedial Works of Bulmentritt Interceptor	Pre-construction															C+							
	Construction									C-			C-						C-				
	O & M																						
Declogging of Blumentritt interceptor	Pre-construction															C+							
	Construction			?						C-	?								C-	C-			
	O & M																						
Construction of a new interceptor	Pre-construction															C+							
	Construction				C-					B-			B-	B-					C-	B-			
	O & M																						
Other remedial works related to the new interceptor	Pre-construction															C+							
	Construction																						
	O & M																						
Improvement of regional inundationproblem in South Manila																							
Improvement of parts of Estero deTripa de Gallina (Bottlenecks)	Pre-construction														B-	C+							
	Construction			?						C-	?		C-						C-	C-			
	O & M																						
Dredging and Declogging of Secondary Channels	Pre-construction														B-	C+							
	Construction			?						B-	?		C-	B-					C-	C-			
	O & M																						
Construction of new drainage mains	Pre-construction															C+							
	Construction				C-					B-			B-	B-					C-	B-			
	O & M																						
Improvement of Management facilities along esteros or drainage mains																							
Roads and related facilities along the esteros	Pre-construction														B-	C+							
	Construction									B-			B-	B-					C-	C-			
	O & M																						
Manholes along drainage mains	Pre-Construction															C+							
	Construction									C-										B-			
	O & M																						
Dredging of the estors and drainage mains																							
Dredging of esteros 42 esteros with a total length of 74 km	Pre-construction														B-	C+							
	Construction			?						B-	?		C-						C-	C-			
	O & M																						
Dredging of Drainage Mains 37 Drainage mains wit atotal length of 35 km	Pre-construction															C+							
	Construction			?						C-	?								C-	C-			
	O & M																						

Environmental Impact Score:

A+: Significant positive impact
B+: Moderate positive impact
C+: Negligible positive impact
A-: Significant negative impact
B-: Moderate negative impact
C-: Negligible negative impact

?: Unclear
Blank: No negative and positive impact caused by project activities

2) Categories of the Project

The proposed projects are categorized based on the JICA Guidelines for Environmental and Social Considerations and on Philippine environmental regulations, specifically DENR Administrative Order (DAO) 96-37 and DAO 2003-30, as follows:

Table 4.7.3 Categories of Proposed Project

Project	JICA	DAO 96-37	DAO 2003-30
1. Rehabilitation of pumping stations	Category C	ECA	Category C
2. Improvement of regional inundation problem in North Manila	Category A	ECP	Category A
3. Improvement of regional inundation problem in South Manila	Category A	ECP	Category A
4. Improvement of management facilities along esteros and drainage mains	Category A	ECP	Category A
5. Dredging of esteros and drainage mains	Category A	ECP	Category A

Described below are relevant sections of the JICA Guidelines for Environmental and Social Consideration (2004) and applicable regulations of the Philippine Government that were used as basis in categorizing the project.

JICA Guidelines for Environmental and Social Consideration (April 2004)

Section 2.5 of the Guidelines states that Projects are classified as Category A if they are likely to have significant adverse impacts on the environment and society. Projects with complicated impacts or unprecedented impacts, which are difficult to assess or which have a wide range of impacts or irreversible impacts, are also classified as Category A. Projects are also classified as Category A if they require a detailed environmental impact assessment by environmental laws and standards of the recipient governments. The impacts may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors (i.e., characteristics that are liable to cause adverse environmental impact) and projects located in or near sensitive areas.

DAO 96-37 and its Procedural Manual

Section 3 (h) Article I of the DAO and Chapter 2 of the Procedural Manual stipulate that major infrastructure projects are environmentally critical projects that would require full-scale environmental impact assessment (EIA). Although dredging and drainage improvement projects are not included in the list of major projects, the Procedural Manual recommends the conduct of EIA instead of IEE for projects that will affect an area of more than 10 ha.

The rehabilitation of pumping stations will be considered a project in an Environmentally Critical Area (ECA) for which an IEE either in a form of a checklist or a more detailed IEE will be required. Under DAO 96-37, the conduct of EIA or IEE studies goes almost through the same process. The difference only lies in the level of scoping required. IEE does not require the conduct of second level scoping and preparation of a scoping report, which is a compulsory requirement for EIA.

For selected projects falling under the ECA category, the DENR has pre-prepared

checklists to facilitate their evaluation. However, there is no such checklist for pumping facilities. This implies that the IEE study for the project would follow the EIA process without second level scoping.

DAO 2003-30, the revised Implementing Rules and Regulations (IRR) for the Philippine Environmental Impact Statement (EIS)

Based on this DAO Category A projects are Environmentally Critical Projects (ECPs), which means that it has significant potential to cause negative environmental impacts. A full-scale environmental impact assessment is required for such projects.

Category C projects are Projects that are intended to address environmental problems whose implementation has no significant potential to cause negative environmental impacts. The rehabilitation of the pumping stations falls under this category if implemented alone but will fall under Category A if implemented with the other components.

(3) Scoping

Scoping is the process of determining the issues to be addressed, the recommendations on measures to mitigate or offset the adverse impacts that should be considered in planning the implementation of the project and recommendations on monitoring requirements to be considered for the project.

The recommended mitigating measures and monitoring requirements are described below. These measures will apply to any project and project phase where the issues were identified.

Table 4.7.4 Result of Scoping for the Master Plan

Issues	Mitigating Measures	Monitoring and Institutional Requirements
Air pollution	• All vehicles and equipment that will be used must pass the emissions tests prescribed by the Clean Air Act. • Proper management of construction activities including storage and transport of dredged material to minimize generation of dust should be included in an environmental management plan that should form part of project implementation plan	☐ Emissions test reports for vehicles and equipment ☐ Monitor level of air pollutants compared with Air Pollution Standards, RA No.8749, 1999, Clean Air Act ☐ Form a monitoring team to monitor compliance with the environmental management plan
Transport and disposal of dredged material	• Temporary storage and transport of dredged materials must be considered in the construction plan. • Identify landfill site for disposal before construction. Temporary storage, transport and disposal should conform to RA 9003.	☐ Monitor compliance with requirements during implementation stage. For disposal arrangements, coordinate with LGUs where sanitary landfills exist, otherwise plan for the construction of a sanitary landfill.
Noise and vibration	• Proper scheduling of activities to avoid use of noise and vibration producing equipment during critical periods of the day like nighttime and early mornings and near sensitive areas like churches, schools, hospitals. Avoid use of much noise and vibration producing equipment as much as possible • Should form part of environmental management plan during construction	☐ Identify location of noise and vibration sensitive areas so that works schedules should be prepared taking these into account. ☐ Monitor noise level compared with Noise Standards ☐ Monitoring team to monitor compliance during implementation stage.

Offensive odors	• Employ proper construction technique, management of spoils and application of odor-reducers (where practicable). This should also form part of the environmental management plan during construction.	☐ Review and approval by proper authorities (e.g., DPWH, MMDA, DENR) of environmental plan for construction before actual works. If odor-reducers will be applied, type of odor-reducers must be environment-friendly and must be environmentally acceptable. This should be an item in compliance monitoring.
Accidents	• Sufficient provisions for prevention of accidents to workers like safety gadgets. Proper construction methods and safety precautions can prevent risks to workers, pedestrians and motorists, e.g. warning signs, temporary cover for excavated areas, proper management of stockpile of construction materials or spoils from excavation, etc. All safety precautions and construction methods to prevent risks to workers' and public's life and health must be detailed in environmental management plan for construction.	☐ Review and approval by proper authorities (e.g., DPWH, MMDA, DENR) of environmental plan for construction before actual works. ☐ Monitoring team to monitor compliance.
Involuntary Resettlement	• This should be addressed before deciding to proceed with the project. Much preparatory works such as public consultations is needed to get conformity of all affected families to resettle. It is advised that resettlement action plan that will look deep into the issue of resettlement be prepared to serve as guide in the conduct of negotiations, resettlement site identification and development before deciding on pursuing the project. The concerns of affected families must be the primary consideration in the preparation of the RAP.	☐ Monitoring of resettlement aspects is better handled by a resettlement monitoring task force that must be created specifically for the project. The task force must have varied sectoral representation. The monitoring task force must be created even before the preparation of the RAP so that they can participate in the RAP planning process. Institutional responsibilities will be determined by the task force members themselves.
Existing social and infrastructure services	• Proper construction techniques and precautionary measures employed during construction can minimize the impact of activities on utilities such water, telephone and electrical connections. However as traffic problems usually cause a host of many other problems as seen from the screening process, it is highly advisable to look deeper into the traffic management aspect of the project. A traffic management plan needs to be drawn up to ensure that the project will not add on to the traffic problems being experienced in the project areas.	☐ Coordination with the MMDA and concerned LGUs in preparing the traffic management plan.
Water-borne diseases	• Sufficient precautionary measures for workers considering their anticipated exposure to unsanitary conditions of the project sites should be taken into account in environmental management plan for construction.	☐ Compliance should be included in the monitoring plan.

4.8 PRELIMINARY PROJECT COST ESTIMATION

4.8.1 BASIC CONDITIONS OF CONSTRUCTION PLAN AND SCHEDULE

The following are the basic conditions/assumptions of construction plan and method.

- Detailed design is to be conducted ahead of construction works,
- Construction works are to be carried out by selected contractors through international competitive bidding with prequalification procedure,
- Annual working days of 260 for construction works are assumed,
- Bidding including prequalification is to be completed within one year immediately after finishing detailed design,
- Construction period is proposed to be basically 3 years including maintenance period from 6 months (drainage channel) to one year (drainage pumping station),
- Informal settlers in the objective channels are to be resettled ahead of construction works,
- Resettlement is to be carried out basically by an implementation body in collaboration with the respective LGUs,
- An interceptor is to be constructed in the underground by open excavation method and a prefabricated culvert box is to be installed to shorten the construction period so as not to disturb traffic flow for a longer duration,
- Three types of dredging methods are to be applied depending on site conditions. They are clamshell on working ship + barge, amphibious excavator and manpower,
- Average distance to disposal area of dredged materials is assumed to be 10 km,
- Cleaning of laterals is to be conducted throughout daily maintenance activities by the respective agencies of MMDA and LGUs separately from contracted companies, and
- The project cost finance is to be shared between national government and LGUs.

In line with the above condition and assumption, construction works by phasing are preliminarily scheduled as shown in *Figure 4.8.1*.

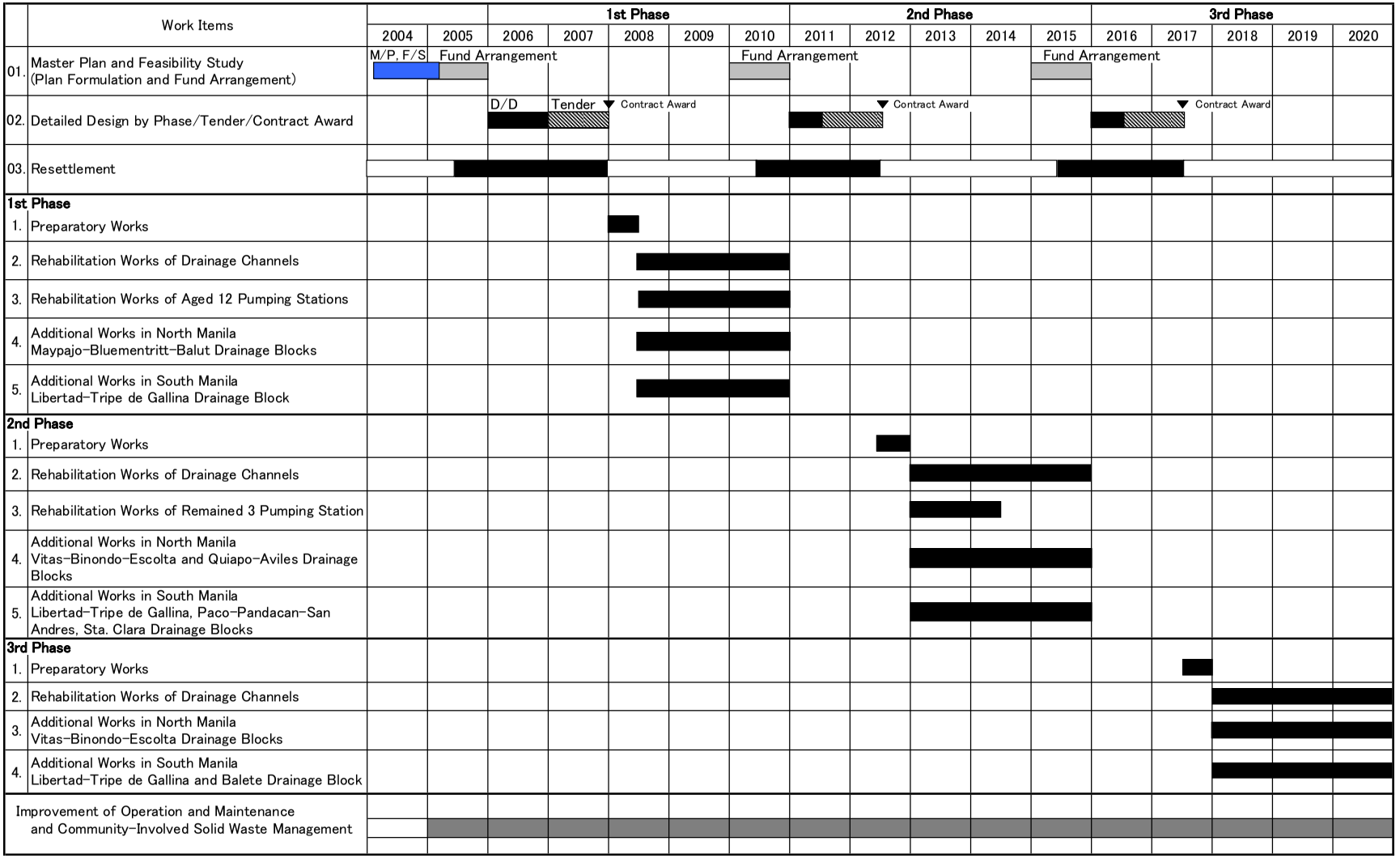


Figure 4.8.1 Preliminary Construction Schedule of Master Plan

4.8.2 COST ESTIMATE

(1) Basic Condition of Cost Estimate

The construction cost for the drainage improvement master plan is estimated. The project cost consists of costs of main works, compensation, engineering services, and administration by government staff and contingency.

The basic conditions of cost estimation are listed as follows:

- Unit cost is estimated referring to the unit price obtained from DPWH and recent similar projects in Metropolitan Manila,
- Price level of July 2004 is used, with exchange rate of US$1.0 = Php55 = JY110,
- Classification of local and foreign currencies is assumed as follows,

  Local currency portion (L/C)
  - Labor cost
  - Cost of locally available materials
  - Inland transportation cost for materials to be imported
  - Value added tax
  - Government administration cost
  - Resettlement cost
  - Local portion of engineering services cost
  - Contingency for local portion

  Foreign currency portion (F/C)
  - Cost of materials and facilities to be imported
  - Depreciation cost of construction equipment
  - Foreign portion of engineering services cost
  - Contingency for foreign portion
- In the master plan study, the following ratios of F/C and L/C are assumed considering actual ratios adopted in the similar drainage projects in Metropolitan Manila.
  - Rehabilitation and additional works for drainage channels
    : F/C (65%) and L/C (35%)
  - Rehabilitation and additional works for drainage pumping stations
    : F/C (80%) and L/C (20%)

(2) Component of Project Cost

The composition of project cost is summarized as follows:

Cost of civil works

- Preparatory works: 5% of the total cost of civil works
- Main works cost
- Other supporting measures cost
- Miscellaneous: 10% of the total cost of preparatory and main works

Value added tax (VAT)

- Value added tax: 10% of cost of main works

Resettlement and compensation cost

- Resettlement cost
- Compensation cost for additional works
- Miscellaneous: 5% of the total cost of resettlement and compensation

Cost of administration

- Administration cost: 3% of the total cost of main works

Cost of engineering services

- Engineering services cost: 10% of the total cost of main works

Physical contingency

- Physical contingency: 10% of the total cost of the above 5 items

Supporting measures cost

- Cost for BEM and Team ESTERO activities
- Cost for IEC campaign

(3) Main Works Cost

The main works cost of the master plan projects is estimated as shown below.

- **Total main works cost:** **Php8,232.4 million**
- Rehabilitation works of drainage channels: Php1,140.5 million
- Rehabilitation works of drainage pumping stations: Php2,129.0 million
- Additional works in North Manila: Php2,250.9 million
- Additional works in South Manila: Php2,712.0 million

The above main works cost is broken down into the following respective phases.

- 1st phase: Php3,258.8 million
- 2nd phase: Php2,839.5 million
- 3rd phase: Php2,134.1 million

The cost for each component is shown in *Table 4.8.1.*

Table 4.8.1 Main Works Cost

Drainage Block		Item			Unit	Quantity	Unit Price (Peso)	Amount (Million Peso)			
								Phase 1	Phase 2	Phase 3	**Total**
		1	**Rehabilitation works of drainage channels**								**1,140.5**
		1-1	Dredging of Esteros/Creeks	Phase 1	m^3	139,000	1,200	166.8			166.8
				Phase 2	m^3	360,000	1,200		432.0		432.0
				Phase 3	m^3	340,000	1,200			408.0	408.0
		1-2	Declogging of Drainage Mains	Phase 1	m^3	20,000	1,650	33.0			33.0
				Phase 2	m^3	50,000	1,650		82.5		82.5
				Phase 3	m^3	11,000	1,650			18.2	18.2
		2	**Rehabilitation works of drainage pumping stations**								**2,129.0**
		2-1	Rehabilitation works of drainage pumping stations	Phase 1 (*1)	L.S.			2,005.0			2,005.0
				Phase 2	L.S.				124.0		124.0
				Phase 3	L.S.					0.0	0.0
N01	**Vitas-Binondo-Escolta**	**3**	**Additional works of South Antipolo area**								**503.0**
		3-1	Replacement of existing Kubulusan Sub Outfall	B.C.(W3.8mxH2.7m)	m	140	250,000		35.0		35.0
		3-2	Additional B.C. along South Antipolo Open Canal	B.C.(W3.3mxH2.7m)	m	400	220,000		88.0		88.0
				B.C.(W2.6mxH2.7m)	m	500	200,000		100.0		100.0
		3-3	Additional B.C. along Solis Tescon D.M.	B.C.(W3.0mxH1.5m)	m	1,400	200,000			280.0	280.0
N02	**Quiapo-Aviles**	**4**	**Additional works of channel to Quiapo Pumping Station**								**307.5**
		4-1	Additional B.C. of Severino Reyes D.M.	B.C.(W2.8mxH2.5m)	m	700	205,000		143.5		143.5
		4-2	Extension of B.C.along Espana Street	B.C.(W2.8mxH2.5m)	m	800	205,000		164.0		164.0
		5	**Additional works for Aviles drainage area**								**699.2**
		5-1	Additional B.C. along Margal	B.C.(W3.8mxH2.1m)	m	630	200,000		126.0		126.0
				B.C.(W3.8mxH2.1m)	m	700	200,000		140.0		140.0
		5-2	Imrpovement of a Bridge along Estero de Sampaloc I		m^2	170	60,000		10.2		10.2
		5-3	Improvement of Est. de Samaploc II and Lepanto-Gov.Forbes D.M.		L.S.				263.0		263.0
		5-4	Installation of Pump Gates at Uli-Uli floodgate		m^3/s	2	80,000,000		160.0		160.0
N04	**Maypajo-Blumentritt-Balut**	**6**	**Additional works of Estero de Vitas**								**18.0**
		6-1	Hightenning of river wall in the lower estro de Vitas	Est.de Vitas L 900m, R 700m	m	3,600	5,000			18.0	18.0
				Est. de Sunog Apog L1200m, R 800m							
		7	**Additional works of Blumentritt Interceptor**								**723.2**
		7-1	Remedial works of existing Blumentritt Interceptor		L.S.			50.0			50.0
		7-2	Construction of Additional Interceptor	B.C.(2xW2.5mxH3.3m)	m	560	245,000	137.2			137.2
				B.C.(W3.2mxH3.3m)	m	1,100	240,000	264.0			264.0
				B.C.(W2.3mxH2.4m)	m	1,600	170,000	272.0			272.0
S01	**Libertad-Tripa de Gallina**	**8**	**Additional works for severe inundation area in South Manila**								**460.1**
		8-1	Additional B.C. along Zobel Roxas D.M.	B.C.(2xW1.8mxH1.4m)	m	650	200,000	130.0			130.0
				B.C.(3xW1.5mxH1.4m)	m	65	210,000	13.7			13.7
		8-2	Additional B.C. along Faraday D.M.	B.C.(2xW2.2mxH1.7m)	m	800	220,000	176.0			176.0
				B.C.(2xW1.5mxH1.4m)	m	65	170,000	11.1			11.1
		8-3	Additional B.C. along Makati Diversion Channel	B.C.(2xW2.2mxH2.1m)	m	550	235,000		129.3		129.3
		9	**Additional works of Libertad pond**								**522.0**
		9-1	Expansion of the exsiting Libertad pond	100mx1700m or equivalent	m^3	900,000	580		522.0		522.0
		10	**Additional Works of Dilain/Maricaban Creek area**								**1,380.8**
		10-1	Construction of Maricaban Interceptor	B.C.(2xW3.5mxH3.3m)	m	460	345,000			158.7	158.7
				B.C.(W3.7mxH3.3m)	m	2,550	245,000			624.8	624.8
				B.C.(W4.0mxH4.0m)	m	1,600	370,000			592.0	592.0
		10-2	Improvement of Dilain Pond		m	350	15,000			5.3	5.3
S02	**Balete**	**11**	**Additional works in Estero de Balete**								**29.1**
		11-1	Improvement of Padre Burgos B.C.		m	50	150,000			7.5	7.5
		11-2	Improvement of bridge cross San Maecelino St.		m^2	360	60,000			21.6	21.6
S03	**Paco-Pandacan-San Andres**	**12**	**Additional works on Perlita Creek**								**160.0**
		12-1	Installation of Pump Gates on Perlita Creek		m^3/s	2	80,000,000		160.0		160.0
S04	**Sta.Clara**	**13**	**Additional works in Sta.Clara drainage basin**								**160.0**
		13-1	Installation of Pump Gates in Sta.Clara drainage basin		m^3/s	2	80,000,000		160.0		160.0
Total								3,258.8	2,839.5	2,134.1	**8,232.4**

Note: (*1) This includes the cost for additional work at Aviles P.S.

(4) Resettlement Cost

Informal settlers within esteros are to be resettled. The resettlement is to be carried out year by year aiming at the target year of 2020. The total number to be relocated is around 1,900 structures (5,500 families) estimated as of July 2004. The required resettlement cost including land acquisition is as follows.

- **Total resettlement cost:** **Php1,510.6 million**
- Resettlement cost excluding land acquisition cost: Php1,289.6 million
- Land acquisition cost for relocation site: Php221.0 million

Note: Considering price increases, unit price of the cost for resettlement excluding land acquisition cost is assumed to be Php234, 472/ family.

Table 4.8.2 Resettlement Cost

Unit : Php million

Phase	Resettlement (excl. land acquisition)	Land Acquisition	Total
1st phase	193.4	33.1	226.5
2nd phase	451.4	77.4	528.8
3rd phase	644.8	110.5	755.3
All Phase	1,289.6	221.0	1,510.6

(5) Compensation Cost for Additional Works

The cost of land acquisition and house compensation for additional works of the existing Blumentritt interceptor (North Manila) and Faraday drainage main (South Manila) are required. The amounts for these, which are allocated in the 1st phase projects, are as follows.

- **Total compensation cost for additional works:** **Php3.8 million**
- Land acquisition: Php0.8 million
- House compensation: Php3.0 million

(6) Supporting Measures Cost

The cost for BEM and Team ESTERO activities and IEC campaign are estimated as follows and the details are explained in *Chapter 4.4*.

- **Total cost for BEM and Team ESTERO activities:** **Php417.8 million**
- **Total cost for IEC campaign:** **Php71.1 million**

Table 4.8.3 Cost for BEM and Team ESTERO Activities and IEC Campaign

Unit : Php million

Phase	BEM and Team ESTERO	IEC	Total
1st phase	63.3	23.9	87.2
2nd phase	141.5	23.6	165.1
3rd phase	213.0	23.6	236.6
All Phase	417.8	71.1	488.9

(7) Other Supporting Measures Cost

To support and sustain structural measures to be recovered and newly constructed, various supporting measures are taken up. These costs are included in the main works cost and the details are explained in *Chapter 4.5*.

- **Total other supporting measures cost:** **Php177.6 million**
- Various management systems: Php138.5 million
- Additional hydrological equipment: Php1.5 million
- Emergency operation and maintenance equipment: Php37.6 million

The above supporting measures cost is allocated as follows.

- 1st phase: Php39.1 million
  (additional hydrological equipment: Php1.5 million and emergency operation and maintenance equipment: Php37.6 million)
- 2nd phase: Php138.5 million
  (various management systems: Php138.5 million)

(8) Operation and Maintenance Cost

Aside from the above, annual operation and maintenance cost of drainage system is estimated as follows and the details are explained in *Chapter 4.5*.

- **Total O&M cost:** **Php241.0 million per annum**

(9) Project Cost

In line with the above conditions, the project cost is estimated. The total project cost is Php15.4 billion as summarized in *Table 4.8.4*. It should be noted that the total project cost shown here does not include the operation and maintenance cost (*Php241.0 million per annum*).

Table 4.8.4 Project Cost

Item	Amount (Php million)	Remarks
1. Civil Work	9,703.8	
1.1 Preparatory	411.6	5 % of (1.2)
1.2 Main	8,232.4	
1.3 Other supporting measures	177.6	
1.4 Miscellaneous	882.2	10 % of (1.1+1.2+1.3)
2. VAT	970.4	10 % of (1)
3. Resettlement and Compensation Cost	1,590.1	
3.1 Resettlement cost	1,510.6	
3.2 Compensation cost for additional works	3.8	
3.3 Miscellaneous	75.7	5 % of (3.1+3.2)
4. Government Administration Cost	291.1	3 % of (1)
5. Engineering Services	970.4	10 % of (1)
6. Physical Contingency	1,352.6	10 % of (1+2+3+4+5)
7. Supporting Measure Cost		
7.1 BEM and Team ESTERO	417.8	
7.2 IEC	71.1	
Total	15,367.3	

Total project cost is approximately broken down into the respective 3 phases as follows.

- 1st phase projects: Php5,503.9 million
- 2nd phase projects: Php5,419.4 million
- 3rd phase projects: Php4,444.0 million

4.9 IMPLEMENTATION PLAN

4.9.1 GENERAL

The phased implementation program for the project is based on the following:

(1) The whole proposed drainage improvement measures are divided into three phases to be completed by the target year of 2020.

(2) For phasing the implementation schedule of proposed measures, economic efficiency and social impact are taken into consideration.

4.9.2 PROJECT COMPONENTS AND PRIORITY ORDER

The drainage improvement plan will be composed of the following components:

- Improvement and rehabilitation plan for drainage channels
- Improvement and rehabilitation plan for drainage pumping stations
- Improvement plan for solid waste management along drainage channels
- Improvement plan for O & M organizations and activities
- Social framework of resettlement

The priority order of each structural measure is proposed and shown in *Tables 4.9.1 to 4.9.8*. For the non-structural measures such as improvement of solid waste management and O & M organization and activities, a barangay-involved management is discussed.

As for the resettlement action plan of the informal settlers in the target drainage channels, it is proposed for the implementation agency to prepare a Resettlement Action Plan based on the social framework of resettlement and to conduct the relocation of informal settlers before the implementation of the rehabilitation of drainage channels by dredging.

4.9.3 PROPOSED PHASED PROGRAM

The three phases of the proposed program are as follows:

(1) Phase-1 (2005-2010)

- Improvement and rehabilitation of drainage channels selected as priority projects for the severe inundation areas in both North Manila and South Manila, including dredging/declogging volume of 159,000 m³
- Improvement and rehabilitation of 12 drainage pumping stations
- Improvement of solid waste management by barangay-involved activities at 137 barangays along drainage channels related to the priority projects
- Improvement plan for O & M organizations and activities including barangay-involved activities
- Installation of equipment and facilities for effective operation and maintenance
- Resettlement of informal settlers [825 families (15% of 5,500 families)]

(2) Phase 2 (2011-2015)

- Improvement and rehabilitation of the remaining major drainage channels, including dredging/declogging volume of 410,000 m³
- Extension of the improvement of solid waste management by barangay-involved activities

at 140 barangays along drainage channels

- Routine solid waste management and O&M activities and barangay-involved activities
- Installation of equipment and facilities for effective operation and maintenance
- Resettlement of informal settlers [1,925 families (35% of 5,500 families)]

(3) Phase 3 (2016-2020)

- Improvement and rehabilitation of the remaining drainage channels, including dredging/declogging volume of 351,000 m³
- Extension of the improvement plan for solid waste management by barangay-involved activities at 99 barangays along drainage channels
- Routine solid waste management and O & M activities and barangay-involved activities
- Resettlement of informal settlers [2,750 families (50% of 5,500 families)]

4.9.4 IMPLEMENTATION SCHEDULE

Implementation schedule of the Master Plan is shown in *Figure 4.9.1*.

4.9.5 DISBURSEMENT SCHEDULE

Disbursement schedule of the Master Plan is shown in *Table 4.9.9*.

Table 4.9.1 Priority Order of Rehabilitation Works for Drainage Channels in North Manila

Code	Name of Estero/Creek and Drainage Main	Portion	Phase 1	Phase 2	Phase 3	Priority Order
NE01	Estero De Vitas			x		3
NE02	Estero De Sunog Apog/ Maypajo	1	x			1
		2			x	32
NE03	Casili Creek				x	31
NE04	Estero Dela Reina	1			x	34
		2		x		13
NE05	Estero De Binondo				x	24
NE06	Estero De Magdalena				x	27
NE07	Estero De San Lazaro				x	25
NE08	Estero De Kabulusan			x		15
NE12	Estero De Quiapo			x		4
NE13	Estero De San Sebastian				x	30
NE14	Estero De San Miguel/ Uli Uli				x	28
NE16	Estero De Aviles				x	29
NE17	Estero De Sampaloc I			x		6
NE18	Estero De Sampaloc II			x		10
NE19	Estero De Calubcob			x		11
NE20	Estero De Valencia				x	22
ND01	Pacheco				x	35
ND02	Lakandula			x		20
ND03	Zaragosa Sub				x	36
ND04	Buendia			x		21
ND05	Blumentritt Interceptor	1			x	33
		2	x			2
ND07	Pampanga-Earnshaw Sub	1		x		18
		2			x	37
ND08	Solis-Tecson	1			x	38
		2		x		19
ND09	South Antipolo			x		16
ND11	Kabulusan			x		14
ND12	Tayuman			x		17
ND13	Fugoso				x	26
ND14	Severino Reyes			x		5
ND15	Lepanto-Gov. Forbes			x		7
ND16	Lepanto-Josefina			x		8
ND17	Economia			x		9
ND18	Washington-P. Margal			x		12
ND19	Visayas				x	23

Table 4.9.2 Priority Order of Rehabilitation Works for Drainage Channels in South Manila

Code	Name of Estero/Creek and Drainage Main	Portion	Phase 1	Phase 2	Phase 3	Priority Order
SE03	Estero De Balete				x	26
SE05	Santa Clara Creek			x		17
SE06	Estero De Paco				x	27
SE07	Estero De Concordia				x	30
SE08	Estero De Pandacan	1			x	28
		2		x		12
		3			x	29
SE09	Estero de Tripa de Gallina	1		x		8
		2			x	21
		3	x			2
		4			x	22
		5		x		13
SE10	Perlita Creek			x		14
SE11	PNR Canal	1	x			4
		2			x	35
SE12	Calatagan Creek I		x			3
SE16	Makati Diversion Channel I			x		10
SE17	Makati Diverson Channel II			x		11
SE18	Dilain Creek/ Maricaban Creek I				x	25
SD01	Padre Faura			x		18
SD02	Remedios			x		19
SD04	Makati Headrace-I			x		20
SD05	Makati Headrace-II				x	31
SD06	Zobel Orbit				x	32
SD07	Onyx			x		16
SD08	Estrada			x		15
SD09	Zobel Roxas		x			5
SD10	Faraday		x			6
SD11	Pasong Tamo		x			7
SD12	SSH-Way				x	34
SD13	Vito Cruz				x	24
SD14	Buendia Outfall		x			1
SD15	Libertad Outfall				x	23
SD16	EDSA Outfall			x		9
SD17	Dolores				x	33

Table 4.9.3 Priority Order of Rehabilitation Works for Drainage Pumping Station in North Manila

Code	Name of Pumping Stataion	Phase 1	Phase 2	Phase 3	Priority Order
NP01	Aviles	x			1
NP02	Quiapo	x			2
NP03	Valencia	x			3
NP04	Binondo	x			4
NP05	Escolta	x			5
NP06	Vitas		x		6
NP07	Balut		x		7

Table 4.9.3 Priority Order of Rehabilitation Works for Drainage Pumping Station in South Manila

Code	Name of Pumping Stataion	Phase 1	Phase 2	Phase 3	Priority Order
SP01	Pandacan	x			4
SP02	Tripa de Gallina	x			1
SP03	Sta.Clara	x			3
SP04	Paco	x			5
SP05	Libertad	x			2
SP06	Makati	x			6
SP07	Balete	x			7
SP08	San Andres		x		8

Table 4.9.5 Priority Order of Additional Works for Drainage Channels in North Manila

Item			Sub-Item	Phase 1	Phase 2	Phase 3	Priority Order
N01	**Vitas-Binondo-Escolta**	**Additional works of South Antipolo area**	Replacement of existing Kubulusan Sub Outfall		x		8
			Additional B.C. along South Antipolo Open Canal		x		9
			Additional B.C. along Solis Tescon D.M.			x	10
N02	**Quiapo-Aviles**	**Additional works of channel to Quiapo Pumping Station**	Additional B.C. of Severino Reyes D.M.		x		3
			Extension of B.C.along Espana Street		x		4
		Additional works for Aviles drainage area	Additional B.C. along Margal		x		7
			Imrpovement of a Bridge along Estero de Sampaloc I		x		5
			Improvement of Est. de Samaploc II and Lepanto-Gov.Forbes D.M.		x		6
N04	**Maypajo-Blumentritt-Balut**	**Additional works of Estero de Vitas**	Hightenning of river wall in the lower estero de Vitas			x	11
		Additional works of Blumentritt Interceptor	Remedial works of existing Blumentritt Interceptor	x			1
			Construction of Additional Interceptor	x			2

Table 4.9.6 Priority Order of Additional Works for Drainage Channels in South Manila

Item			Sub-Item	Phase 1	Phase 2	Phase 3	Priority Order
S01	**Libertad-Tripa de Gallina**	**Additional works for severe inundation area in South Manila**	Additional B.C. along Zobel Roxas D.M.	x			1
			Additional B.C. along Faraday D.M.	x			2
			Additional B.C. along Makati Diversion Channel		x		3
		Additional works of Libertad pond	Expansion of the exsiting Libertad pond		x		4
		Additional Works of Dilain/Maricaban Creek area	Construction of Maricaban Interceptor			x	7
			Improvement of Dilain Pond			x	8
S02	**Balete**	**Additional works in Estero de Balete**	Improvement of Padre Burgos B.C.			x	5
			Improvement of bridge cross San Maecelino St.			x	6

Table 4.9.7 Priority Order of Additional Works for Drainage Pumping Stations in North Manila

Item			Sub-Item	Phase 1	Phase 2	Phase 3	Priority Order
N02	**Quiapo-Aviles**	**Additional works in Quiapo-Aviles Drainage Block**	Increase of pump capacity ($3m^3/s$) at Aviles pumping station	**x**			1
			Installation of pump gates ($2m^3/s$) at the existing Uli-Uli floodgate		**x**		2

Table 4.9.8 Priority Order of Additional Works for Drainage Pumping Stations in South Manila

Item			Sub-Item	Phase 1	Phase 2	Phase 3	Priority Order
S03	**Paco-Pandacan-San Andres**	**Additional works in Paco-Pandacan-San Andres Drainage Block**	Installayion of pump gates on Perita Creek		**x**		2
S04	**Sta.Clara**	**Additional works in Sta.Clara Drainage Block**	Installation of pump gates in Sta.Clara drainage basin		**x**		1

Table 4.9.1 Priority Order of Rehabilitation Works for Drainage Channels in North Manila

Code	Name of Estero/Creek and Drainage Main	Portion	Phase 1	Phase 2	Phase 3	Priority Order
NE01	Estero De Vitas			x		3
NE02	Estero De Sunog Apog/ Maypajo	1	x			1
		2			x	32
NE03	Casili Creek				x	31
NE04	Estero Dela Reina	1			x	34
		2		x		13
NE05	Estero De Binondo				x	24
NE06	Estero De Magdalena				x	27
NE07	Estero De San Lazaro				x	25
NE08	Estero De Kabulusan			x		15
NE12	Estero De Quiapo			x		4
NE13	Estero De San Sebastian				x	30
NE14	Estero De San Miguel/ Uli Uli				x	28
NE16	Estero De Aviles				x	29
NE17	Estero De Sampaloc I			x		6
NE18	Estero De Sampaloc II			x		10
NE19	Estero De Calubcob			x		11
NE20	Estero De Valencia				x	22
ND01	Pacheco				x	35
ND02	Lakandula			x		20
ND03	Zaragosa Sub				x	36
ND04	Buendia			x		21
ND05	Blumentritt Interceptor	1			x	33
		2	x			2
ND07	Pampanga-Earnshaw Sub	1		x		18
		2			x	37
ND08	Solis-Tecson	1			x	38
		2		x		19
ND09	South Antipolo			x		16
ND11	Kabulusan			x		14
ND12	Tayuman			x		17
ND13	Fugoso				x	26
ND14	Severino Reyes			x		5
ND15	Lepanto-Gov. Forbes			x		7
ND16	Lepanto-Josefina			x		8
ND17	Economia			x		9
ND18	Washington-P. Margal			x		12
ND19	Visayas				x	23

Table 4.9.9 Disbursement Schedule of the Master Plan

Unit: Million Peso

Work Item	Project Cost				Phase 1						Phase 2					Phase 3					Total
	Phase 1	Phase 2	Phase 3	Total	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Civil Works	3,806.9	3,432.0	2,464.9	9,703.8	0	0	0	2315	756.1	735.5	0	156.2	1160.2	1069.3	1046.3	0	117.4	782.7	782.5	782.3	9703.8
1) Preparatory	162.9	142.0	106.7	411.6	0	0	0	162.9	0	0	0	142.0	0	0	0	0	106.7	0	0	0	411.6
2) Main	3,258.8	2,839.5	2,134.1	8,232.4	0	0	0	1921.6	668.6	668.6	0	0	1008.5	925.9	905.1	0	0	711.5	711.4	711.2	8232.4
- Rehabilitation of Drainage Channels	199.8	514.5	426.2	1,140.5	0	0	0	40.0	79.9	79.9	0	0	171.5	171.5	171.5	0	0	142.1	142.1	142.0	1140.5
- Additional Works in North Manila	723.2	1,229.7	298.0	2,250.9	0	0	0	144.6	289.3	289.3	0	0	409.9	409.9	409.9	0	0	99.4	99.3	99.3	2250.9
- Additional Works in South Manla	330.8	971.3	1,409.9	2,712.0	0	0	0	66.2	132.3	132.3	0	0	323.8	323.8	323.7	0	0	470.0	470.0	469.9	2712.0
- Rehabilitation of Pumping Station	2,005.0	124.0	0	2,129.0	0	0	0	1670.8	167.1	167.1	0	0	103.3	20.7	0	0	0	0	0	0	2129.0
3) Other Supporting Measures	39.1	138.5	0	177.6	0	0	0	20.3	18.8	0	0	0	46.2	46.2	46.1	0	0	0	0	0	177.6
4) Miscellaneous	346.1	312.0	224.1	882.2	0	0	0	210.5	68.7	66.9	0	14.2	105.5	97.2	95.1	0	10.7	71.2	71.1	71.1	882.2
VAT	380.7	343.2	246.5	970.4	0	0	0	231.5	75.6	73.6	0	15.6	116.1	106.9	104.6	0	11.7	78.3	78.3	78.2	970.4
Resettlement and Compensation Cost	241.8	555.2	793.1	1590.1	95.1	95.1	51.6	0	0	222.1	222.1	111	0	0	317.2	317.2	158.7		0	0	1590.1
1) Resettlement Cost	226.5	528.8	755.3	1510.6	90.6	90.6	45.3	0	0	211.5	211.5	105.8	0	0	302.1	302.1	151.1		0	0	1510.6
2) Compensation Cost for Additional Works	3.8	0	0	3.8	0	0	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0	3.8
3) Miscellaneous	11.5	26.4	37.8	75.7	4.5	4.5	2.5	0	0	10.6	10.6	5.2	0	0	15.1	15.1	7.6	0	0	0	75.7
Government Administration Cost	114.2	103.0	73.9	291.1	0	0	0	69.4	22.7	22.1	0	4.7	34.8	32.1	31.4	0	3.5	23.5	23.5	23.4	291.1
Engineering Services	380.7	343.2	246.5	970.4	0	0	0	231.5	75.6	73.6	0	15.6	116.1	106.9	104.6	0	11.7	78.3	78.3	78.2	970.4
Physical Contingency	492.4	477.7	382.5	1352.6	9.5	9.5	5.2	284.8	93	112.7	22.2	30.3	142.7	131.5	160.4	31.7	30.3	96.3	96.3	96.2	1352.6
Sub-Total					104.6	104.6	56.8	3132.5	1023.0	1239.6	244.3	333.4	1569.9	1446.7	1764.5	348.9	333.3	1059.1	1058.9	1058.3	14878.4
Supporting Measure Cost	87.2	165.1	236.6	488.9	8.2	9.6	12.4	16.7	18.6	21.7	26.7	29.1	32.6	37.1	39.6	42	45.6	46.9	49.4	52.7	488.9
1) BEM and Team ESTERO	63.3	141.5	213	417.8	3.4	5.9	8.7	12	15.1	18.2	21.3	24.8	28.3	31.8	35.3	37.7	40.2	42.6	45.1	47.4	417.8
2) IEC	23.9	23.6	23.6	71.1	4.8	3.7	3.7	4.7	3.5	3.5	5.4	4.3	4.3	5.3	4.3	4.3	5.4	4.3	4.3	5.3	71.1
Total					112.8	114.2	69.2	3149.2	1041.6	1261.3	271.0	362.5	1602.5	1483.8	1804.1	390.9	378.9	1106.0	1108.3	1111.0	15367.3