F. PRELIMINARY DESIGN

TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

F.1 GENERAL

The priority projects subject to a feasibility study were selected within the scope of the formulated drainage master plan. The scope of works of the priority projects consist of 1) rehabilitation and additional works for the drainage facilities and 2) rehabilitation and additional works for the drainage pumping stations. A preliminary design for the drainage facilities is made in this stage. Subsequently, a more detailed rehabilitation plan of the drainage pumping stations is examined with identification of rehabilitation work items by stations for the 12 stations. The result of the above design/study is described in the following.

F.2 OBJECTIVE PRIORITY PROJECTS

F.2.1 DRAINAGE CHANNEL FACILITIES

The priority projects for the drainage channel facilities identified in the master plan consist of rehabilitation and additional works for drainage channel facilities of estero/creek/canal/drainage main. Locations of objective drainage facilities and drainage pumping stations are presented in *Figure F. 2.1*. The following are the objective drainage facilities.

(1) Rehabilitation and Additional Works of Drainage Channel Facilities in North Manila

Estero de Sunog Apog

- Dredging (Clearing)

Blumentritt Interceptor

- Declogging of existing interceptor and related works
- Construction of additional interceptor by box culvert and remedial works

(2) Rehabilitation and Additional Works of Drainage Channel Facilities in South Manila

Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I

- Dredging (Clearing)

Buendia Outfall

- Declogging and related works

Ø bel Roxas Drainage Main

- Declogging and construction of additional box culvert

Pasong Tamo Drainage Main

- Declogging

Faraday Drainage Main

- Declogging and construction of additional box culvert

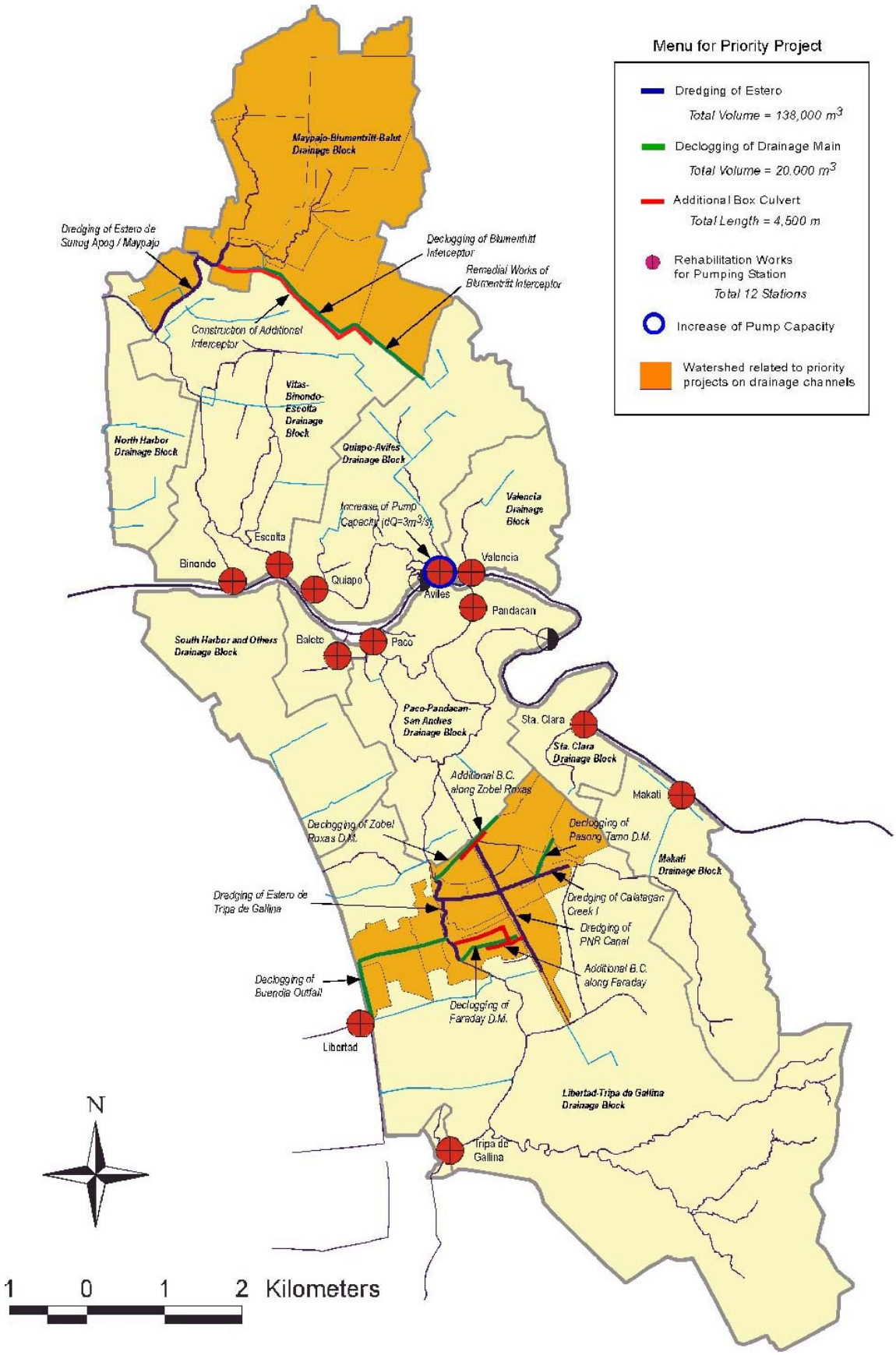


Figure F.2.1 Locations of Priority Projects

F.2.2 DRAINAGE PUMPING STATIONS

Presently there are 15 major drainage pumping stations in the core area. For the objective 12 aged drainage pumping stations identified in the master plan, a further detailed rehabilitation work items of repair and replacement of pump equipment and apparatus by stations will be examined in this stage. Those locations of aged pumping stations are shown in *Figure F.2.1*. The objective pumping stations will be as follows.

- Aviles,
  At Aviles station, increase of pump capacity of $3m^3/s$ is proposed in connection with the rehabilitation works as an additional work.
- Quiapo,
- Valencia,
- Pandacan,
- Paco,
- Sta. Clara,
- Tripa de Gallina,
- Ilibertad,
- Makati,
- Binondo,
- Escolta and Balete

F.2.3 NON-STRUCTURAL AND SUPPORTING MEASURES

The following non-structural and supporting measures are incorporated with the priority projects in the drainage improvement. In this preliminary design, further description will be made in the later section for 1) recommendation of countermeasures for rapid urbanization, 2) recommendation of application of existing floodplain management system, and 3) proposed additional hydrological equipment in connection with improvement of operation and maintenance activities, respectively. Others are explained in the respective sector reports.

Non-Structural Measures

1) Recommendation of countermeasures for rapid urbanization

2) Recommendation of application of existing floodplain management systems

Supporting Measures

1) Improvement of Operation and Maintenance Organization and Activities and Promotion of Community-Involved Activities
   - Improvement of the existing O&M organiza tion and activities including establishment of community-involved O&M
   - Community-Involved Solid Waste Management

2) Installation of Additional Hydrological Equipment

3) Introduction of Emergency Operation and Maintenance Equipment

4) Preparation of Guideline for Resettlement

F.3 PRELIMINARY DESIGN OF DRAINAGE CHANNEL FACILITIES

F.3.1 GENERAL

A preliminary design is conducted for the objective drainage channel facilities such as estero, creek and drainage main. The preliminary design results for the drainage channel facilities are described in this section covering inventory survey result of underground and related facilities, rehabilitation and design criteria, result of preliminary design of drainage channel facilities and proposed work quantities, as follows.

F.3.2 INVENTORY SURVEY OF UNDERGROUND AND RELATED FACILITIES

Prior to planning and designing of the additional works of the priority projects, an inventory survey on underground facilities and maintenance holes, etc., was conducted mainly by collection of related documents/drawings, site reconnaissance and interview with persons in charge.

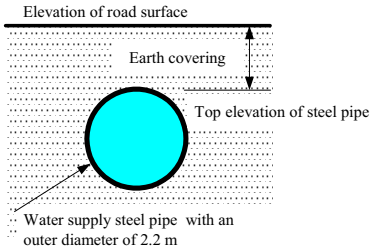
(1) Water Supply Pipe

There exist various underground facilities such as drainage pipes, water supply pipes, sewerage pipes, etc. Such underground facilities are mostly placed within 1 m depth from the ground surface. These facilities would not be obstacle to construct additional box culverts. However, a main obstacle will be a water supply steel pipe installed under the main streets in the core area from north to south. The pipe having an outer diameter of 2.2 m (850, 000 m^3/day) was placed by MWSS in 1987. A special attention should be paid to depth of earth cover above the placed steel pipe at crossing points of additional culverts. Those existing conditions are summarized in the following *Table F.3.1*. As seen in the Table, some modification works such as partial replacement is needed at 2 crossing points of additional Blumentritt Interceptor and Faraday box culvert.

Table F.3.1 Existing Depths of Earth Covering at Questioned Intersections

Objective Drainage Facilities	Location	Elevation of Road Surface (EL.m)	Top Elevation of Steel Pipe(EL.m)	Earth Covering (m)
Additional Blumentritt Interceptor	Intersection of Hermosa street and Juan Luna street	12.47	10.75	1.72
Additional Zobel Roxas Box Culvert	Intersection of Zobel Roxas ave. and South Super Highway	13.10	8.50	4.50
Calatagan Creek I	South Super Highway	15.00	9.70	5.30
Additional Faraday Box Culvert	Intersection of Faraday street and South Super Highway	13.00	10.70	2.30

Note: The dimensions of steel pipe are as shown below.



(2) Foundation of Light Rail Transit (LRT) in Rizal Avenue

A Light Rail Transit (LRT) is running on the median (strip) of Rizal Avenue in north Manila which is partially to be the proposed route of additional Blumentritt Interceptor. The additional interceptor is to place in the underground of seaside lane of the Rizal Avenue whereas existing interceptor runs in the opposite lane. For construction of additional interceptor, it was confirmed that required space for box culvert is available in the underground of the seaside lane.

(3) Maintenance Hole

Maintenance holes have been constructed on the box culvert for maintenance activities of cleaning/declogging of culvert. Principally, maintenance holes have been installed at an interval of 50 m. However, some maintenance holes are not functioning due to artificial covering by asphalting or earth embankment. Considering proper and effective maintenance works of the culvert, modification works will be made to the covered maintenance holes.

An inventory survey was conducted throughout site inspection and using available drawings in order to clarify the present conditions of maintenance holes for the objective 5 drainage box culverts for Blumentritt Interceptor, Buendia Outfall, Øbel Roxas Drainage Main, Pasong Tamo Drainage Main and Faraday Drainage Main to be declogged in the priority projects. *Table F.3.2* is the results of inventory survey and those locations are indicated in *Databook II (Drawings)*.

Table F.3.2 Present Conditions of Maintenance Holes

Channel	Total Number of Maintenance Hole	Number of Covered Maintenance Holes
Blumentritt Interceptor	91	20
Buendia Outfall	47	29
Øbel Roxas Drainage Main	17	3
Pasomg Tamo Drainage Main	13	0
Faraday Drainage Main	43	0

F.3.3 DESIGN CRITERIA FOR DRAINAGE FACILITIES

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

The menus for preliminary design are rehabilitation of drainage channels by dredging/declogging and additional and/or remedial works for the interceptors (or box culverts).

The rehabilitation works for the existing drainage channels are designed to recover the original flow area (or cross-sectional area) of channels and box culverts so as to convey storm water properly. Accordingly, the rehabilitation work is to dredge or declog the bottom deposits in the channels and culverts, including related works like installation of stop logs and improvement of maintenance holes (or manholes) for enabling proper maintenance activities.

Aside from the above, that of the additional works is to construct new box culverts and remedial works for improvement of the existing drainage conditions. For Blumentritt Interceptor, preliminary design of additional box culvert and remedial works for road surface flow inlets and widening of narrow sections are conducted. The design scale of drainage main shown in *Table F.3.3* is applied for additional works.

Table F.3.3 Design Scale for Additional Works

Objective Channel	Design Scale
Secondary Channels (Blumentritt Interceptor, Zobel Roxa D.M., Faraday D.M.)	3-year return period (60 mm/hour)

(2) Basic Data to be used

Basic topographic maps and other data to be used in the preliminary design will be as follows.

Topographic Maps

- The most recent available topographic information based on 15,000 topographic map prepared in 2004, with low-lying areas modified using the result of manhole survey in 2000, is utilized for preliminary design.
- Primary benchmark is BM-M3 located in Quezon City.
- Elevation above DPWH datum of 10.475 m is equivalent to Mean Sea Level (MSL).

Channel Cross-Sections and Profiles

- For rehabilitation works, cross-sections and longitudinal profiles of the channels surveyed in the master plan stage and in SEDMM (2000) are used as basis to retrieve original channel section.
- For additional works, cross-sections (ground elevation) at major points (100m interval) and longitudinal profiles (ground elevation) were surveyed in the feasibility stage of 2004 is used as basis to design of box culvert channel.

Design High Water Levels at Surroundings

- Mean Spring High Tide Level (El. 11.34 m) is applied for design high tide level on Manila Bay.
- Completion of on-going Pasig-Marikina River Improvement Project is assumed. The design high water level along the Pasig River determined by the on-going Pasig-Marikina River Improvement Project is applied.

Soil Conditions

- Soil investigation by boring and soil analysis was conducted in the feasibility stage. Major soil data obtained from the above is utilized in the design of additional works and construction method, etc., and summarized in *Table F.3.4*.

Table F.3.4 Major Soil Data in Priority Projects Areas

Feature	Blumentritt Interceptor						Zobel Roxas DM		Faraday DM
	1	2	3	4	5	5A	6	7	8
1.N-value									
0-1 m	10	7	0	4	7	4	-	2	3
1-3 m	5	22	3	26	29	8	23	5	7
3-5 m	5	47	14	58	55	21	8	20	29
5-7 m	25	50	11	57	42	42	6	37	tuff
7-10 m	60	55	24	tuff	60	51	10	tuff	
2.Specific gravity	2.57	2.48	2.41	2.58	2.46	2.47	2.63	2.41	2.48
3.Unit weight(g/cu.cm)				1.67	1.73			1.81	1.72
4.Unconfined compression test, qu (kg/sq.cm)				47.04	12.29			41.25	15.48
5.Water table (m)	1.50	1.00	1.60	1.85	2.90	1.90	2.50	1.00	1.00
6.Workability									
Depth of sample taken (m)	14		6		2		12	8	
Liquid limit (LL)	49		70		62		61	48	
Plastic limit (PL)	27		29		26		26	25	

Referred Guidelines and References

- Design Guidelines, Criteria and Standards for Public Works and Highways, Volume-II (Orange Book) DPWH
- Technical Standards and Guidelines for Planning and Design, Volume-II, Urban Drainage, DPWH
- Technical Standard for River and Sabo Works, River Association of Japan, Ministry of Land, Infrastructure and Transport (MLIT)

(3) Hydraulic Analysis

Discharge capacities of the drainage channels and box culverts are estimated respectively as follows.

Discharge capacities after dredging of open channels are estimated with the following conditions.

- Uniform flow
- Bankfull flow
- Resistance law:Manning formula
- Manning's coefficient:0.025 for open channels
- Surface water slope:Average bed slope or planned bed slope

Discharge capacity (estimation of required cross-sectional area) for a box culvert is determined as the discharge without overflow at any manholes along the questioned culvert. For box culvert, the design discharge estimated in the master plan is applied to design. Applied design discharges will be explained in the following respective sections of designing of additional box culvert. To estimate it, pressure flow is assumed because when large flood comes, the water level becomes almost equal to bank elevation in esteros/creeks. In such situation, pressure flow in the box culvert would occur. The water level at the following downstream ends is assumed as follows.

- Esteros/creeks:Top level of drainage main (culvert)
- Drainage mains:Top level of drainage main (culvert)
- Pumping stations:Pump start level

Other conditions are as follows.

- Resistance law:Manning formula
- Manning's coefficient:0.015 for box culvert

After necessary or recovered dimension of the drainage channels is determined, a more sophisticated unsteady, hydrodynamic simulation by MOUSE is executed to confirm its validity.

(4) Basic Line for Dredging and Declogging of Drainage Channels and Related Works

The following are the basic lines for dredging (clearing) and declogging of drainage channels including related works.

- Bottom deposits accumulated in the esteros/creeks is to be removed by dredging/clearing. The channel bed elevation to be dredged is set either by modifying original bed elevation in the previous construction stage or by estimating the original bed level based on the existing observed cross-sectional shape and connections between channels.
- Informal settlers residing within the objective channels are to be relocated by resettlement.
- Bottom deposits accumulated in the box culverts are to be cleaned by declogging. In declogging, maintenance holes which are improper conditions for practical maintenance activities are repaired, if needed.
- Stop log gate is installed at some sections for a purpose of that maintenance works of the culvert will be made in dry or no water condition, especially in Blumentritt Interceptor and Buendia Outfall. These two channels are always occupied by water because of high water level at outlet. The respective channel bed elevations are around E.L. 8.5 m to 8.0 m whereas mean tide level is E.L. 0.475 m.

Image of rehabilitation works for esteros is illustrated in *Figure F.3.1*. However, as reference, the river channel and its easement may be recovered eventually in the future with the image shown in *Figure F.3.2*, according as progress of resettlement of informal settlers residing within the channels.

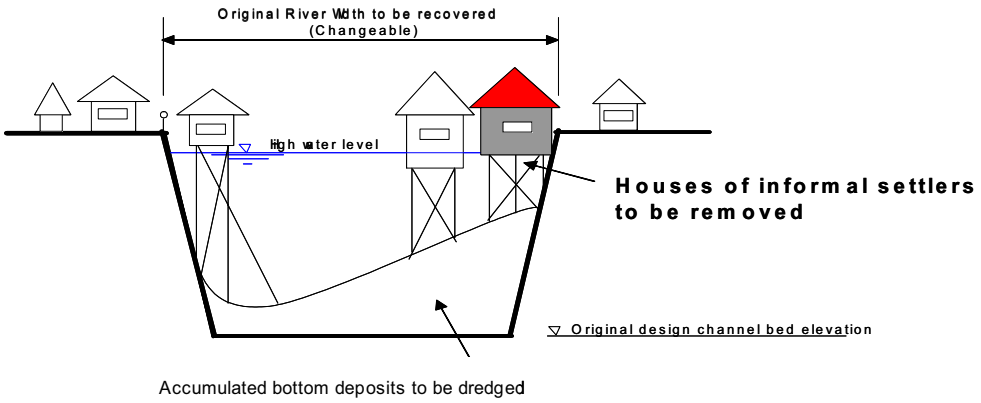


Figure F.3.1 Image of Rehabilitation of Open Drainage Channels (Estero/Creek/Canal)

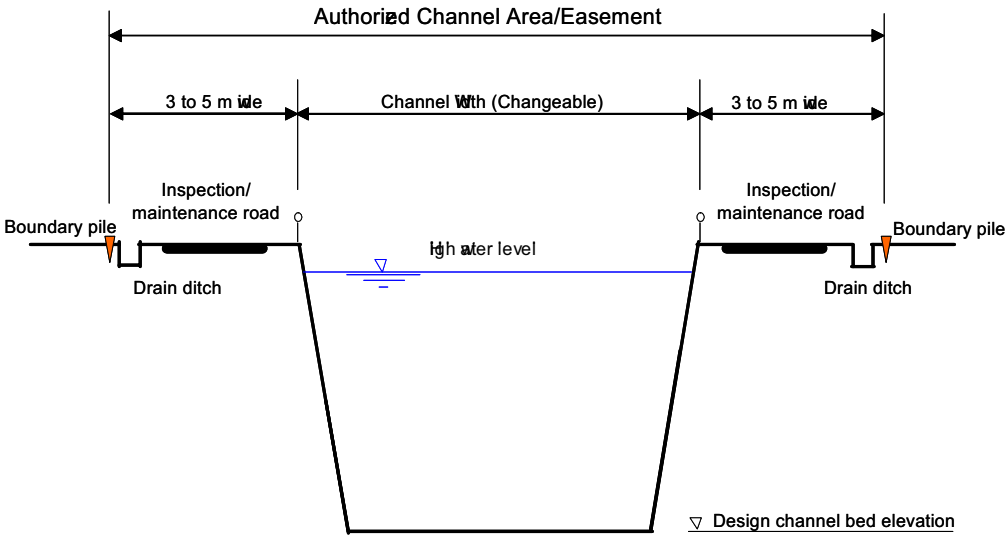


Figure F.3.2 Ideal Typical Section of Open Channel and Its Easement

(5) Basic Line for Construction of Additional Culverts and Remedial Works

The following are the basic lines for construction of additional box culverts and remedial works.

- Additional box culvert is to be constructed along the questioned existing culvert in principle. When there is no space for installation of box culvert, it is aligned in the adjacent street.
- Longitudinal bed slope is set from gentle to steep towards upper end.
- Required box culvert cross-sectional area is estimated as pressure one under the condition that storm water in the box culvert does not spout from maintenance hole or manhole as mentioned in the above (3).
- Box culvert is constructed by concreting in site in principle.
- A 1.0 m is adapted to minimum earth cover in roadway and railway.
- Minimum inner height of box culvert will be 1.2 m considering easy maintenance activities.
- Direct foundation is applied as the foundation structure of box culvert considering soil and geological conditions.
- Street inlet with steel grating is installed at intersection depending on site condition, especially along the proposed Blumentritt Interceptor.
- Maintenance hole is installed at interval of around 50 m or major intersections, points of changing slopes, depressions, etc., and closed maintenance holes due to road pavement/embankment are to be recovered by modification of original holes.
- Stop log gate is to be installed depending on water level at outlet of box culvert. The criteria of installation of stop log gate are 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

  In priority projects, the objective culverts will be Blumentritt Interceptor and Buendia Outfall.
- For construction works of box culvert, some affected house buildings are to be relocated temporarily or permanently depending site conditions

F.3.4 PRELIMINARY DESIGN OF DRAINAGE CHANNEL FACILITIES IN NORTH MANILA

"Maypajo-Blumentritt-Balut Drainage Block" is the objective drainage channel facilities subject to preliminary design in North Manila as shown in *Figure F.3.3*. The results of the preliminary design in line with the design criteria already explained in *Chapter F.3.3* are described in the following.

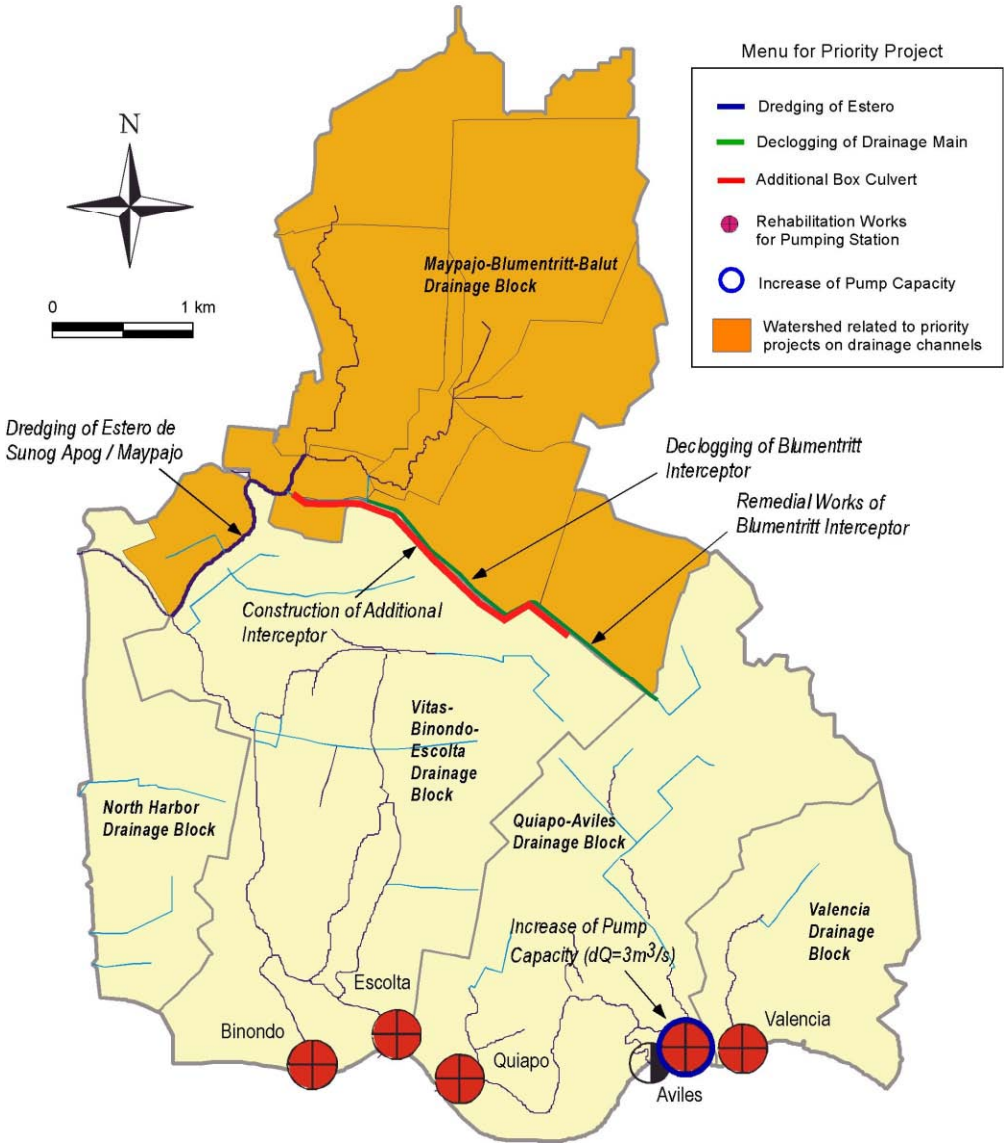


Figure F.3.3 Location Map of Priority Projects in North Manila

(1) Objective Drainage Facilities in North Manila

The following are the objective drainage facilities in North Manila.

Estero de Sunog Apog
- Dredging (Clearing)

Blumentritt Interceptor
- Declogging of existing interceptor and related works
- Construction of additional interceptor by box culvert and remedial works

(2) Dredging (Clearing) of Estero de Sunog Apog

Estero de Sunog Apog is discharging storm water collected in the upper catchments of Casili Creek and Estero de Maypajo including Blumentritt Interceptor to Estero de Vitas as shown in *Figure F.3.4*.

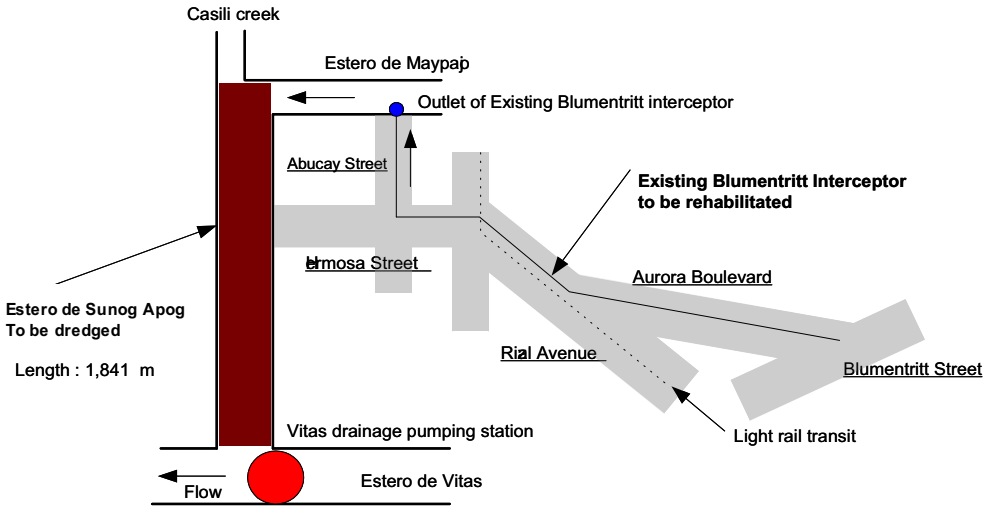


Figure F.3.4 Schematic Location of Estero de Sunog Apog

The accumulated bottom deposits in Estero de Sunog Apog is cleared so as to recover original cross-sectional area assigned in the previous construction stage. Recovering is made as follows.

- Stretch: Confluence with Estero de Vitas to confluence with Estero de Maypajo (total length:1,841 m)
- Channel width: within the existing channels bed width (70 m to 7 m)
- Channel bed elevation: longitudinal profile proposed in the construction stage of Vitas drainage pumping station in 1997 is modified partially. At the confluence with Estero de Vitas, channel bed elevation is set above the lowest bed elevation of the existing Estero de Vitas. The dimensions of longitudinal profiles are as summarized in *Table F.3.5*.
- Riverbed bed at the upper end of stretch to be dredged is excavated with a slope of 1:10 to prevent washing away of riverbed materials
- Clearing volume: 91,600 m^3 in total
- Estimated discharge capacity after dredging: 200-90 m^3/s
- Relocation of informal settlers: Based on field observation during the feasibility study, it is judged that the existing informal structures in the stretch will not be obstacle for the dredging work. At the feasibility study stage, it is assumed that there is no family who will be resettled.

For the above Estero de Sunog Apog, outline of plan, profile and cross-sections for clearing works is shown in *Databook II (Drawings)*.

Table F.3.5 Dimensions of Longitudinal Profile of Estero de Sunog Apog

	Dimensions at major sections			
	Lower end (Sta. 0+000)	Balut bridge (Sta. 0+160)	Confluence with new Blumentritt Interceptor (Sta. 1+500)	Upper end (Sta. 1+841)
Length (m)	0	160	1340	341
Existing River bank elevation				
- right (sea side)	12.2	12.4	12.5	11.4
- left (land side)	12.1	12.4	12.5	11.8
Existing lowest bed elevation	7.3	8.5	9.2	10.0
Bed elevation after dredging	7.6	7.6	7.7	8.0

Source:cross-sections and longitudinal profiles surveyed in SEDMM (2000) Unit:ELm

(3) Declogging of Existing Blumentritt Interceptor and Related Works

Figure F.3.5 shows a schematic route map of the existing Blumentritt Interceptor to be rehabilitated.

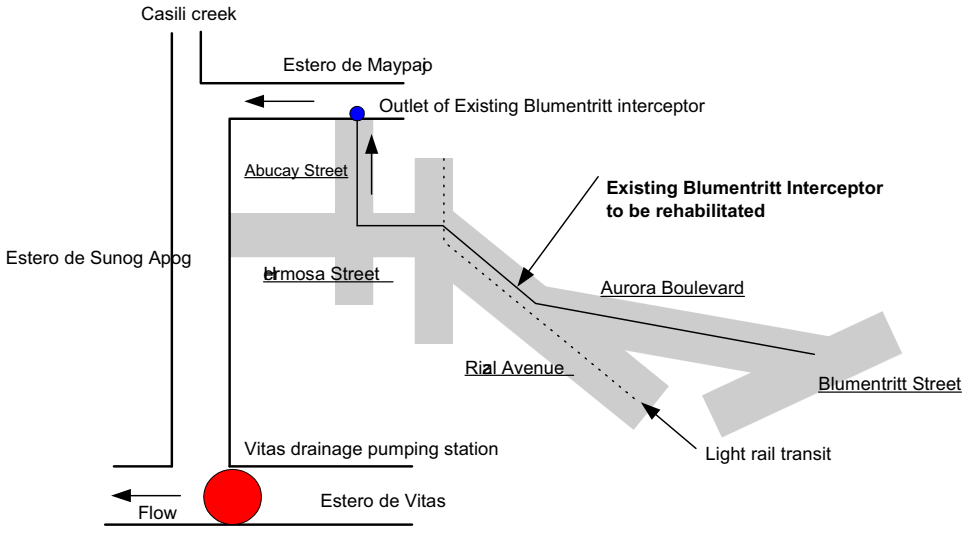


Figure F.3.5 Route of Existing Blumentritt Interceptors

The existing Blumentritt Interceptor is presently not discharging storm water smoothly because of accumulated bottom deposits in culvert, clogging in Estero de Maypajo and partial structural detects with narrow sections. Several existing maintenance holes are not being functioned due to covering by road pavement. To improve the above problems, the required works will be 1) related works of modification of maintenance holes and installation of stop log gates for easy operation and maintenance and 2) declogging of existing culvert. The required works will be explained as follows.

1) Related Works

The related works consist mainly of modification of maintenance holes covered by road pavement and installation of stop log gates. Those are explained in the following.

Modification/raising of maintenance hole

- Closed maintenance holes by road pavement are modified for easy maintenance activities.
- 20 units of maintenance hole out of 91 holes will be modified by raising of hole cover with images as shown in *Figure F.3.6*.
- The locations of maintenance hole modified are indicated in *Databook II (Drawings)*.

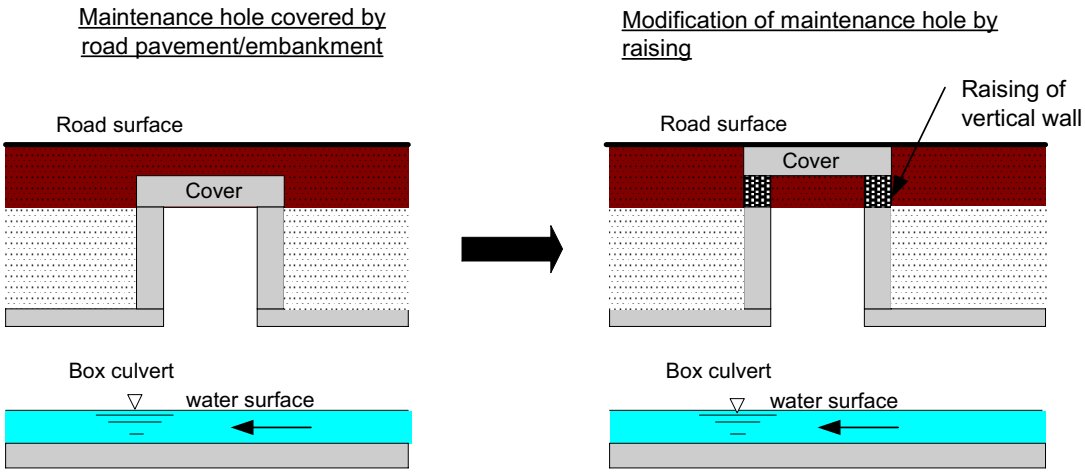


Figure F.3.6 Image of Modification of Closed Maintenance Hole

Installation of stop log gate for easy maintenance activity

- The existing box culvert/additional new culvert is to always submerge due to back water from outlet, resulting in difficulty of periodical maintenance activities.
- In view of effective maintenance works in the dry condition of the culvert, the stop log gate is additionally installed at 8 sections jointly (same sections) for the existing and additional culverts with images shown in *Figure F.3.7*.

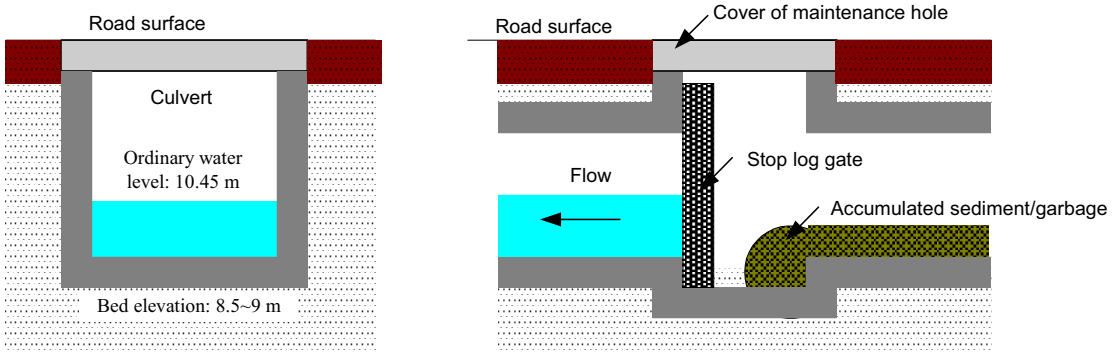


Figure F.3.7 Cross Section of Stop Log Gate to be Installed

2) Declogging of Existing Blumentritt Interceptor

In parallel with related works of the existing interceptor, declogging for a total length of 2,655 m from the closing section at Hermosa Street to the upper end of the intersection of Dapitan Street will be made as described below.

- Stretch: Section to be closed at Hermosa Street to upper end of the intersection of Dapitan street (total length:2,655 m)
- The dimensions of longitudinal profiles of the interceptor are as presented in *Databook II (Drawings)*.
- Declogging volume: 9,800 m^3 in total
- Estimated discharge capacity after declogging: 8 m^3/s

For the above the existing Blumentritt Interceptor, plan, profile and cross-sections for remedial works and declogging are presented in *Databook II (Drawings)*.

(4) Construction of Additional Blumentritt Interceptor and Remedial Works

The additional Blumentritt Interceptor with a total length of 2,570 m is newly constructed along the existing interceptor. Also widening of existing box culvert at narrow sections and construction of inlets for road surface flow will be additionally made as remedial works. The results are as follows and the details are presented in *Annex F.1* and *F.5* and in *Databook II (Drawings)*.

1) Proposed Route of Additional Interceptor

The proposed route of the additional interceptor will be as follows.

- A proposed route of the additional interceptor will be, as shown in *Figure F.3.8*, mostly along the existing culvert. Total length of new culvert is around 2,570 m.
- As already explained in the master plan stage (refer to *Annex F.1*), the lowermost of existing culvert including outlet is shifted to the Estero de Sunog Apog in connection with construction of new culvert as shown in *Figure F.3.8*.

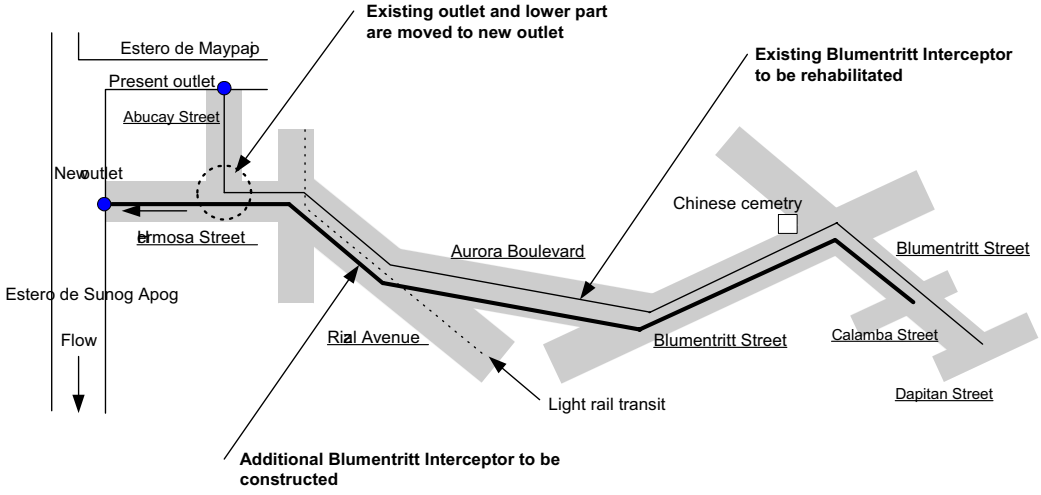


Figure F.3.8 Proposed Route of Additional Blumentritt Interceptor

2) Design Discharge of Additional Interceptor

The estimated design discharge for additional culvert with a 3-year return period of design scale is presented in *Figure F.3.9*.

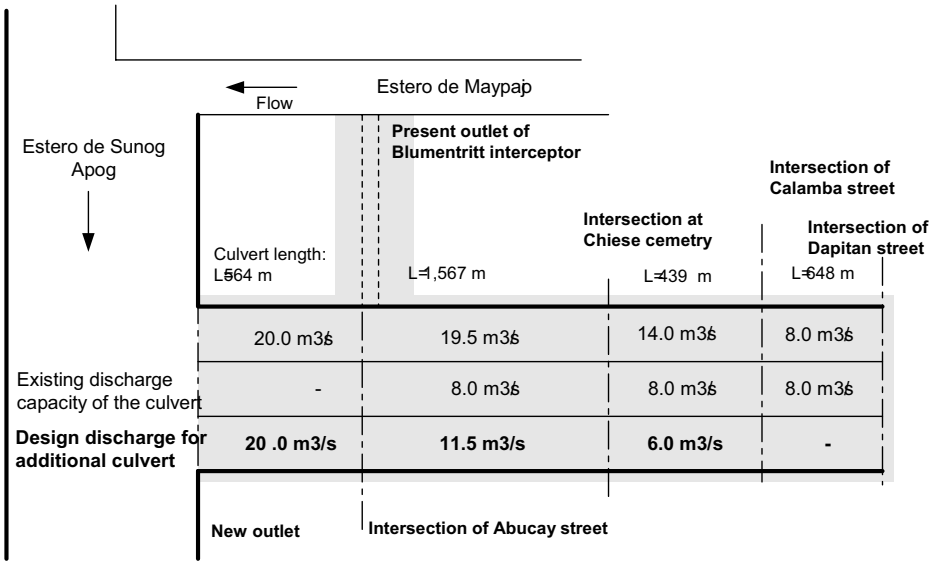


Figure F.3.9 Design Discharge of Additional Blumentritt Interceptor

3) Preliminary Design of Additional Box Culvert

In accordance with the above section of Rehabilitation and Design Criteria for Drainage Facilities, additional box culvert was designed and summarized as follows. The details are presented in *Annex F.1* and *F.5* and in *Databook II (Drawings)*.

Additional box culvert

- The proposed additional box culvert consists of concrete box culvert with a total length of 2,570 m.
- The dimensions of additional box culvert are divided into 3 sections or 3 types as indicated in *Table F.3.6*. An image at section of Rizal Avenue will be as shown in *Figure F.3.10*.
- There are some house buildings that will be affected by the construction of the additional box culvert. It is possible that the house buildings around the new outlet and the corner near Chinese cemetery will be required to be tentatively relocated during the construction.

Table F.3.6 Dimensions of Additional Box Culvert

Stretch	Length	Culvert Dimension
Outlet - Intersection of Abucay Street	564 m	Width 3.4 m × height 2.6 m × 2 lanes
Intersection of Abucay St. - Intersection of Chinese cemetry	1,567 m	W 3.6 m × h 2.7 m × 1 lane
Intersection of Chinese cemetry - Intersection of Calamba St.	439 m	W 2.3 m × h 2.4 m × I lane

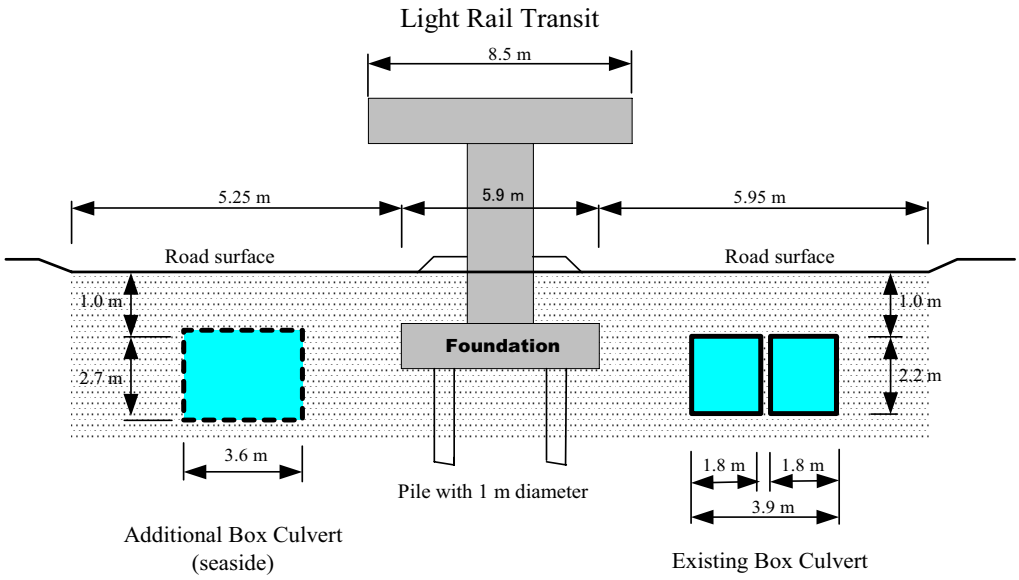


Figure F.3.10 Image of Additional Box Culvert at Section of Rizal Avenue

Inlet for road surface flow

- In order to drain road surface flow into the box culvert smoothly and effectively, inlets are newly installed at 10 sections which shall be located at intersections in the upper Blumentritt street from intersection of Chinese cemetery to Dapitan Street.
- Inlet ditch is installed on the whole carriageway width as imaged in *Figure F.3.11* and covered by steel grating.

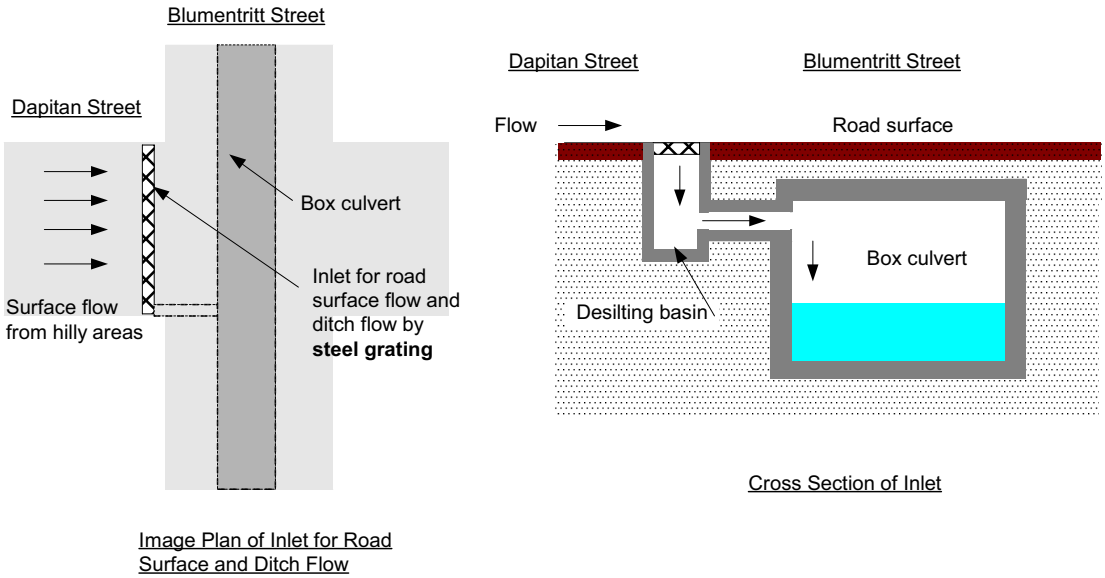


Figure F.3.11 Image of Inlet for Road Surface Flow

Maintenance hole

- In order to operate and maintain the new box culvert smoothly and effectively, maintenance holes are installed at an interval of 50 m. The number of maintenance holes will be 51 places.
- As mentioned in the above, stop log gate will be jointly installed at 8 sections of the proposed maintenance holes.

Widening of existing box culvert at narrow sections

- There exist 2 places of extremely narrow sections in the stretches of Rizal Avenue and Aurora Boulevard with a total 200 m in length, of which locations are shown in *Figure F.3.12*.
- The narrow sections are to be modified/reconstructed with the same section of upper and lower reaches as shown in *Databook II (Drawings)*.

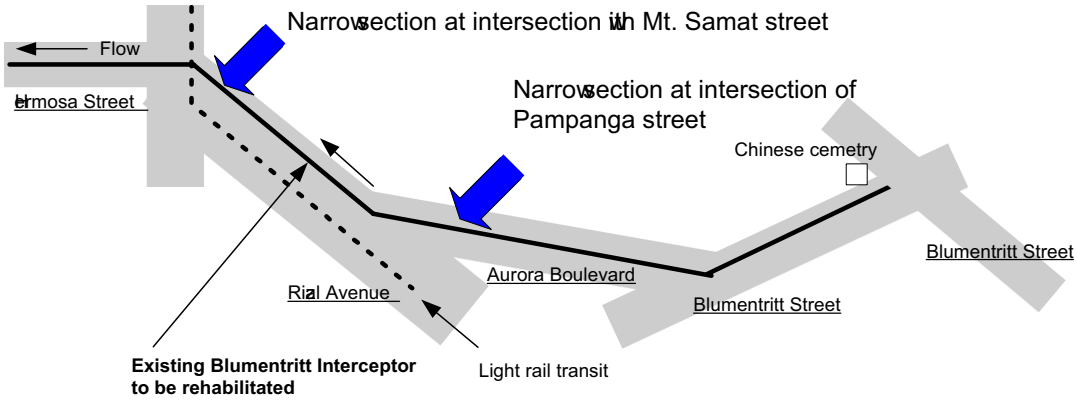


Figure F.3.12 Locations of Narrow section of Existing Box Culvert

(5) Summary of Rehabilitation and Additional Works for Drainage Channel Facilities in North Manila

The major proposed works in North Manila are outlined below and detailed work quantities are described in *Supporting Report G*.

Estero de Sunog Apog

- Dredging (Clearing): 91,600 m^3 (for a total length 1,841 m)

Blumentritt Interceptor

- Raising/modification of cover of maintenance holes: 20 holes
- Installation of stop log gate: 8 sections
- Declogging: 9,800 m^3 (for a total length 2,655 m)
- Construction of additional interceptor by box culvert: 2,570 m in length
- Installation of maintenance hole: 51 places
- Widening of narrow sections of existing box culvert: 2 sections with a total length 200 m
- Installation of inlet for road surface flow: 10 sections
- Affected buildings by the construction of additional interceptor: Some house buildings

F.3.5 PRELIMINARY DESIGN OF DRAINAGE CHANNEL FACILITIES IN SOUTH MANILA

Objective drainage facilities subject to prelim inary design locate in the South Manila is "Libertad-Tripa de Gallina Drainage Block" as shown in *Figure F.3.13*. The results of the preliminary design in line with the design criteria already explained in *Chapter F.3.3* are described in the following.

(1) Objective Drainage Facilities in South Manila

The following are the objective drainage facilities s ubject to preliminary design in south Manila.

Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I

- Dredging (Clearing)

Buendia Outfall

- Declogging and related works

Zobel Roxas Drainage Main

- Declogging
- Construction of additional box culvert

Pasong Tamo Drainage Main

- Declogging

Faraday Drainage Main

- Declogging
- Construction of additional box culvert

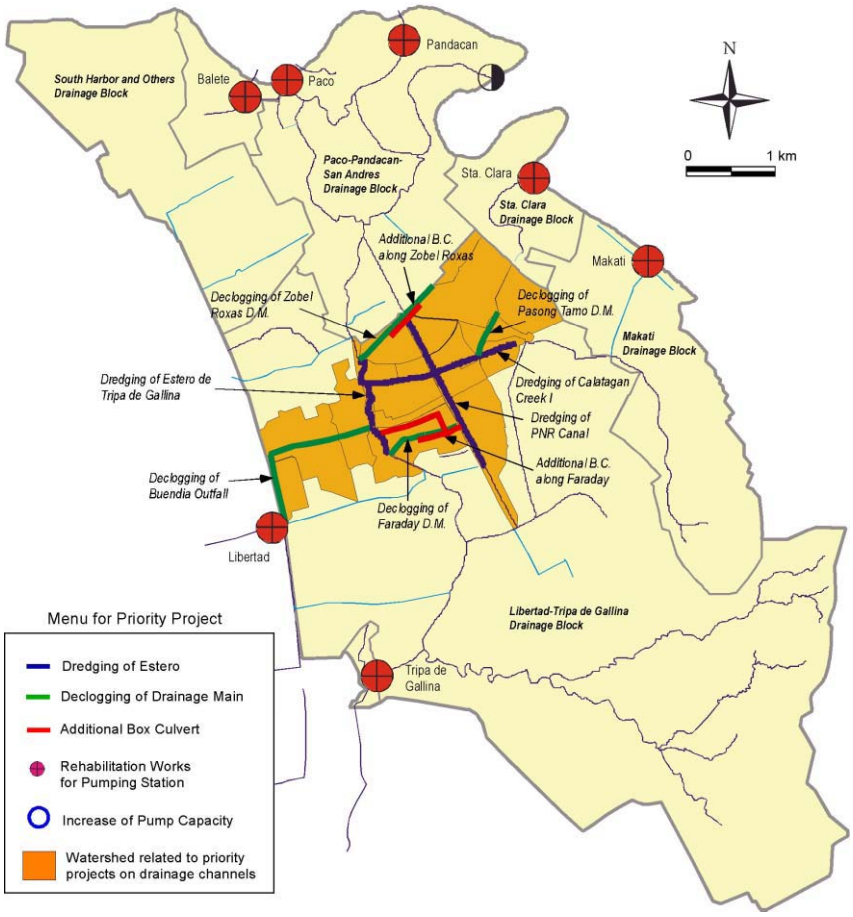


Figure F.3.13 Location Map of Priority Projects in South Manila

(2) Dredging (Clearing) of Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I

The recovering of cross-sectional areas of Estero de Tripa de Gallina (partial stretch), PNR canal and Calatagan Creek I is made so as to convey storm water collected in San Isidro, San Antonio and Pio del Pilar area towards Libertad drainage pumping station through Buendia Outfall. *Figure F.3.14* schematically shows locations of the above objective 3 channels.

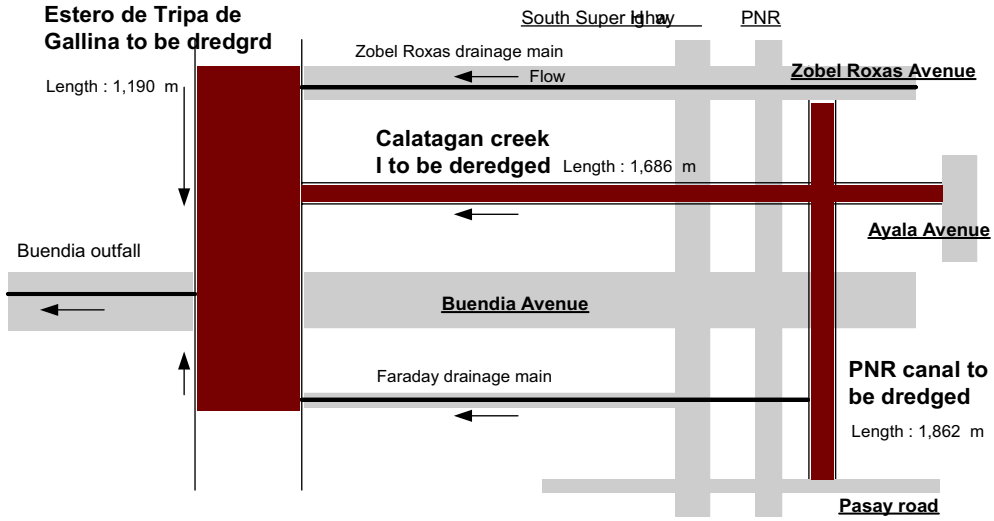


Figure F.3.14 Schematic Locations of Objective Channels to be Dredged/Cleaned

The recovering by dredging/clearing will be made as follows.

Tripa de Gallina

- Stretch: Confluence with Faraday Drainage Main to confluence with Zobel Roxas Drainage Main (total length:1,190 m)
- Channel width: within the existing channels bed width (12 m to 6 m)
- Channel bed elevation: Longitudinal profile proposed in the previous construction stage of Estero de Tripa de Gallina is modified. The dimensions of longitudinal profiles are presented in *Databook II (Drawings)*.
- At confluence with Calatagan Creek I, a corner of the left bank or Makati city side will be widened with more gentle angle in view of smooth joint with Estero de Tripa de Gallina. Accordingly resettlement or compensation is required.
- Riverbed bed at both the ends of stretch to be dredged is excavated with a slope of 1:10 to prevent washing away of riverbed materials
- Clearing volume: 28,900 m^3 in total
- Estimated discharge capacity after dredging: 50-30 m^3/s
- Relocation of informal settlers: Based on the survey during EIA study, about 700 families are required to resettle prior to the dredging works.

PNR Canal

- Stretch: Confluence with Zobel Roxas Drainage Main to the bridge across Pasay Road (total length:1,862 m)
- Channel width: within the existing channels bed width (12 m to 2 m)

- Channel bed elevation: Bed elevation is set by estimating the original bed level based on the existing observed cross-sectional shape and connections between channels. The dimensions of longitudinal profiles are as presented in *Databook II (Drawings)*.
- Clearing volume: 5,000 m^3 in total
- Estimated discharge capacity after declogging: 104 m^3/s
- Relocation of informal settlers: Based on field observation during the feasibility study, it is judged that the existing informal structures in the stretch will not be obstacle for the dredging work. At the feasibility study stage, it is assumed that there is no family who will be resettled.

Calatagan Creek I

- Stretch: Confluence with Estero de Tripa de Gallina to the upper end (total length: 1,686 m)
- Channel width: within the existing channels bed width (8 m to 3 m)
- Channel bed elevation: Bed elevation is set by estimating the original bed level based on the existing observed cross-sectional shape and connections between channels. The dimensions of longitudinal profiles are as presented in *Databook II (Drawings)*.
- Clearing volume: 13,200 m^3 in total
- Estimated discharge capacity after dredging: 20-5 m^3/s
- Relocation of informal settlers: Based on field observation during the feasibility study, it is judged that the existing informal structures in the stretch will not be obstacle for the dredging work. At the feasibility study stage, it is assumed that there is no family who will be resettled.

For the above 3 drainage channels, the drawings are shown in *Databook II (Drawings)*.

(3) Declogging of Buendia Outfall and Related Works

Storm water collected in Estero de Tripa de Gallina in the stretch selected in the priority projects is discharged through 2 box culverts of Buendia Outfall into Ibertad drainage pumping station as shown in *Figure F.3.15*. The total length of the existing culvert will be around 1,960 m.

In the existing Buendia Outfall, there are sufficient numbers of maintenance holes for periodical maintenance activities installed with a 50 m interval, however, such maintenance holes are mostly not functioning due to covering by asphalt pavement and botanical gardens developed upward of the box culvert of Buendia Outfall. Also the existing box culverts are always submerged due to back water from outlet resulting in difficulty of periodical maintenance activities.

The required works for Buendia Outfall consist of 1) related works of modification of covered maintenance holes and installation of stop log gates for maintenance activities and 2) declogging of the accumulated bottom deposits in the box culvert. For the above, the following related and declogging works will be proposed.

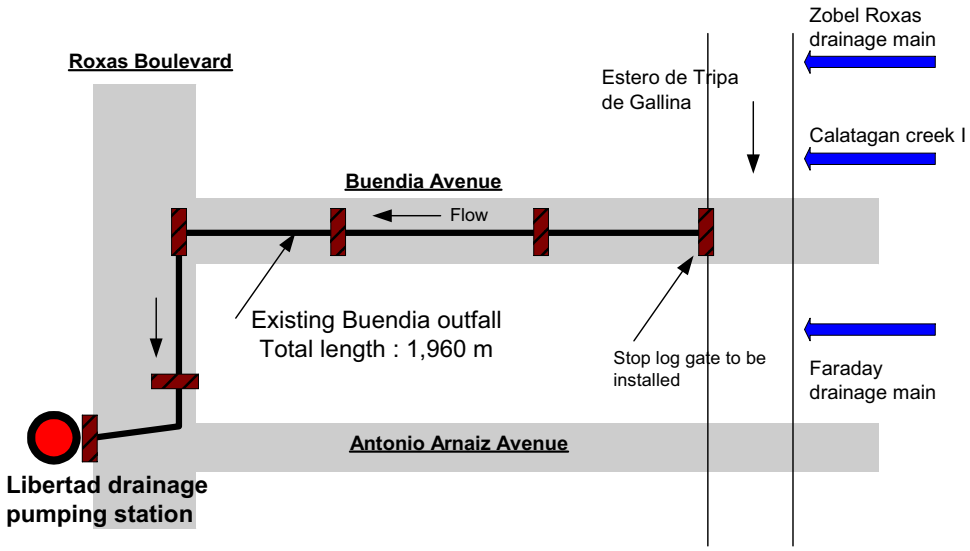


Figure F.3.15 Schematic Route of Buendia Outfall

1) Related Works

The related works are modification of maintenance holes and installation of stop log gate for easy maintenance activities. Those are outlined below.

Modification of maintenance holes closed by road pavement/embankment

- 22 maintenance holes out of the total 47 holes are presently not functioning due to covering by road pavement/embankment.
- These closed maintenance holes are to be modified for easy maintenance activities in line with an image as shown in *Figure F.3.6*.

Installation of stop log gate

- The existing box culvert is always submerged due to back water from outlet as shown in *Figure F.3.16*, resulting in difficulty of periodical maintenance activities.

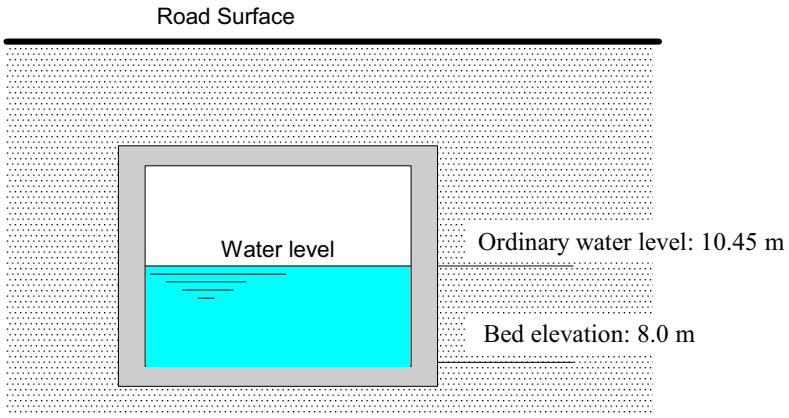


Figure F.3.16 Present Condition of Outlet of Buendia Outfall

- For this problem, stop log gates are to be installed at 6 sections for the existing 2 culverts with an image indicated in *Figure F.3.7*. Those sections are outlet of culvert at Roxas Boulevard, bending section at Buendia street and inlet of culvert at confluence with Estero de Tripa de Gallina as shown in *Figure F.3.15*.

2) Declogging Works

The declogging of the existing drainage main is made as follows.

- Stretch: Outlet to upper end of the conflu ence with Estero de Tripa de Gallina (total length:1,960 m)
- The dimensions of longitudinal profiles of the interceptor are as shown in *Databook II (Drawings).*
- Declogging volume: 7,200 m^3 in total
- Estimated discharge capacity after declogging: 55 m^3/s

Related structural figures of the above remedial works and declogging are presented in *Annex F.2* and in *Databook II (Drawings)*.

(4) Declogging of Zobel Roxas Drainage Main and Construction of Additional Box Culvert

Zobel Roxas Drainage Main is discharging st orm water collected along Zobel Roxas Avenue and PNR canal into Estero de Tripa de Gallina. The drainage main exists under the present Roxas Avenue, which crosses South Super Highway and PNR. The existing box culvert has been clogged by accumulated bottom deposits. An upper part of the existing culvert does not have sufficient flow area against design discharge to be allocated. For Zobel Roxas Drainage Main, major proposed works will be 1) declogging of existing box culvert with related works for modification of covered maintenance holes due to road pavement and 2) construction of additional culvert as shown in *Figure F.3.17*.

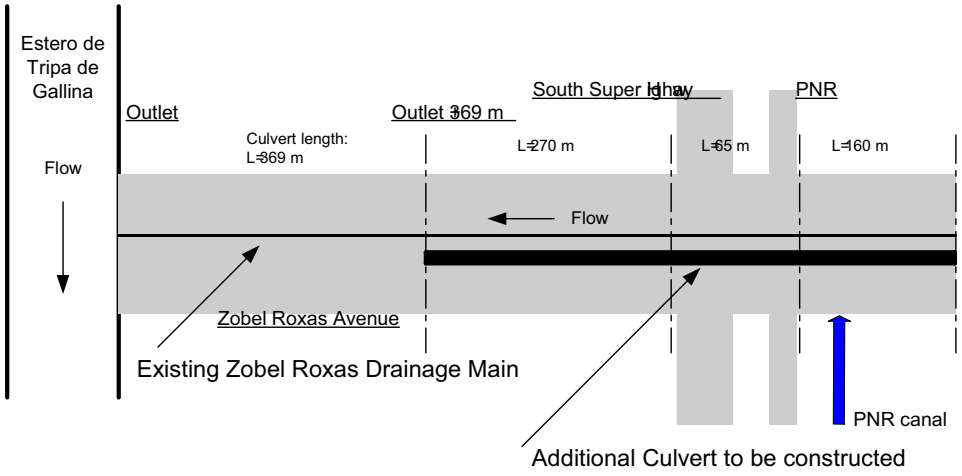


Figure F.3.17 Existing and Proposed Routes of Zobel Roxas Drainage Main

1) Declogging Works of Existing Zobel Roxas Drainage Main

The declogging and related works of the existing drainage main for a total length of 864 m is made as follows.

Declogging

- Stretch: Outlet of Zobel Roxas Drainage Main to 160 m point ahead of PNR canal (total length:864 m)
- Declogging volume: 2,200 m^3 in total
- Estimated discharge capacity after declogging: 14 m^3/s

Modification of maintenance holes covered by road pavement/embankment

- 3 maintenance holes out of the total 17 holes are presently not functioning due to covering by road pavement.
- These closed maintenance holes are to modify for easy maintenance activities in line with an image as shown in *Figure F.3.6*.

For the above Zobel Roxas Drainage Main, plan , profile and cross-sections for declogging works are outlined in *Databook II (Drawings)*.

2) Construction of Additional Zobel Roxas Drainage Main

In accordance with the above section of Rehabilitation and Design Criteria for Drainage Facilities, additional box culvert was designed and summarized as follows. The details are presented in *Annex F.3* and *F.5* and in *Databook II (Drawings)*.

Proposed route of additional culvert

- The additional culvert is to be aligned in parallel with the existing one as shown in *Figure F.3.17*. The total additional culvert length is 495 m.

Design discharge for additional culvert

- The estimated design discharges for additional culvert with a 3-year return period of design scale is shown in *Figure F.3.18*

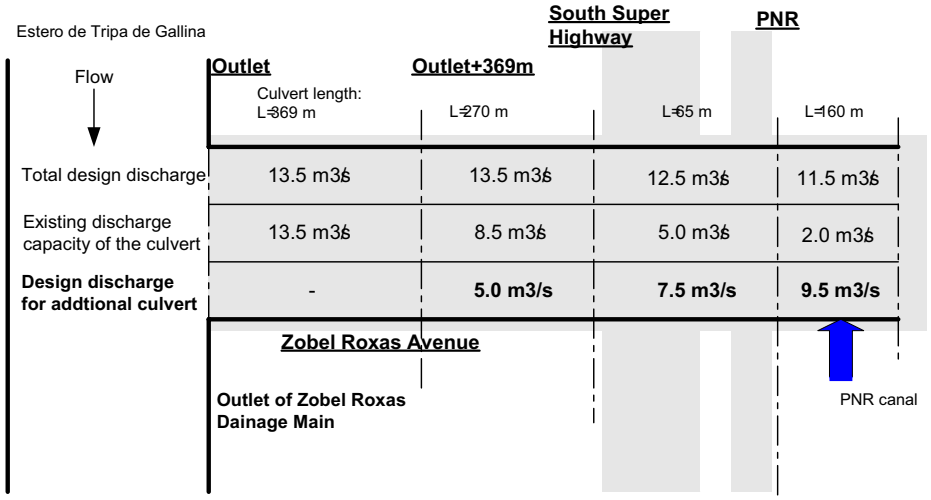


Figure F.3.18 Design Discharge of Zobel Roxas Drainage Main

Dimensions of additional culvert

- The proposed additional box culvert consists of concrete box culvert with a total length of 495 m.
- The additional box culvert is divided into 3 sections or 3 types as indicated in *Table F.3.7* .

Table F.3.7 Dimensions of Additional Box Culvert

Stretch	Length	Culvert Dimension
Outlet-369 m - South super highway	270 m	Width 1.7 m × height 1.6 m × 2 lanes
South super highway - PNR	65 m	W 1.8 m × h 1.5 m × 2 lanes
PNR - upperend	160 m	W 2.3 m × h 1.5 m × 2 lanes

Maintenance hole

- In order to operate and maintain the box culvert smoothly and effectively, maintenance holes are installed at an interval of 50 m. The number of maintenance holes will be 10 places.

For the above additional culvert of Zobel Roxas Drainage Main, plan, profile and cross-sections are outlined in *Annex F.3* and *F.5* and in *Databook II (Drawings)*.

(5) Declogging of Pasong Tamo Drainage Main

Pasong Tamo Drainage Main with a total length of 550 m is joined by Calatagan Creek I, as shown in *Figure F.3.19*.

There exist maintenance holes installed with a 50 m pitching for the whole stretch. Declogging of the Pasong Tamo box culvert will be made through these maintenance holes with following conditions.

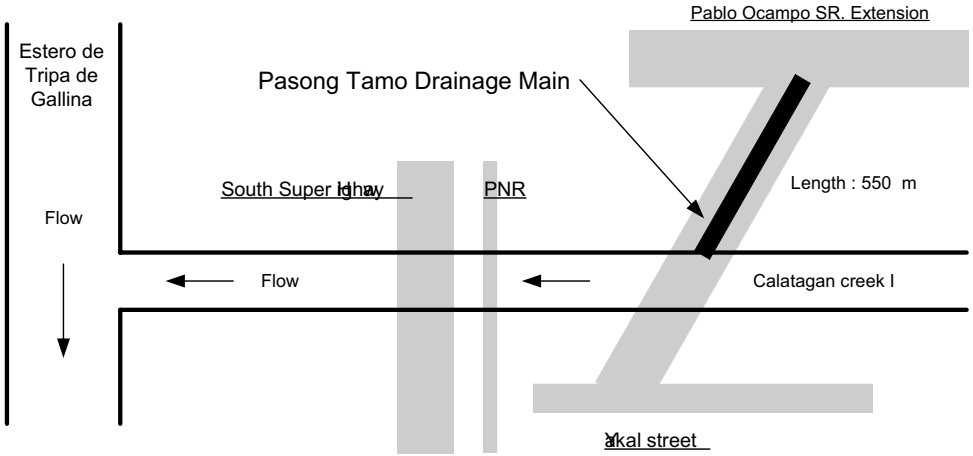


Figure F.3.19 Schematic Location Map of Pasong Tamo Drainage Main

- Stretch: Confluence with Calatagan cr eek I to intersection of Pablo Ocampo SR. Extension with a total length of 550 m
- The dimensions of longitudinal profiles of the drainage main are as presented in *Databook II (Drawings)*.
- Declogging volume: 900 m ^{3} in total
- Estimated discharge capacity after declogging: 12 m ^{3}/s

For the above Pasong Tamo Drainage Main, plan, profile and cross-sections for declogging works are outlined in *Databook II (Drawings)*.

(6) Declogging of Faraday Drainage Main and Construction of Additional Box Culvert

The Faraday Drainage Main is running under the Faraday street connecting with PNR canal and Estero de Tripa de Gallina as shown in *Figure F.3.20*. The carrying capacity of existing drainage main is of shortage compared with its design discharge assigned. Major works in the Faraday Drainage Main will be 1) declogging of the existing box culvert and 2) construction of additional box culvert as indicated in *Figure F.3.20* .

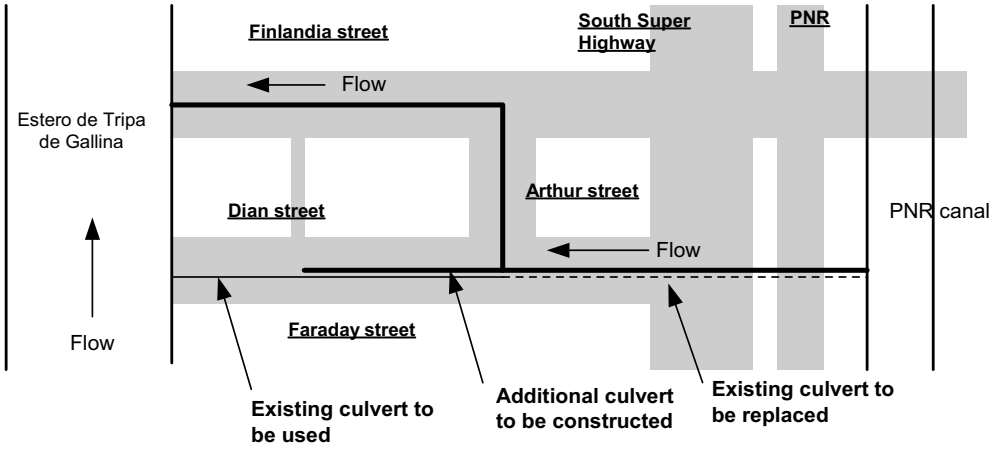


Figure F.3.20 Existing and Additional Proposed Route of Faraday Drainage Main

1) Declogging Works

The declogging of the existing drainage main is made as follows.

- Stretch: Confluence with Estero de Trip a de Gallina to proposed diversion point with a total length of 713 m
- The dimensions of longitudinal profiles of the drainage main are as presented in *Databook II (Drawings)*.
- Declogging volume: 100 m ^{3} in total
- Estimated discharge capacity after dredging: 53.5 m ^{3}/s

For the above Faraday Drainage Main, plan, profile and cross-sections for clearing works are outlined in *Databook II (Drawings)*.

2) Construction of Additional Faraday Drainage Main

In accordance with the above section of Rehabilitation and Design Criteria for Drainage

Facilities, additional box culvert was designed and summarized as follows. The details are presented in *Annex F.4 and F.5* and in *Databook II (Drawings)*.

Proposed route of additional culvert

- An additional box culvert is basically to be constructed along the existing culvert. However, in the lower reach, there is no space for construction of additional one. Accordingly, the additional culvert is also to be constructed under the Finlandia and Arthur streets as shown in *Figure F.3.20*.

Design discharge for additional culvert

- The estimated design discharge for additional culvert with a 3-year return period of design scale is shown in *Figure F.3.21*.

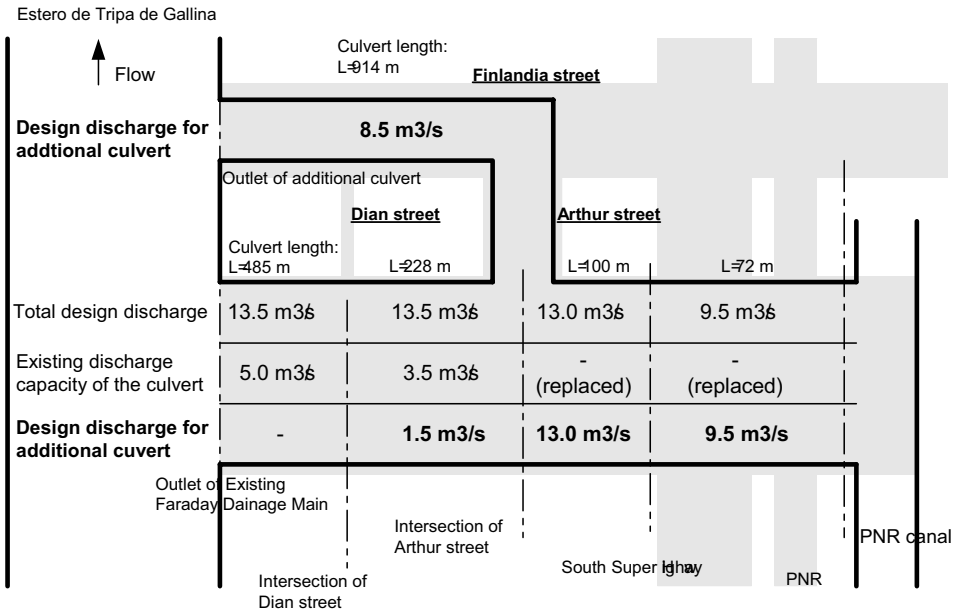


Figure F.3.21 Design Discharge of Faraday Drainage Main

Dimensions of additional culvert

- The proposed additional box culvert consists of concrete box culvert with a total length of 1,314 m.
- The additional box culvert is divided into 4 types as indicated in *Table F.3.8* .

Table F.3.8 Dimensions of Additional Box Culvert

Stretch	Length	Culvert Dimension
Existing Faraday DM route		
Intersection of Dian st. - Intersection of Arthur st. (diversion point)	228 m	Width 1.8 m×h 1.4 m×1 lane
Intersection of Arhtur st. (diversion point) - South super highway	100 m	W 2.2 m×h 1.7 m×2 lanes
South super highway - PNR canal	72 m	W 1.8 m×h 1.4 m×2 lanes
Finlandia and Arthur streets route		
Outlet in Finlandia st. - diversion point	914 m	W 3.5 m×h 1.7 m×1 lane

Maintenance hole

- In order to operate and maintain the box culvert smoothly and effectively, maintenance holes are installed at an interval of 50 m. The number of maintenance holes will be 26 places.

Affected House Buildings

- There are some house buildings that will be affected by the construction of the additional box culvert. It is possible that the house buildings around the inlet of Faraday Drainage Main on PNR canal will be required to tentatively relocate during the construction.

For the above Faraday additional culvert, plan, profile and cross-sections are presented in *Annex F.4* and *F.5* and in *Databook II (Drawings)*.

(7) Summary of Quantity for Rehabilitation and Additional Works for Drainage Facilities in South Manila

The proposed works in north Manila are outlined below and detailed work quantities are described in *Supporting Report G.*

Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I

- Dredging (Clearing) of Tripa de Gallina: 28,900 m^3 (for a total length of 1,190 m)
- Dredging (Clearing) of PNR canal: 5,000 m^3 (for a total length of 1,862 m)
- Dredging (Clearing) of Calatagan creek I: 13,200 m^3 (for a total length of 1,686 m)
- Resettlement prior to the dredging works: About 700 families

Buendia Outfall

- Raising/modification of cover of maintenance hole: 22 holes
- Installation of stop log gate: 6 sections
- Declogging: 7,200 m^3 (for a total length of 1,960 m)

Øbel Roxas Drainage Main

- Raising/modification of maintenance hole: 3 holes
- Declogging: 2,200 m^3 (for a total length of 864 m)
- Construction of additional box culvert: 495 m
- Installation of maintenance hole:10 places

Pasong Tamo Drainage Main

- Declogging: 900 m^3 (for a total length of 550 m)

Faraday Drainage Main

- Declogging: 100 m^3 (for a total length of 713 m)
- Construction of additional box culvert: 1,314 m
- Installation of maintenance hole: 26 places
- Affected buildings by the construction of additional box culvert: Some house buildings

F.3.6 FURTHER ISSUES FOR NEXT STAGE OF DETAILED DESIGN

Subsequent works for the priority projects will be a detailed design for rehabilitation and additional works of drainage facilities and pumping stations. In order to conduct the detailed design especially for rehabilitation and additional works of drainage channels, a cross-sectional survey of drainage channels is firstly required. It is necessary to clarify the detail of original cross-sectional area of drainage channels. An interval of cross-sections to be surveyed will be minimum 20 m including partial narrow points and sections.

Subsequently, based on the results of surveyed cross-sections and detailed site reconnaissance, the following considerations will be widely made in the coming detailed design stage.

- Clarification of original boundary line of drainage channels
- Clarification of original boundary of easement as maintenance road, if planned
- Clarification of locations of local narrow points/ sections

In line with the above clarification results, required works will be studied to secure original cross-sectional area of drainage channels with considering stability of concerned riverbank structures.

F.4 REHABILITATION OF DRAINAGE PUMPING STATIONS

F.4.1 GENERAL

The rehabilitation works consist of 2 categories of repair and replacement of pump equipment and appurtenants facilities for the 12 pumping stations. Prior to execution of the rehabilitation works, it is proposed to conduct a careful and thorough technical investigation and analysis including overhauling at 12 pumping stations. Based on the above investigation and analysis results, a detailed rehabilitation program is to be prepared. In this stage, detailed rehabilitation work items are clarified for the 12 drainage pumping stations based on the diagnosis results conducted in the master plan stage of this study and previous reports on Metro Manila Drainage System Rehabilitation Project (Phase II), Japan Consulting Institute, Sept. 1999 and Follow-Up Service Report on Metro Manila Drainage System Rehabilitation Project (Phase II), Japan Plant Association, Feb. 2002.

F.4.2 REHABILITATION CRITERIA FOR DRAINAGE PUMPING STATIONS

(1) Rehabilitation Target of Discharge Capacities

The capacities of the 12 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 aging. It should be noted that the capacity should be increased at Aviles station. The existing and proposed drainage capacities of the 12 stations with the respective target scales of 10-year return period applied in the original design are shown in *Table F.4.1*.

Table F.4.1 Drainage Capacity of Pumping Stations

Pumping station	Construction Year and (Operation Hours as of June 2004)	Existing discharge capacity (m^3/s)	Proposed discharge capacity(m^3/s)	Remarks
Aviles	1976 (14,650)	15.6	18.6	+3 m^3/s
Quiapo	1976 (15,830)	10.8	10.8	No change
Valencia	1976 (10,790)	11.8	11.8	No change
Pandacan	1976 (10,890)	4.4	4.4	No change
Paco	1977 (16,630)	7.6	7.6	No change
Sta. Clara	1977 (7,420)	5.3	5.3	No change
Tripa de Gallina*1	1977 (8,010)	57.0	57.0	No change
Libertad*1	1977 (12,880)	42.0	42.0	No change
Makati	1984 (4,030)	7.0	7.0	No change
Binondo	1985 (8,220)	11.6	11.6	No change
Balete	1988 (140)	3.0	3.0	No change
Escolta	1982 (360)	1.5	1.5	No change

Note:*1 indicates installed pump is horizontal one and others, vertical one.

(2) Basic Lines for Rehabilitation of Drainage Pumping Stations

In rehabilitation works of the drainage pumping stations, the basic lines to be considered are as follows:

- In the implementation stage, a further careful and thorough technical investigation and analysis through overhauling at the12 drainage pumping stations is to be conducted for formulation of a detailed rehabilitation program. The rehabilitation works are to be made based on the above detailed rehabilitation program consisting of 2 categories of repair and replacement works.
- In principle, no action is considered to the pump houses and other civil works.
- Detailed work items by the above categories for the 12 stations are to be clarified.
- Based on the diagnosis results conducted in the master plan stage, the categorization of detailed work items for repair and replacement of pump equipment and appurtenant facilities is to be made.
- Mean spring high tide level (El. 11.34 m) is applied for design high tide level on Manila Bay.
- On-going Pasig-Marikina River Improvement Project is assumed to be completed. The design high water level along the Pasig River determined by the on-going Pasig-Marikina River Improvement Project is applied.
- Change of present (original) start/stop levels of pump operation as shown in *F.4.2* including other minor adjustment of total working head will be made in the next stage of detailed investigation. The minor adjustments of drainage capacity due to changing of the total working head or increase of drainage capacity (3 m^3/s) at Aviles station can be made by means of changing the angle of impeller without installation of additional pump equipment.

Table F.4.2 Present Pump Start/Stop Levels for Drainage Pumping Station

Pumping station	Pump Start level (Elm)	Pump Stop Level (Elm)	Remarks
Aviles	10.5	10.3	3 m^3/s
Quiapo	10.5	10.2	
Valencia	10.5	10.3	
Pandacan	10.5	10.2	
Paco	10.5	10.2	
Sta. Clara	11.2	11.0	
Tripa de Gallina	9.9	9.6	
Ibertad	9.9	9.6	
Makati	11.3	10.9	
Binondo	10.0	9.8	
Balete	10.6	10.5	Pump gate
Escolta	10.0	9.8	Pump gate

- Manual of Rehabilitation of Pump Equipment and Appurtenant Facilities, Ministry of Land, Infrastructure and Transport (MLIT), Japan will be referred to in the rehabilitation works.
- As reference, average working life of pump equipment and electrical parts is summarized from both the aspects of physical and functional in *Table 5.3.3*, quoting from the above manual by MLIT, Japan.

Table F.4.3 Working Life of Pump Equipment and Appurtenant Facilities

System/Part	Equipment/Facilities	Physical Working Life (year) *1	Functional Working Life (year)*2
Main pump equipment	Main pump	40	30
	Main discharge pipe	40	40
	Valve	40	25
Engine	Prime mover for diesel	40	27
	Reduction gear	40	30
Fuel system	Fuel transfer pump	20	20
	Storage tank	30	30
Cooling system	Cooling water pump (vertical/horizontal)	20	18
	Cooling water pump (submergible)	10	10
Air supply system	Air compressor	20	17
Electrical system	Panel	20	18
	Generator	40	18
Trash rake	Trash rake/conveyor/ screen	20	20
Crane	Overhead crane	40	40
Flood gate	Sluice gate	40	40

Note;*1:Working life based on life cycle cost(physical life), *2;Working life to be replaced by working reliability (functional life)

F.4.3 REHABILITATION OF DRAINAGE PUMPING STATIONS

As summarized in *Table F.4.3*, 8 stations out of 12 objective st ations were constructed in 1970s and other 4 stations, in 1980s, respectively. Approximate 30 to 20 years have been passed since their installations. These pumping stations have been operating not only for draining of storm water but also for removal of flowing solid waste in daily basis so far and as the results, annual operation hours exceed 500 hours at some stations. Consequently mechanical and electrical superannuation at 12 stations are being considerably progressed. According to the average working life indicated in *Table F.4.3*, it can be said that some pump equipment and electrical apparatus have already exceeded their functional working lives. Above all, the pump equipment and apparatus at the 4 stations of Aviles, Quiapo, Valencia and Tripa de Gallina are in serious conditions and require urgent rehabilitation. Meantime, existing installed pump type at the 2 stations of Escolta and Balete is a submergible pump, and was proposed in the master plan to convert the existing type to gate pump type by using the existing drainage gate.

The proposed rehabilitation works intend to partially improve the system by repairing/renewing it with application of new technology, and to finally recover the capacity of pump facilities to its original condition in line with the results of technical investigation and analysis of pumping

stations scheduled ahead of the actual rehabilitation works. In this section, rehabilitation works are discussed, by dividing the 12 pumping stations into 3 groups of:1) 4 stations of very old and serious conditions, 2) 6 stations of old and marginal service life, and 3) 2 stations with submergible pumps of outdoor type. The detailed work items taken up in the rehabilitation are summarized in *Table F.4.4* and major work items are discussed below.

(1) Technical Investigation and Analysis of Pumping Station

As already explained, a further careful and thorough technical investigation and analysis through overhauling at the 12 drainage pumping stations are to be conducted for formulation of a detailed rehabilitation program in the next implementation stage. Accordingly, the detailed rehabilitation work items is to be finalized based on the results of the above technical investigation and analysis.

The rehabilitation works of drainage pumping stations consist of 1) repair and replacement works of pump equipment and appurtenant facilities, and 2) supply of spare parts and consumables.

(2) 4 Stations of Aviles, Quiapo, Valencia and Tripa de Gallina

The contents of rehabilitation works for the aged four stations required for urgent rehabilitation are summarized as follows.

Main pump and discharge valve

- For vertical pumps of Quiapo, Aviles and Valencia, vertical pumps including main pipe are to be repaired based on the results by the prior investigation and analysis.
- For horizontal pumps of Tripa de Gallina, horizontal pumps are to be repaired based on the results by the prior investigation and analysis.
- Discharge valve, shaft, shaft seal, prime detector, submerged bearing and radial/thrust bearing are to be replaced with new ones.

Gear box and engine

- Gear box and diesel engine for the main pump and auxiliary equipment are to be replaced.
- All the existing engines including air starting system, cooling water system, lubrication system, etc., are to be replaced.

Electrical system and generator

- All the existing electrical systems including main electrical panels, local panels, cable/wires trays, etc., are to be replaced.
- Generator equipment including panels is to be repaired.

Automatic trash removal equipment

- Automatic trash rake and screen and horizontal/inclined conveyor are to be repaired. Replacement of some minor parts is to be included.

Water level gauging

- The existing water level gauging facilities are to be replaced by new one of ultrasonic type.

Table F.4.4 summarizes rehabilitation work items by each part of the 4 stations.

Table F.4.4 Tentative Detailed Work Items to be Taken Up in Rehabilitation

No.	Pump Equipment/Appurtenant Facilities	Aviles	Quapo	Valencia	Pandacan	Paco	Sta. Clara	Tripa de Gallina	Libertad	Makati	Binondo	Balete	Escolta
1	Main Pump	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	●	●
2	Reduction Gear	●	●	●	●	●	●	●	●	●	●	NA	NA
3	Butterfly Valve (inclu. replace of actuator)	□/●	□/●	□/●	□/●	□/●	□/●	□/●	□/●	□/●	□/●	NA	NA
4	Flap Valve	○	○	○	○	○	○	○	○	○	○	●	●
5	Diesel Engine for Main Pump	●	●	●	●	●	●	●	●	●	●	NA	NA
6	Generator Panel	●	●	●	●	●	●	●	●	●	●	○	○
7	Diesel Engine for Generator	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○
8	Vacuum Pump (for priming)	NA	NA	NA	NA	NA	NA	●	●	NA	NA	NA	NA
10	Clear Water Pump	●	●	●	●	●	●	●	●	●	●	NA	NA
11	Cooling & Sealing Water Pump	NA	NA	NA	NA	NA	NA	●	●	NA	NA	NA	NA
12	Cooling Water Pump for Gen.	●	●	●	●	●	●	●	●	●	●	NA	NA
13	Fuel Transfer Pump	●	●	●	●	●	●	●	●	●	●	NA	NA
14	Cooling Tower	●	●	●	●	●	●	●	●	●	●	NA	NA
15	Air Compressor	●	●	●	●	●	●	●	●	●	●	NA	NA
16	Air Reservoir Tank	□	□	□	□	□	□	□	□	□	□	NA	NA
17	Ventilating Fan	●	●	●	●	●	●	●	●	●	●	NA	NA
18	Fuel Storage Tank	□	□	□	□	□	□	□	□	□	□	NA	NA
19	Fuel Service Tank	□	□	□	□	□	□	□	□	□	□	NA	NA
20	Cooling Water Tank	□	□	□	□	□	□	□	□	□	□	NA	NA
21	W. L. Gauge at Inlet (ultrasonic type)	●	●	●	●	●	●	●	●	●	●	●	●
22	W. L. Gauge at Outlet (ultrasonic type)	●	●	●	●	●	●	●	●	●	●	●	●
23	Automatic Trash Rake and Screens	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	NA	NA
24	Horizontal Conveyor	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	NA	NA
25	Inclined Conveyor	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	NA	NA
26	Hopper	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	▲/○	NA	NA
27	Conveyor Pit Drain Pump	●	●	●	●	●	●	●	●	●	●	NA	NA
28	Pump Room Drain Pump	●	●	●	●	●	●	●	●	●	●	NA	NA
29	Overhead Crane	□/○	□/○	□/○	□/○	□/○	□/○	□/○	□/○	□/○	□/○	NA	NA
30	Flood Gate/Control Panel	-/●	-/●	-/●	-/●	-/●	-/●	-/●	-/●	-/●	-/●	▲	▲
31	Electric Panel	●	●	●	●	●	●	●	●	●	●	●	●

Note; Definition of marks is as follows.

□: Inspection
▲: Overhaul
○: Repair
●: Replacement
-: No action
NA: Not applicable

(3) 6 Stations of Pandacan, Paco, Sta. Clara, Libertad, Makati and Binondo

The contents of rehabilitation works for the above 6 stations will be mostly the same as that of the above four stations.

Main pump and discharge valve

- For vertical pumps of Pandacan, Paco, Sta. Clara, Makati and Binondo, vertical pumps are to be repaired based on the results by the prior investigation and analysis.
- For horizontal pumps of Libertad, it is to be repaired based on the results of the prior investigation and analysis.
- Discharge valve, shaft, shaft seal, prime detector, submerged bearing and radial/thrust bearing are to be replaced with new ones.

Gear box and engine

- Gear box and diesel engine for the main pump and auxiliary equipment are to be replaced.
- All the existing engines including air starting system, cooling water system, lubrication system, etc., will be replaced.

Electrical system and generator

- All the existing electrical systems including main electrical panels, local panels, cable/wires trays, etc., are to be replaced.
- Generator equipment including panels is to be repaired.

Automatic trash removal equipment

- Automatic trash rake and screen and horizonta l/inclined conveyor are to be repaired. Replacement of some minor parts is to be included.

Water level gauging

- The existing water level gauging is to be replaced by new one of ultrasonic type.

The rehabilitation work items by each part are summarized in *Table F.4.4*.

(4) 2 Stations of Escolta and Balete

The contents of rehabilitation works for the above 2 stations are outlined as follows.

Main pump

- The existing submergible pumps at the 2 stations are to be converted into a gate pump type.
- The gate pumps are to be installed in the existing floodgates with due investigation of their mechanical durability.

Electrical system and generator

- All the existing electrical systems including main electrical panels, local panels, cable/wires trays, etc., are to be replaced.
- Generator equipment including panels is to be repaired.

Automatic trash removal equipment

- A small type automatic trash rake and screen and horizontal/inclined conveyor are to be additionally installed, if necessary, based on the technical investigation and analysis in due time.

Water level gauging

- The existing water level gauging facilities are to be replaced by a new one of ultrasonic type.

The rehabilitation work items by each part are summarized in *Table F.4.4*.

(5) Other Countermeasures for Environmental Preservation and O/M Activities of Drainage Pumping Stations

At present, solid waste flowing in the drainage channels are mostly collecting at automatic trash rakes installed at pumping stations and accumulated in the stock yard for several days, then transported into disposal sites. Meantime, engine exhausts fume and noise are generating during pump operation. To improve such negative environmental impacts and to operate pump and auxiliary equipment properly, the following countermeasures are proposed through the rehabilitation works.

- A detailed management of accumulated bottom deposits will be considered in combination with the proposed solid waste management, and improvement of O/M organization and activities for the drainage channels and pumping stations.
- Amount of engine exhaust fume and noise to be generated by pump operation will be mitigated within the allowable levels in Metropolitan Manila by using modern technology.
- In line with the above improvement of operation and maintenance organization and activities for drainage system, an effective and appropriate management system will be taken into the daily operation and maintenance for the 15 drainage pumping stations.

(6) Summary of Quantity for Rehabilitation Works of Drainage Pumping Stations

Work categories and quantities of drainage pumping stations for rehabilitation works are summarized as follows.

- Technical investigation and analysis including overhaul:12 stations
- Supply of spare part and consumable:12 stations
- Rehabilitation works of pump equipment and appurtenant facilities:12 stations

F.5 NON-STRUCTURAL AND SUPPORTING MEASURES

Objectives of the non-structural and supporting measures are to support and sustain the original functions of structural measures assigned in the rehabilitated drainage facilities by means of reducing damageable objects or lowering vulnerability against repeating disasters. In this study, the following measures are taken up.

Non-Structural Measures
- Recommendation of countermeasures for rapid urbanization
- Recommendation of application of existing floodplain management systems

Supporting Measures
- Establishment of community-involved operation and maintenance
- Installation of additional hydrological equipment
- Introduction of emergency operation and maintenance equipment
- Preparation of guideline for resettlement

Out of the above, 1) Recommendation of countermeasures for rapid urbanization, 2) Recommendation of application of existing floodplain management system and 3) Installation of additional hydrological equipment in connection with improvement of O/M activities are described.

(1) Recommendation of Countermeasures for Rapid Urbanization

Urbanization has been highly progressing in the core area of Metropolitan Manila and thereby open and green spaces, ponds, forest, etc., are decreasing year by year. Consequently, both the capacities of storm water retention and infiltration into underground are lowered. Eventually, run-off volumes towards drainage channels are significantly increased especially in the case of unexpected urbanization.

The extent of increase of runoff coefficient by land use conditions in the past 35 years was studied in the master plan stage. It reveals that 15 to 20% by drainage basins increased in the period from 1970s to 2004 in North Manila and 10 to 23% in South Manila, respectively as summarized in *Table F.5.1*.

For such situation, only improvement of drainage facilities can not be coped with remarkable increase of runoff coefficient resulting in frequent inundations. An implementation of special countermeasures is required to compulsively reduce runoff volumes and to sustain capability/function of the present drainage system. As one of options, construction of storm water retention facilities is recommended in combination with urban development plans under the related LGUs. The following samples are applicable ones in the core area of Metropolitan Manila, which is from The Guideline of Urban Drainage Improvement, MLIT, Japan.

Table F.5.1 Increase of Run-off Ratio by Basins of Drainage Pumping Stations

Drainage Area	Pump Drainage Basin	1970s Runoff Coefficient		1980s-1990s Runoff Coefficient		This Study Runoff Coefficient	% Increase from Original Runoff Coefficient
North	Vitas		→	0.75	→	0.74	
	Binondo-Escolta	0.64	→	0.64	→	0.77	20
	Quiapo	0.63	→	0.63	→	0.73	16
	Aviles	0.60	→	0.60	→	0.70	17
	Valencia	0.59	→	0.59	→	0.68	15
	Balut		→	0.65	→	0.79	
South	Tripa de Gallina	0.56	→	0.60	→	0.62	11
	Ibertad	0.64	→	0.64	→	0.75	17
	Balete	0.52	→		→	0.64	23
	Paco	0.64	→	0.64	→	0.71	10
	Pandacan	0.68	→	0.68	→	0.63	
	San Andres		→	0.72	→	0.72	0
	Sta. Clara	0.56	→	0.56	→	0.63	13
	Makati	0.62	→	0.62	→	0.68	10

Ordinary Time

Rain Time

Figure F.5.1 Sample of Storm Water Retention Facility (Park)

Ordinary Time

Rain Time

Figure F.5.2 Sample of Storm Water Retention Facility (Ground in School/University)

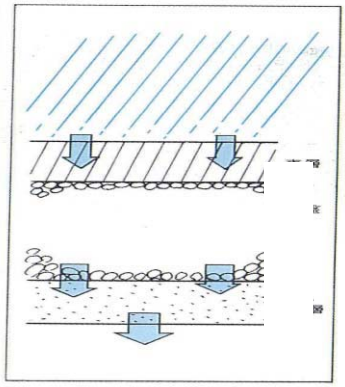


Figure F.5.3 Sample of Storm Water Retention by Permeable Pavement (Parking Area)

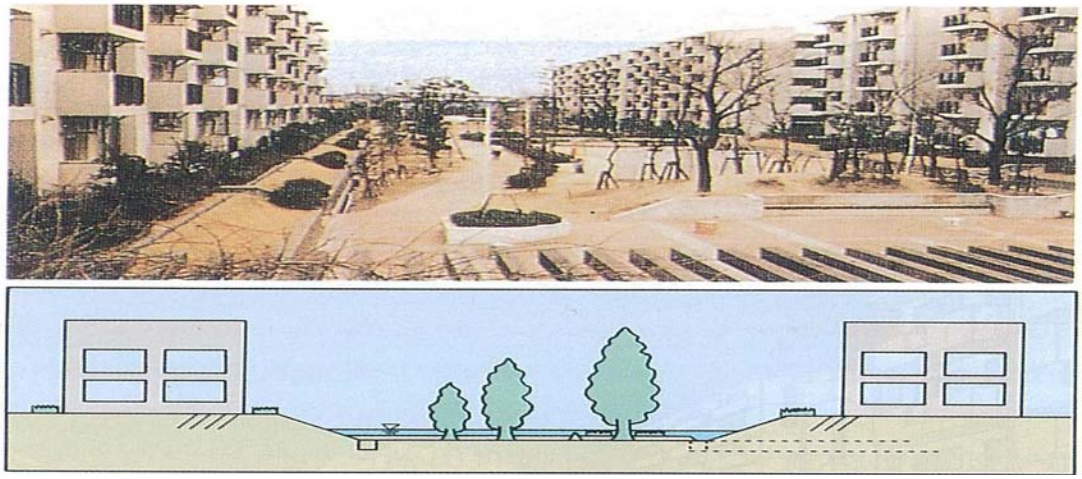


Figure F.5.4 Sample of Storm Water Retention Facility (Apartment Building)

Overview of the Facility

Ordinary Time

Rain Time

Figure F.5.5 Sample of Storm Water Retention Facility (Tennis Court)

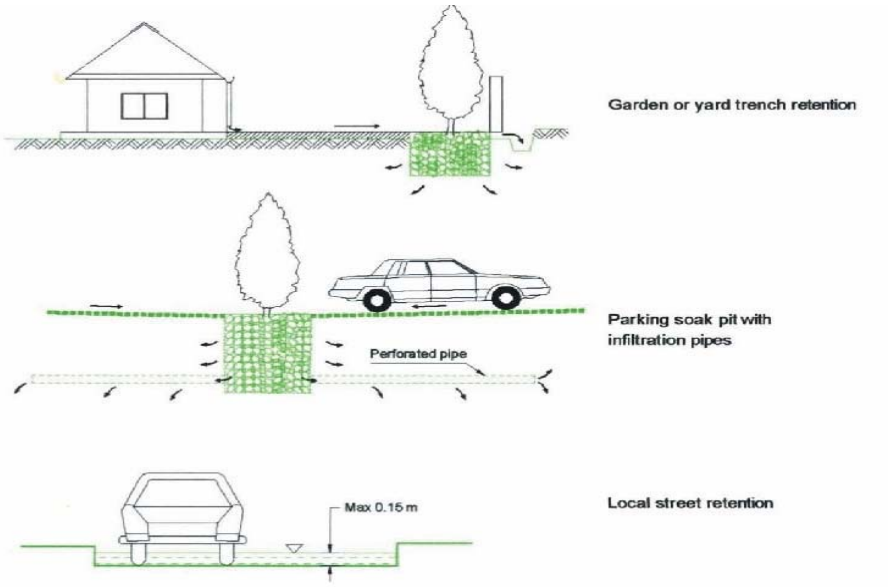


Figure F.5.6 Sample of Various Storm Water Retention Facilities

(2) Application of Existing Various Disaster Preparedness Systems

In the Metropolitan Manila, existing systems of EFCOS, Inter-Agencies Floodplain Management, Disaster Management System, etc., are available for emergency countermeasures for disasters preparedness. Especially in the disaster management system, it is being developing by a disaster coordination committee consisting of national and regional levels including barangay level and a special fund allotment is available for emergency times.

The core area of Metropolitan Manila is a center of the capital of the Philippines. In a case of severe inundation, a tremendous loss of casualty, properties, and stagnation of social and economic activities resulting from traffic interruption will be brought about into the core area. To prevent such emergency cases, it is recommended to put in practice positively the above various existing systems in the core area of Metropolitan Manila.

(3) Installation of additional hydrological equipment

1) Observatory Network

Within the core area of Metropolitan Manila, available data on rainfall and water level is quite limited to conducting hydrological analysis. Only one station of Port Area is available for rainfall data, while water level data recorded are available at respective 15 drainage pumping stations. However, there exists no water level data in the major esteros. It is considerably important to observe and accumulate such rainfall and water level data for hydrological and hydraulic analysis such as rainfall patterns, total amounts, intensities, flow conditions of channels, etc., in view of further future procedure for drainage improvement in the core area of Metropolitan Manila. In order to supplement such limited data, rainfall stations and water level gauges are to be newly installed, and those proposed sites are considered in the following. Such accumulated rainfall and water level data shall highly contribute to the necessary procedure for future drainage improvement including effective operation of the present drainage channels and drainage pumping stations.

From this aspect, additional rainfall observation stations are to be proposed at appropriate locations. Taking into consideration of aerial distribution of rainfall in the core area, the 3 stations are proposed at the respective drainage pumping stations of Vitas, Paco and Ibertad as shown in *Figure F.5.7*. The rainfall observatory equipment will be an automatic rain gauge.

On the other hand, at 15 drainage pumping stations, water levels are recorded at 2 sides; inlet and outlet of the stations. However, no water level data is presently available in the esteros in the core area of Metropolitan Manila. In order to supplement water level data in the esteros, installation of staff gauge is proposed. The proposed sites of staff gauge will be 15 sites in the major esteros joining to the drainage pumping stations as shown in *Figure F.5.7.*

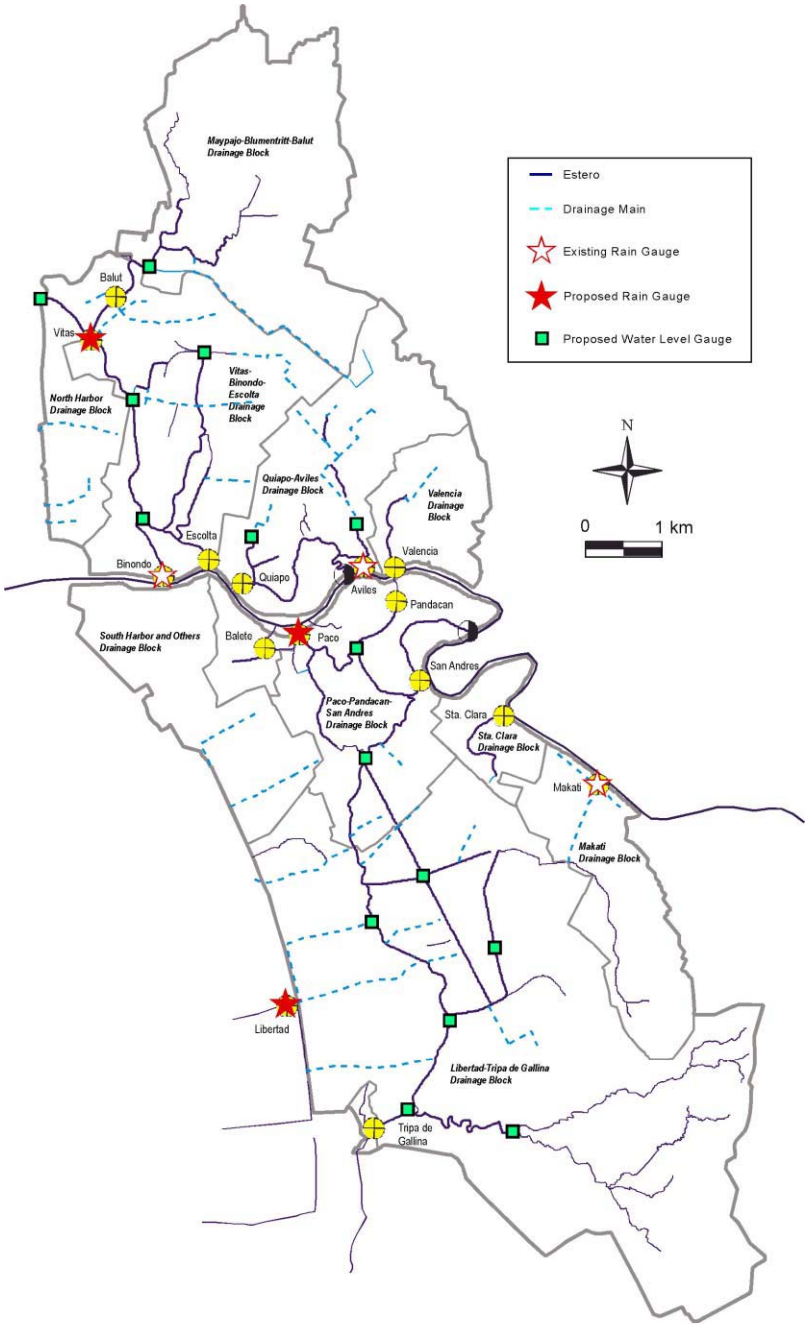


Figure F.5.7 Locations of Additional Hydrological Equipment

2) Work Quantity of Rainfall and Water Level Observation Network

The work quantities of the observation network are summarized in *Table F.5.2.*

Table F.5.2 Work Quantity of Observation Network

Item	Work Quantity	Remarks
Rainfall station	3 sets	Automatic rain gauge
Water level gauge	15 sets	Staff gauge

ANNEX F.1

BLUMENTRITT INTERCEPTOR

ANNEX F.1: BLUMENTRITT INTERCEPTOR

A.F.1.1 SITE CONDITION

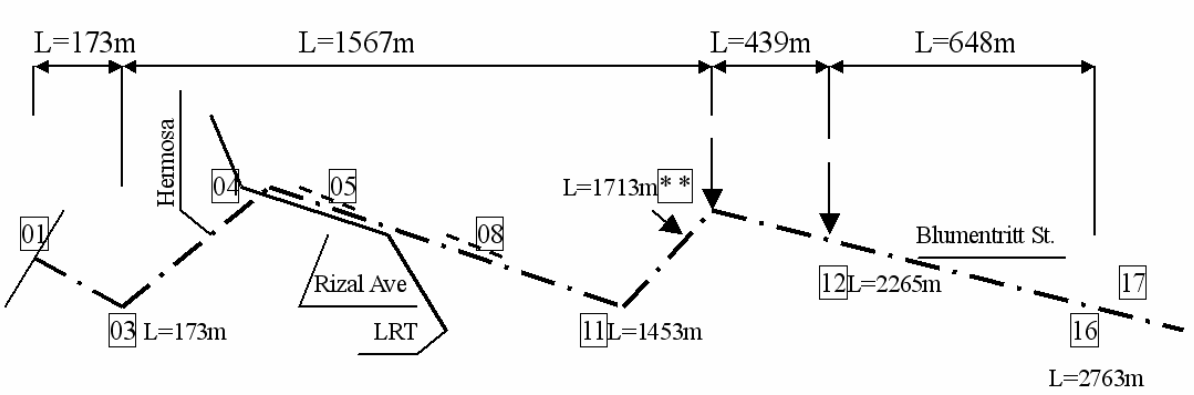
(1) At outlet Sunog Apog NE02 1+500 (Elev. +11.34m at sea)

HWL	Elev. +11.54 m	
Proposed river bed	Elev. +7.74 m	(+7.50 m at sea)
Existing river bed	Elev. +9.16m	
Normal water level	Elev. +10.5 m	

(2) Existing Culvert

Invert level at outlet	Elev.+7.8 m	
Dimensions of culvert	width 1.2 to 2.15m	(average 1.8m, 2 cells)
	height 1.7 to 2.63m	(average 2.2m)

Locations of Culverts Surveyed



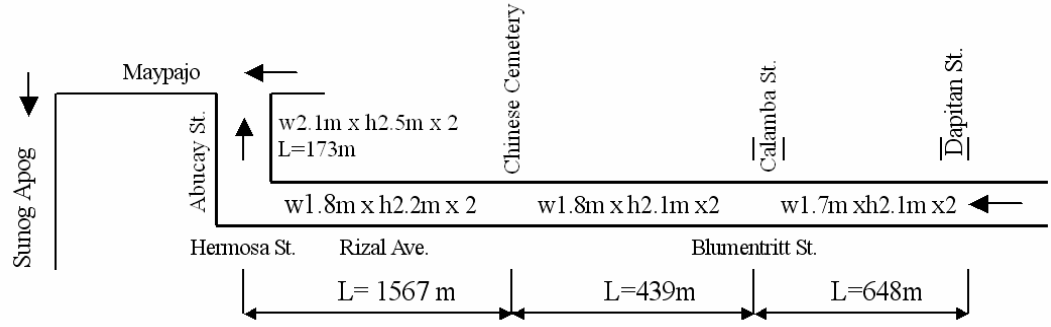
Legend 03 , 11 : Number of Manhole surveyed
: Main drain
05 , 08 : Narrow part

Dimensions of Interceptor

Number of manhole	Distance (m)	Cell	Width (m)		Height (m)	
			Survey	MMDA	Survey	MMDA
01	0	2	(2.1)	2.57	(2.5)	2.57
02		2				
03	173	2	2.1		2.58	
04	392	2	1.8		2.28	
05	561	2	1.35		2.0	
06	766	2	1.7		2.63	
07	923	2	1.72		2.12	
08	1031	2	1.2		2.4	
09	1186	2	2.03	2.46	2	2.46
10	1345	2	2		2.5	
11	1453	2	1.85		2.54	
**	1713	2	1.85	2.38	2.54	2.38
12	2265	2	2.15	2.2	2.08	2.2
13	2438	2	2.15		1.71	
14	2505	2	1.7		2.4	
15	2602	2	1.8	1.69	2.16	1.69
16	2763	2	1.4		2.25	
17	2828	2	1.75		1.56	

Note :Survey was made in 2000. MMDA data are gotten from MMDA. In this study, the smaller data are adopted because of no As Built Drawings.

Schematic Plan of Existing Culvert

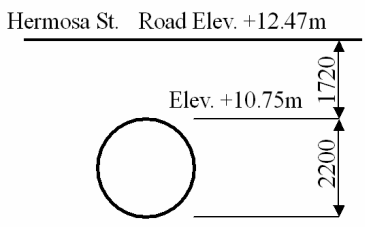


(3) Ground Elevation

- Hermosa Street Elev.+2.2 m to +3.66m
- Rizal Ave. Elev.+3.91m to +2.5 m
- Philippine National Railway Elev.+2.47 m

(4) Water Supply Pipe

Diameter of pipe 2200mm steel pipe



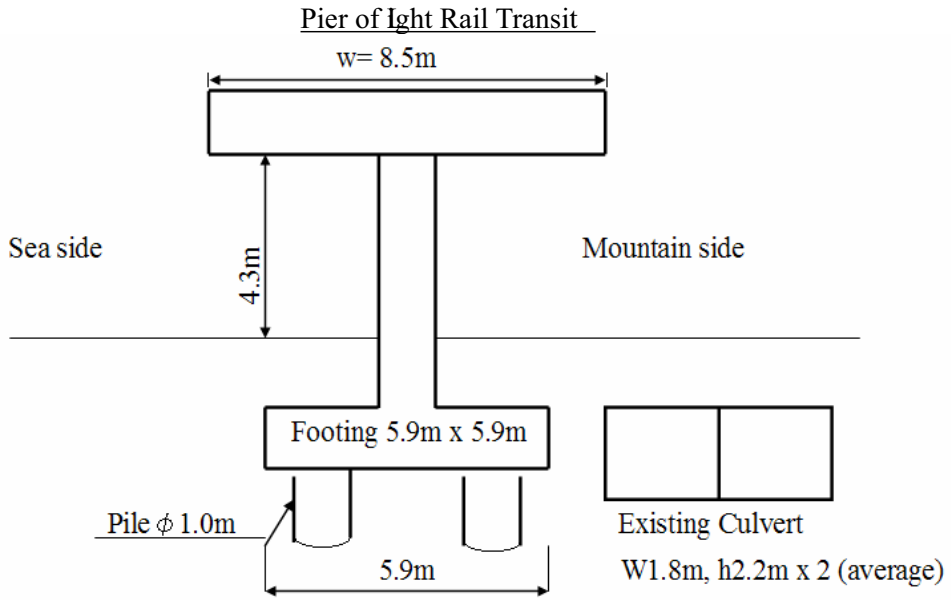
(5) Light Rail Transit

- Super structure

Vertical clearance	h =4.3 m
Width of railway	w=8.3 m

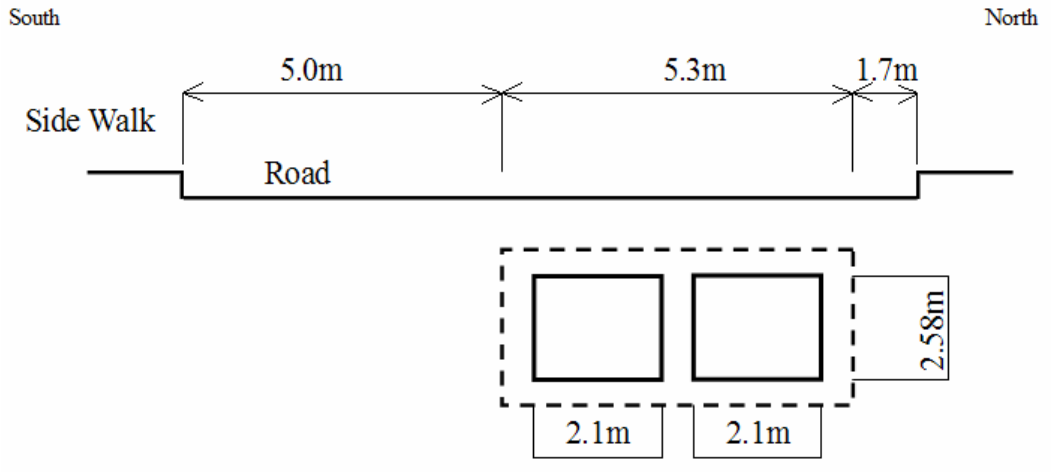
- Substructure

Dimensions of foundation	5.9m x 5.9m
Soil cover of footing	D =1.0m to 1.3m
Pile of foundation	ϕ 1000mm x 4 piles / Pier
Pier	2m x 2m, ctc . 25m



(6) Road Width

Example of Cross-section at Hermosa St.

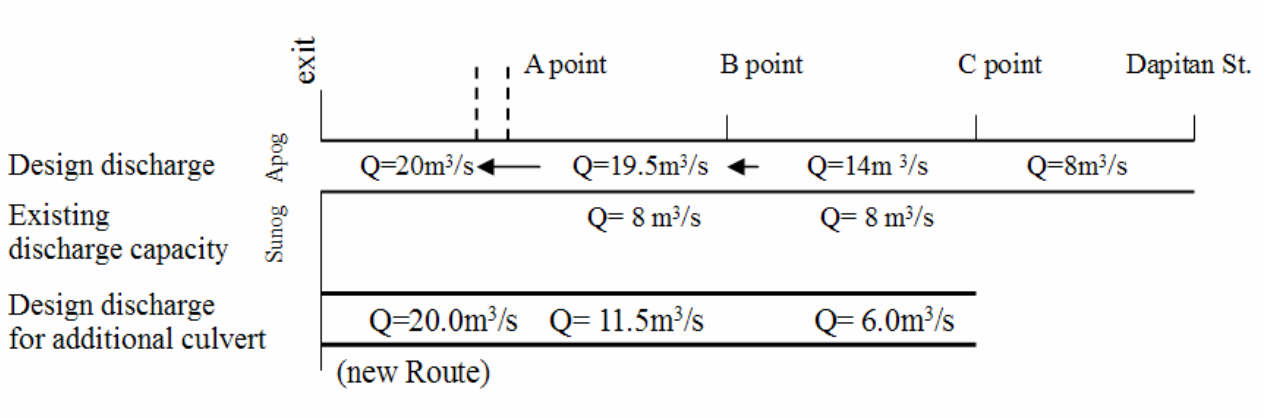


Hermosa st.	w=12.0m	Aurora Blvd.	w=18.1m
Abucay st.	w=6.3m	Blumentritt St.	w=19.0m
Rizal Ave.	w=19.8m	Blumentritt St.	w=11.0m (upper)

A.F.1.2 DESIGN

The discharge capacity of existing culvert is 8m ^{3}/s at Exit. The design discharge will be as follows:

Illustration of Flow (Catchments Area =2km ^{2}, 0.95km^2)



A point :Intersection of Hermosa St. and Abucay St.
B point :Intersection of Hermosa St. and Rizal Ave.
C point :Intersection of Blumentritt and Calamba St.

A.F.1.3 ROUTE OF ADDITIONAL CULVERT

The route of additional interceptor is finally determined mostly along the existing route. In the lowermost part, outlet is moved to the Estero de Sunog Apog based on the comparison study as shown below.

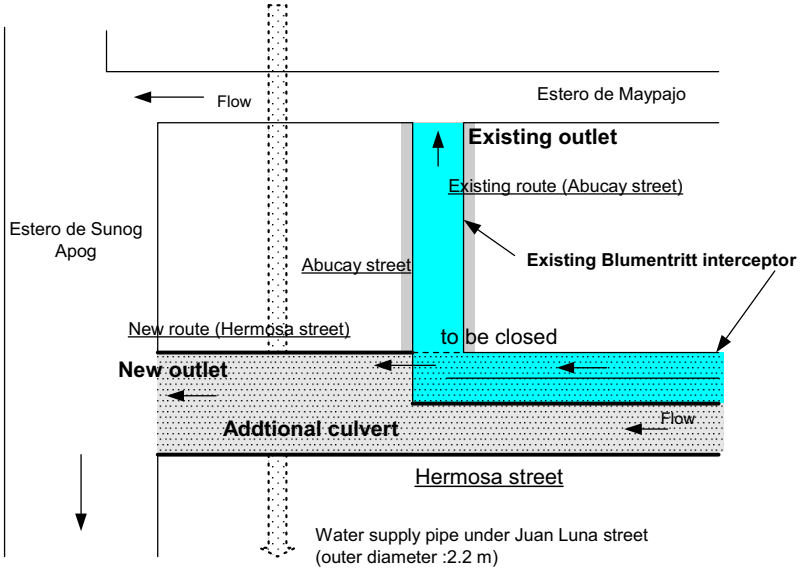
- lower part (outlet) Sunog Apog to Hermosa St. L=564m
- Under RT Rizal Ave. and Aurora Blvd. L=567m
- Bending part Blumentritt St. L=100m

(1) Lower part / Hermosa Street (L=564m)

Changing of outlet from the present with estero de Maypajo to estero de Sunog Apog

- The lower part of the present box culvert from the present outlet to Hermosa Street (a part of Abucay street: 175 m in length) is closed at the bending section of Hermosa Street to stop backwater from Estero de Maypajo and stor m water collected within its catchment is drained through the present outlet.
- In the Abucay Street, there is no space for additional culvert. Accordingly, additional culvert will be aligned along the Hermosa Street as shown in the following Figure. The remained existing box culvert in the upper reaches is connected with additional new interceptor and directly joined with the Es tero de Sunog Apog as indicated in the below Figure based on the following preliminary comparison study.

New Outlet of Additional Blumentritt Interceptor



For the above changing of outlet location, the comparison results of 2 routes are summarized in the following Table.

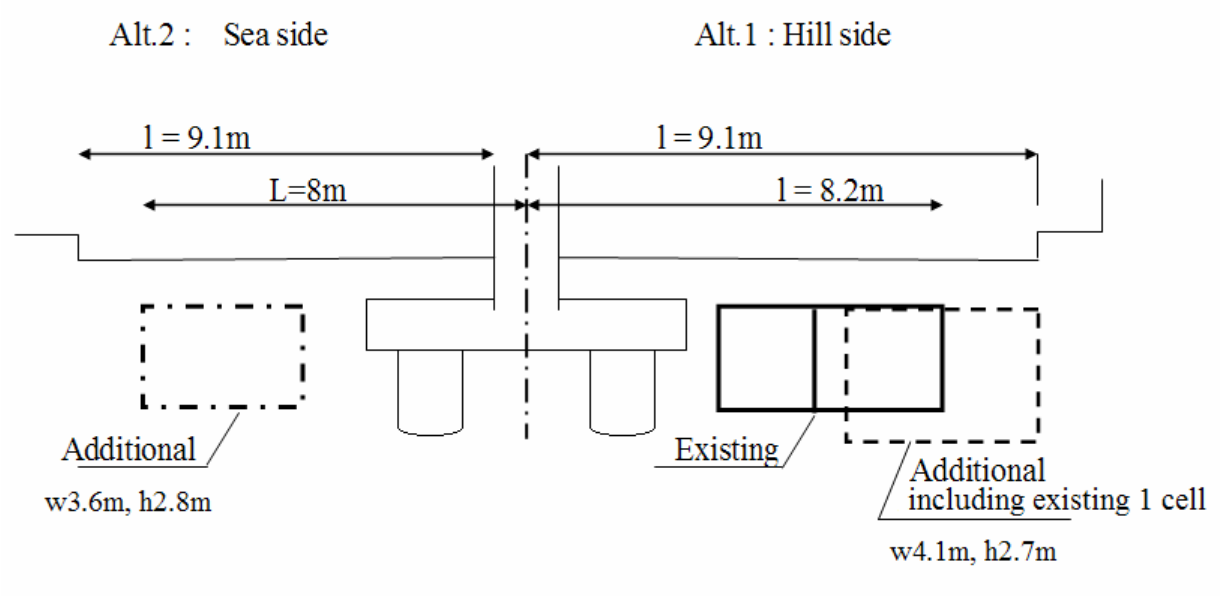
Comparison of Existing and New Routes

Item	Existing Route		New Route	
Proposed plan	To drain by existing culvert and additional culvert to Estero de Maypajo		To drain all by new culvert to Estero de Sunog Apog	
Design discharge	For additional : 11.5 m3/s		Total incl. existing : 20.0 m3/s	
Culvert to be constructed	Additional culvert	w3.6m x h2.7m x 1lane x 175 m	New culvert	w3.4m x h2.6m x 2lanes x 564 m
Related works	- Dredging of Estero de Maypajo - Bank protection	18,000 m3 3,000 m2	- Replacement of water supply pipe	Lump sum (for partially:30m)
Land acquisition	- Abucay street/Estero de Maypajo	4,500 m2	- Outlet site	450 m2
House compensation	- Abucay street - Estero de Maypajo	30 houses(formal) 250 houses(informal)	- Outlet site	3 houses (Barangay office)
Direct construction cost	- Culvert - Related works - Land/house compensation Total	20,200,000 pesos 66,000,000 pesos 79,800,000 pesos 166,000,000 pesos	- Culvert - Related works - Land/house compensation Total	93,100,000 pesos 50,000,000 pesos 2,500,000 pesos 145,600,000 pesos
Technical and construction aspects	Conventional works, simple and easy		Conventional works, simple and easy	
Operation and maintenance aspect	Almost same as new route		Almost same as existing route	
Social impacts	- Large scale resettlement: 280 houses - Trafic congestion during construction - Serious social impact		- Small resettlement: 3 houses - Traffic congestion during construction - Less social impact	
Economical aspect	Costly		Less cost than that of existing route	
Overall evaluation	Not recommendable		Recommendable	

(2) Rizal Ave. / Aurora Blvd. (L=1,567m)

The design discharge for additional culvert is 62m ^{3}/s.

Cross-section under Rizal Ave.



Comparison of locations of Additional Culvert to be Constructed

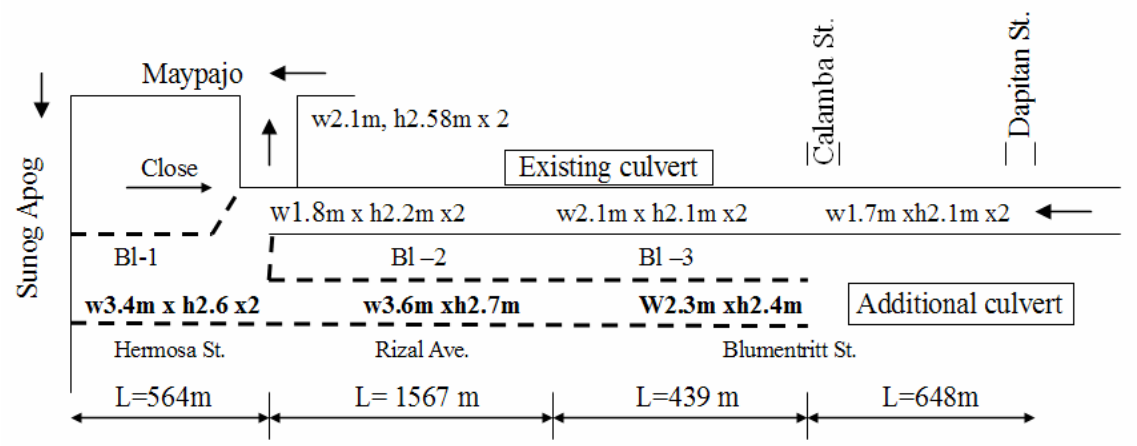
Items	Alt.1 :Sea side	Alt.2 : Hill side
Construction Work	Construction of Additional culvert	Demolishing of Existing one cell and Additional culvert
Cost		
Cost	Economically	Costly
Conclusion	○	×

A.F.1.4 DIMENSION OF ADDITIONAL CULVERT

(1) Assumed Dimension of Additional Culvert

The dimensions of the additional culvert to be added are assumed considering the design discharge and the road width. The dimensions of additional culverts are shown as follows.

Assumed Dimensions of Additional Culvert Box (and Existing Culvert)



(2) Head Loss

The head loss due to friction loss of culvert is calculated using the following formula.

discharge $Q = A \cdot v$
velocity $v = (1/n) \times I^{1/2} \times R^{2/3}$
friction loss $\Delta h = \{ Q \cdot n) / (A \cdot R^{2/3}) \}^2 \times L$

Friction loss

Unit :m

Items	Sunog Apog to Point A	Point A to Point B		Point B to Point C		Point C to Dapitan St.
Mark of Culvert	Bl-1	(Existing)	Bl-2	(Existing)	Bl-3	(Existing)
Roughness	n=0.015 (concrete)					
Gradient						
Discharge	20.0	19.5		14.0		8.0
		7.1	12.4	7.7	5.6	
Distance	564	1567	1567	439	439	648
Width	3.40	1.8	3.6	2.1	2.3	1.7
Depth	2.60	2.2	2.7	2.1	2.4	2.1
No. of cell	2	2	1	2	1	2
w x h	8.84 x 2	3.96 x 2	9.72	7.56	5.52	7.14
Friction loss	0.24	0.78	0.78	0.18	0.18	0.50
Δh	0.24	0.78		0.18		0.50
Total loss	$\Sigma(\Delta h) = 0.24 + 0.78 + 0.18 + 0.50 = 1.71$m					

(3) Check of Water Level

At two points it was checked that the water level through the culverts was lower than the ground elevation.

- At Dapitan St. (edge of interceptor)

Water level at Exit	Elev. +1.54m
Total friction loss	1.71m
Total water level at intersection of Dapitan St.	Elev. +3.25m < Ground Elev. +4.47m
	Ok

- At point C

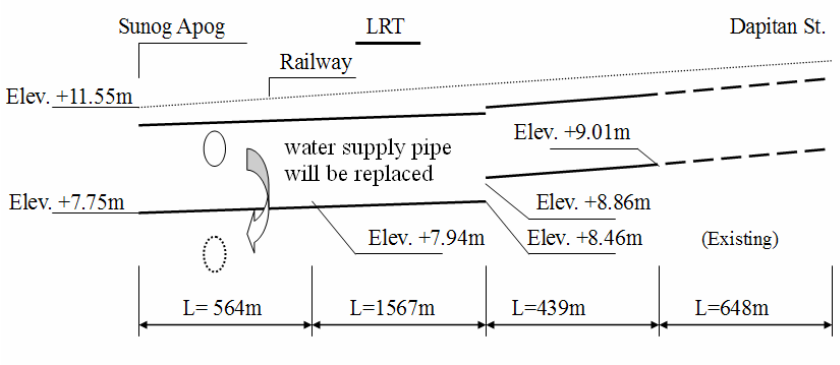
Water level at Exit	Elev. +1.54m
Total friction loss	1.21m
Total	Elev. +2.75m < Ground Elev. +2.79m
	Ok

A.F.1.5 LONGITUDINAL PROFILE

(1) Assumed Longitudinal Profile

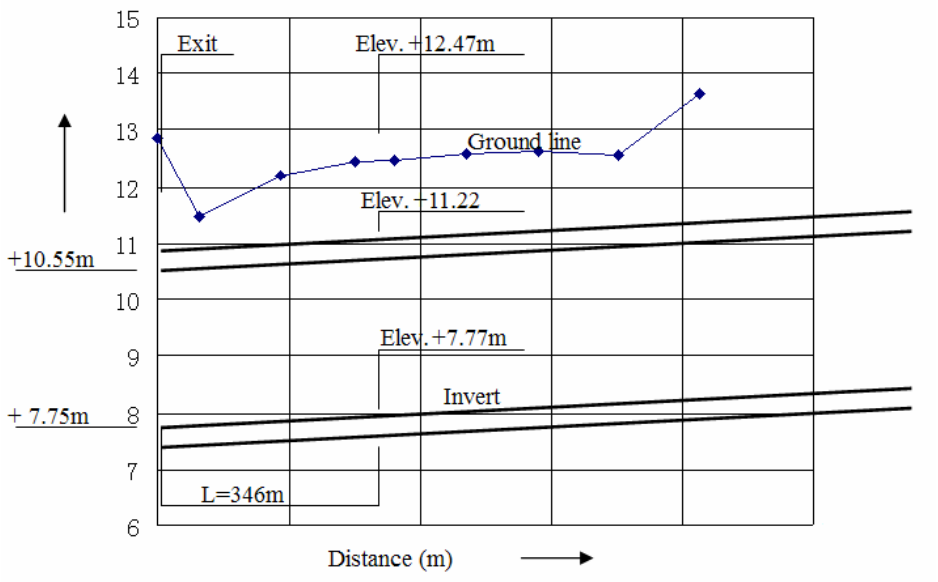
The longitudinal profile is assumed as follows, considering related elevations of ground, riverbed of Sunog Apog, existing culvert and depth of cover.

Assumed Longitudinal Profile



(2) Check of Covering under Railway

Covering under Railway



Top Elev. of Upper Slab

Invert Elev. at Exit of interceptor		+7.75m
Height of culvert		2.60m
Incline of slop	346 / 3000	0.12m
Thickness of slab		0.50m
Total		+10.97m

Cover under Railway D

D =Top of Railway (Elev.+12.47m) - Top Elev. of Upper Slab(+10.97m)

=1.5 m > $D_{min.}$ (1.0m) +rail with mound (0.5m)

ok

A.F.1.6 STOP LOG GATE TO BE INSTALLED

(1) Maintenance Work

Sequence of cleaning work for the culvert :

Dewatering → Dry-up → Declogging

Equipment to be applied :

The following equipments will be applied.

Equipment of Dewatering work

Work	Equipment
Installation of Stop-log	Crawler Crane , stop-log 1ton/piece
Discharge	Pump Truck 0.6m3/min.

(2) Interval of Stop Log Gate

Length between stop log gates =400m (assumed)

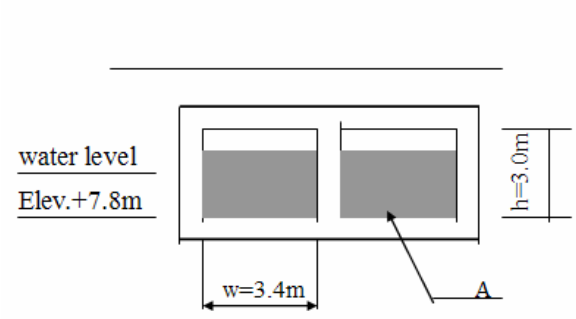
Required time to drain by pump: T

T =water volume (A x L)/ pump capacity (Q)

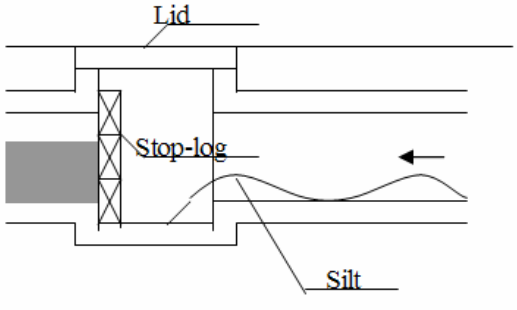
9.2m2 x 400m / 6m3/min.

=613 min. (10 Hours) ------- 1day

Cross-Section



Profile of Maintenance Hole



A =w x h =3.4m x 2.7m

=9.2m ^{2}

where

w:width of culvert 4.0m

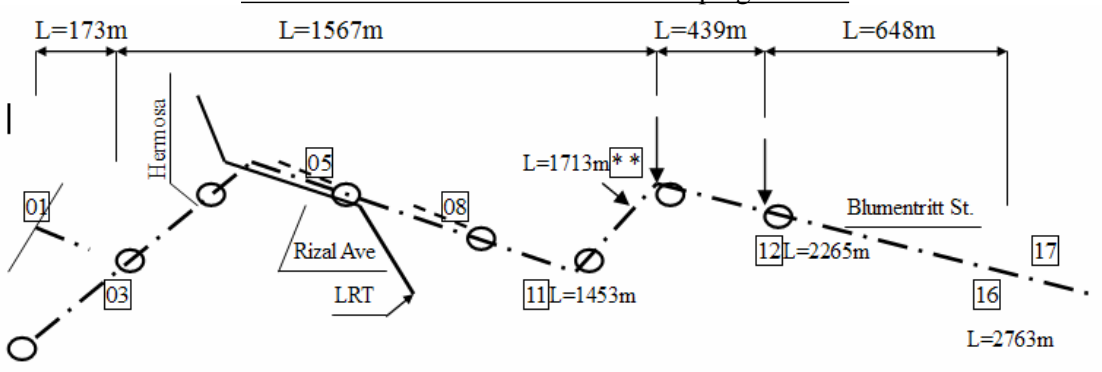
h:water depth

=normal W.L(+10.5m) - Invert Elev.(7.8m) =2.7m

(3) Numbers of Stop Log Gate

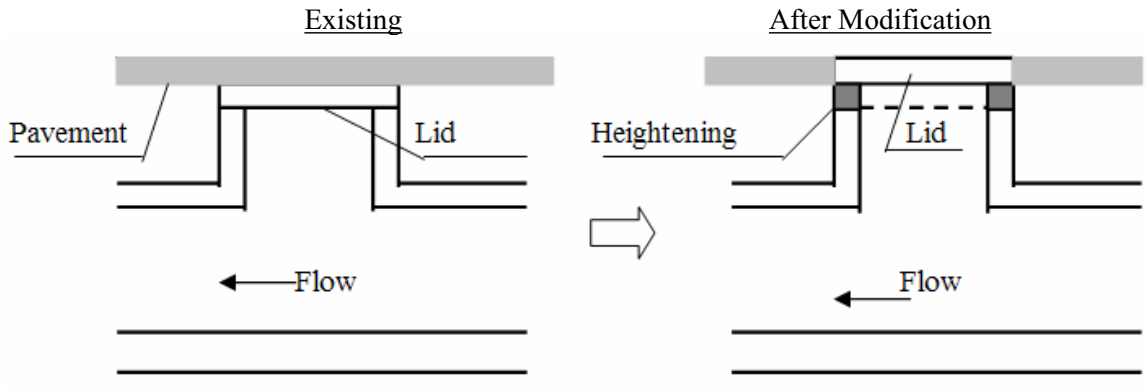
n = Length of Buendia outfall (L) / interval (l)
= 3220m / 400m
= 8 -------- 8 places

Locations of Maintenance Hole with Stop Log Gate



(4) Maintenance Hole to be Modified

Some manholes are presently covered by the road pavement. These are modified by heightening of the top in order to keep the function.

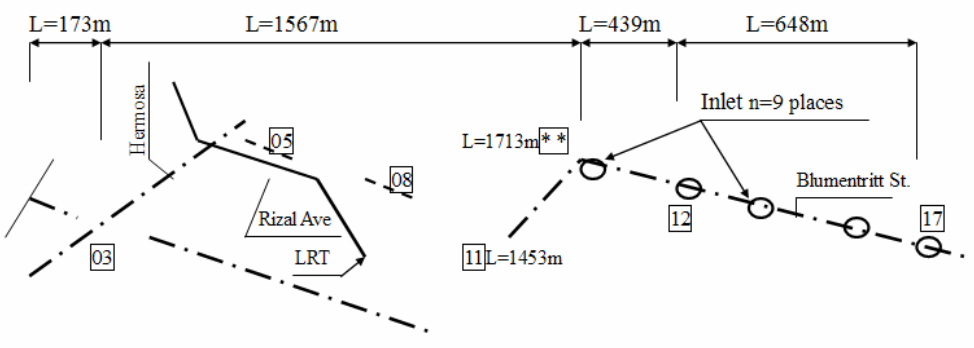


Number of maintenance holes to be modified is 20 (by site survey).

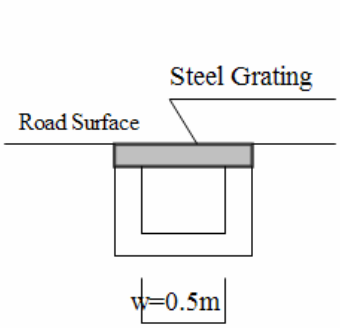
(5) Inlet for Road Surface Flow

The inlet is made at road intersection in order to intake the road surface flow coming from hilly areas. The profile of the inlet is imaged as shown below. The required inlet is proposed at 9 places.

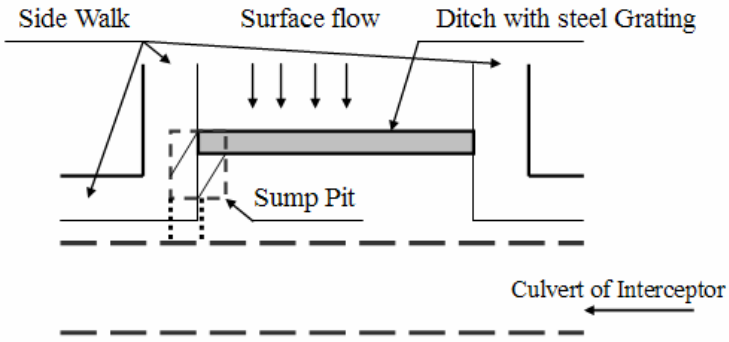
Location of Inlet on Blumentritt St.



Cross-Section of Ditch



Plan of Inlet



A.F.1.7 ALTERNATIVE STUDY: IMPROVEMENT OF ESTERO DE MAYPAJO

(1) Profile of Estero de Maypajo

- Channel width, longitudinal profile

  Channel width w=7.1m to 12 m
  longitudinal profile 1/ 5000 to 1/500

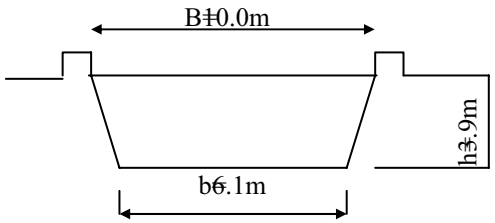
- Proposed Discharge

  Q=35m ^{3}/s

(2) Proposed Cross-section

- Design value

  Gradient 1/ 3000
  Roughness n=0.025
  Slope numb. 1:0.5



Hydraulic value of Proposed Cross-section

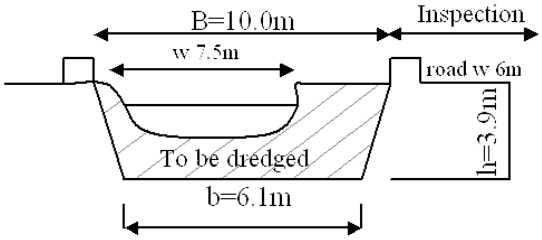
Area m^2	R 1/m	v m/s	Capacity m^3/s	Proposed
31.2	2.0	1.15	36	35

(3) Required Work

The work quantities to be widened are shown in table.

Items	Unit	Description	Remarks
Dredging	M^3	b3.6m x h3.9m x 270m =3,800	Dredging of Maypajo 14,200 m^3
Bank Protection	M^2	5.5m x 270m x 2 =3,000	

Length to be widened: L=270m
From bridge to outlet of interceptor



(4) Land and House

Location	Land	House
Maypajo	W11.5m x 270m =1230m ^{2}	200 (informal settler)
Abucay St.	W7.0m x 175m =3100m ^{2}	20 (formal)

ANNEX F.2

BUENDIA OUTFALL

ANNEX F.2: BUENDIA OUTFALL

A.F.2.1 SITE CONDITION

(1) Outlet to Libertad DM

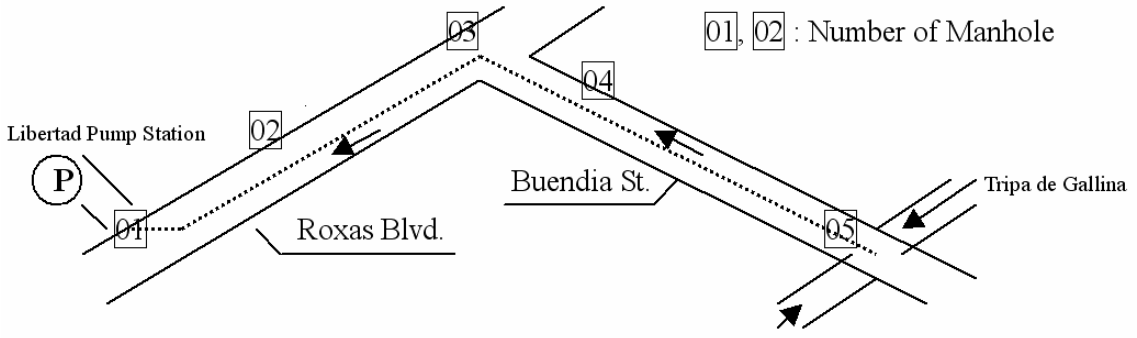
Normal water level: Elev.+0.45m
Pump stop level: Elev.+0.45m
Riverbed: Elev.-7.5 m

(2) Profile of Culvert

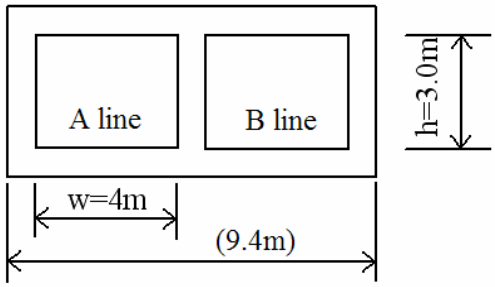
Invert level: Elev.-8.29m
Dimensions: Width =3.0 to 4.8m x 2 cell (average 4.0m)
Height =2.6 to 3.2m (average 3.0m)
Length: =960m

(3) Locations of Culverts Surveyed

Location of Culverts Surveyed



Typical Cross-Section



Surveyed Data of Existing Culvert

No.	Estimated Distance (m)	Width(m)		Height(m)	
		A line	B line	A line	B line
01	0	3.6	4.8	2.5	3.13
02	299	3.6	4.7	3.0	3.27
03	803	3.7	3.0	3.26	2.35
04	1071	3.8	4.0	3.25	2.6
05	1956	3.5	3.5	3.0	3.0

A.F.2.2 STOP LOG GATE TO BE INSTALLED

(1) Maintenance Work

Sequence of cleaning work for the culvert :

Dewatering → Dry-up → Declogging

Equipment to be applied :

The following equipments will be applied.

Equipment of Dewatering work

Work	Equipment
Installation of Stop-log	Crawler Crane , stop-log 1ton/piece
Discharge	Pump Truck 0.6m3/min.

(2) Interval of Stop Log Gate

Length between Maintenance Holes = 400m (assumed)

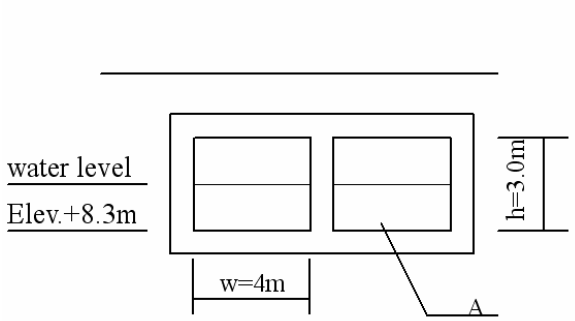
Required time to discharge :T

T = water volume (A x L) / pump capacity (Q)

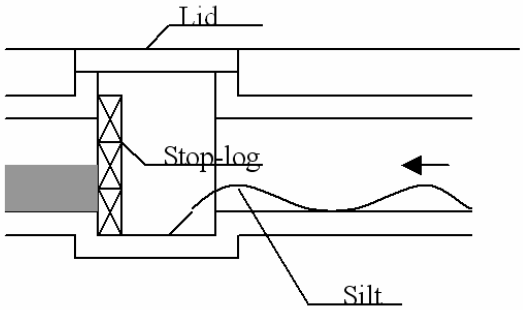
= 8.8m2 x 400m / 6m3/min.

= 587 min. (10Hours) ------- 1day

Cross-Section



Profile of Maintenance Hole



A = w x h = 4.0m x 2.2m

= 8.8m ^{2}

where

w:width of culvert 4.0m

h:water depth

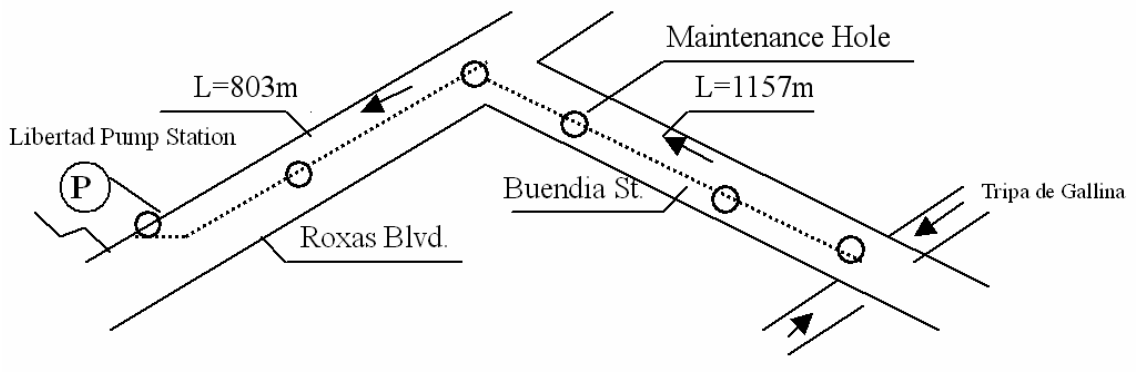
= normal W.L(+10.5m) - Invert Elev.(8.3m) = 2.2m

The Stop-log will be stored at near Pumping Station.

(3) Numbers of Stop Log Gate

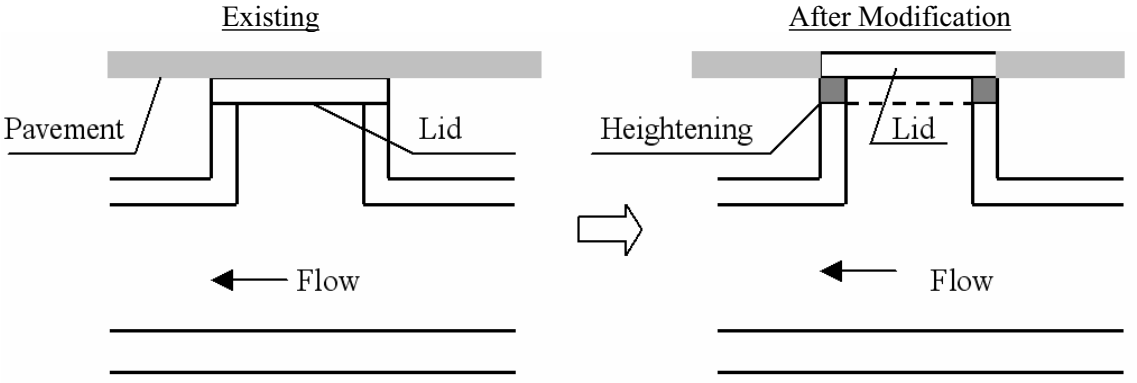
n = Length of Buendia outfall (L) / interval (l) - 1
= 1960m / 400m - 1
= 5 - 1 -------- 6 places

Locations of Maintenance Hole with Stop Log Gate



A.F.2.3 MAINTENANCE HOLE TO BE MODIFIED

Some manholes are presently covered by the road pavement. These are modified by heightening of the top in order to keep the function.



Number of Manholes to be modified = 60 (by site survey)

ANNEX F.3

ZOBEL ROXAS DRAINAGE MAIN

ANNEX F.3: ZOBEL ROXAS DRAINAGE MAIN

A.F.3.1 SITE CONDITION

(1) At Outlet to Tripa de Gallina No. 4+ 670m

Proposed channel bed of Tripa: Elev. +8.27m
Normal water level: Elev. +0.4 m
Existing channel bed: Elev. +0.0 m

(2) PNR Canal No. 0+ 10m

Proposed canal bed: Elev. +0.75 m
Right bank elevation: Elev. +3.3 m

(3) Ground Elevation

At outlet: Elev. +2 .95 m
SSH: Elev. +3 .1 m to +3.2 m
Top of PNR: Elev. +3 .55 m
Upper part (860m): Elev. +3 .2 m

(4) Existing Culvert Box

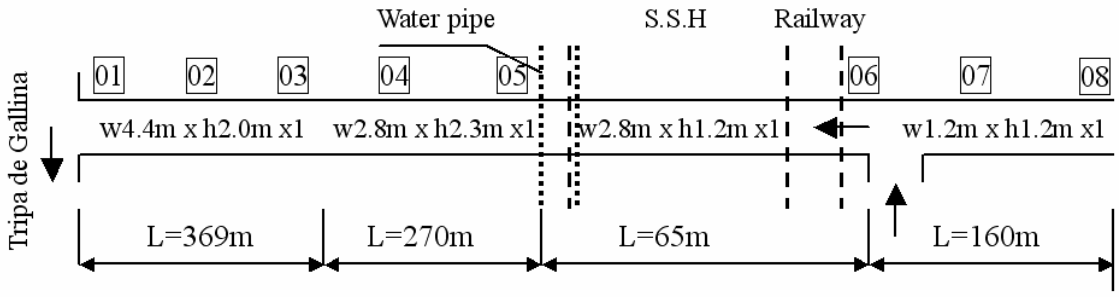
Invert elev. at outlet: Elev. +0.0 m (+0.35 m)
Bottom elev. of top slab at outlet: Elev. +2.36m
Dimensions: width 1.2m to 4.4m x 1 cell
height 1.2m to 2.5m

Dimensions of Box Culvert Surveyed

Mark of Manhole	Distance (m)	Width (m)		Height (m)	
		Survey data	MMDA data	Survey data	MMDA data
01	0	4.4	3.6	2.02	2.25
02	95	4.4		2.52	
03	369	4.3		2.48	
04	413	2.84		2.33	
05	639	2.9		2.26	
06	723	2.8		1.22	
07	762	1.22		1.22	
08	862	1.22		1.22	

Note: Survey Data made in 2000 was checked at site.

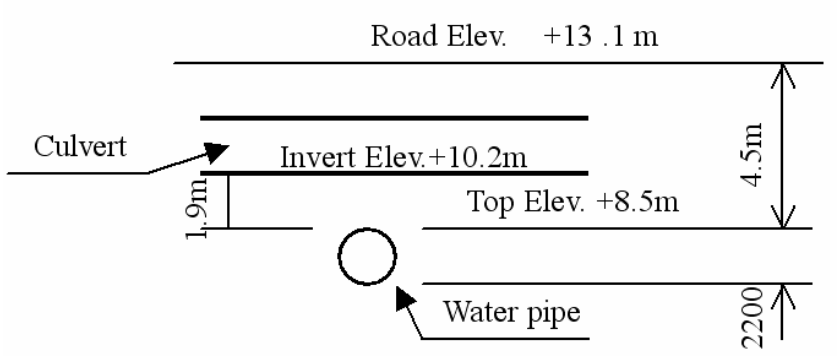
Dimension of Existing Box Culvert



(5) Water Supply Pipe along SSH

Diameter of steel pipe: ϕ 2,200mm (under side walk)
Top of pipe: Elev. 8.5 m (D=0.8 m)

Cross Section of Culvert and Water Supply Pipe



The cover for the pipe is big enough.

(6) Road Width

Tripa to PNR: w=14.8m
PNR to Kamagong St.: w=14.8m

A.F.3.2 DISCHARGE

(1) Discharge Capacity and Proposed Discharge

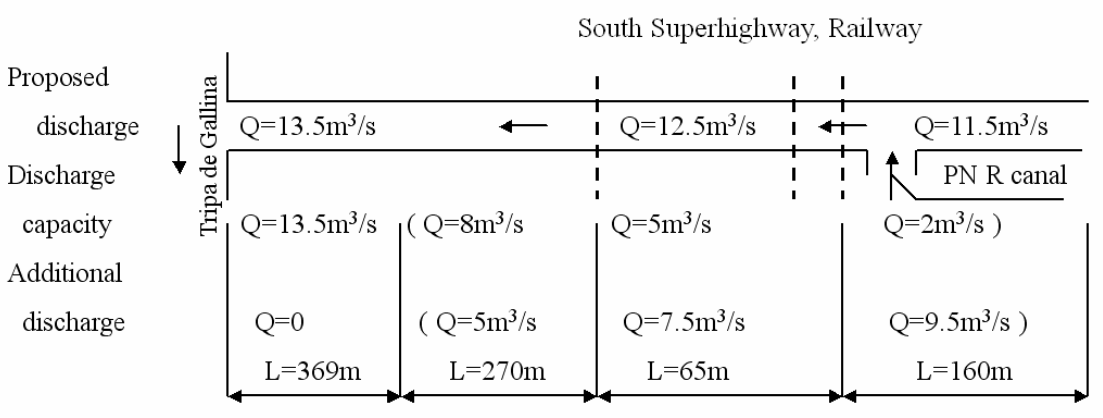
The discharge capacity of existing culvert are Q=13.5 m^3/s at Exit.

The proposed discharge are Q=13.5 m^3/s at Exit (Catchments Area =1.01km2 / 0.79km2).

(2) Additional discharge

The discharge to be added are known by the discharge mention above, and are shown below.

Schematic Flow Diagram



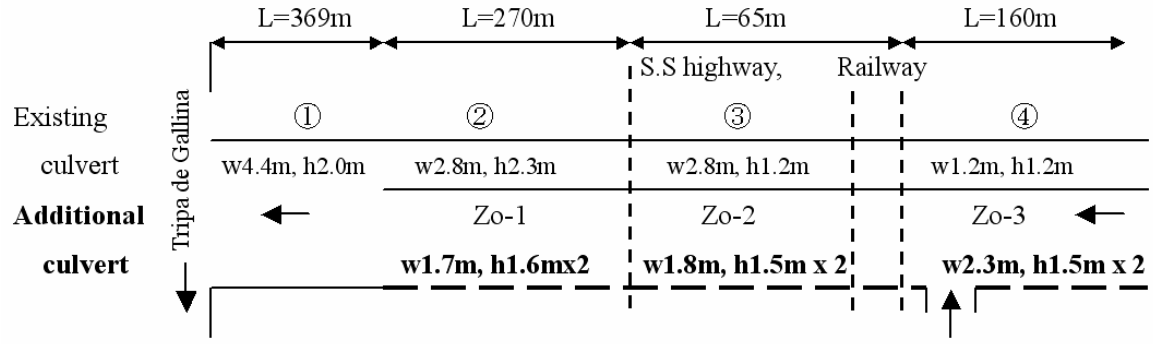
Note: (Qm^3/s・・) is the assumed value.

A.F.3.3 DIMENSIONS OF ADDITIONAL CULVERT

(1) Assumed Dimensions of Additional Culvert

The dimensions of the culvert to be added are assumed depending on the discharge to be added as shown below.

Dimensions of Additional Box Culvert



(2) Head Loss

The head loss is obtained by the estimation of the friction loss of the culvert using following formula.

discharge $Q = A \cdot v$

velocity $v = (1/n) \times I^{1/2} \times R^{2/3}$

friction loss $\Delta h = \{ Q \cdot n) / (A \cdot R^{2/3}) \}^2 \times L$

Friction loss of Culvert (pressure flow)

Items	Tripa to SSH			Under SSH and PNR		PNR to	
Name of culvert	①	②	Zo-1	③	Zo-2	④	Zo-3
Roughness	n=0.015 (concrete)						
Gradient	h/L=1/1100 (average) (13.2m)-(12.36m)/860						
Discharge m^3/s	13.5			12.5		11.5	
	13.5	8.2	5.3	4.8	7.7	2.1	9.4
Distance m	369	270	270	65	65	160	160
Width m	4.40	2.80	1.70	2.80	1.80	1.20	2.30
Depth m	2.00	2.30	1.60	1.20	1.50	1.20	1.50
A =w x h	9.02	6.44	2.72 x2	3.36	2.7x2	1.44	3.45x2
No. of Cell	1	1	2	1	2	1	2
Friction loss m	0.32	0.18	0.19	0.10	0.10	0.18	0.19
Δh	0.32	0.19		0.10		0.19	
Total loss	$\Sigma(\Delta h) = 0.32 + 0.19 + 0.10 + 0.19 = 0.80$ m						

(3) Checking of Water Level at Upper Part

Water level at Exit: Elev. 12.36 m

Total friction loss: 0.80 m

Total Elev. 13.16 m < Ground Elev. 13.2m

ok

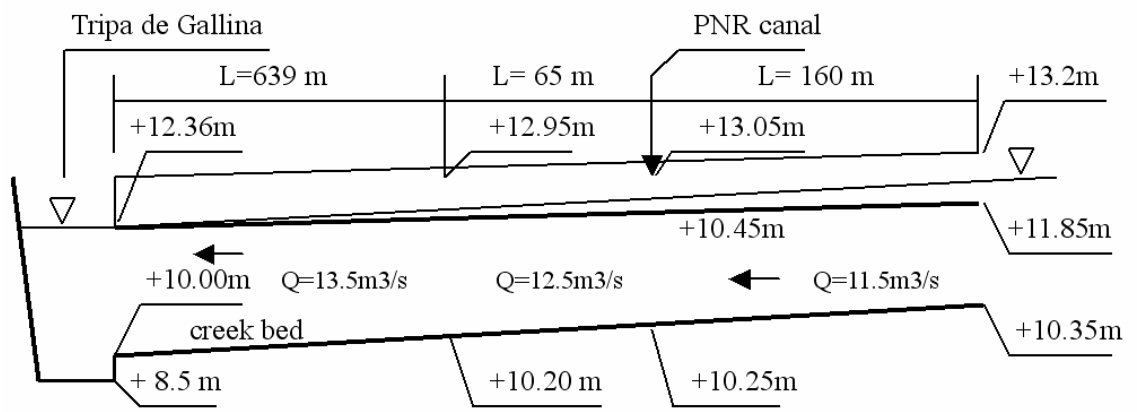
It is known that the assumed dimensions are acceptable.

A.F.3.4 DIMENSIONS OF ADDITIONAL CULVERT

(1) Longitudinal Profile and Water Level

The longitudinal Profile of the drainage is assumed considering the ground elevation of Zobel Roxas St., elevation of the existing culvert and Philippine National Railway Elev. .

Schematic Longitudinal Profile



(2) Checking of Covering

- Covering under PNR

  Top Elev. of Upper Slab

Invert Elev. of culvert	Elev.+10.25m
Height of culvert	1.50m
Thickness of slab	0.30m
Total	Elev. +12.05m

  Cover under Railway:D

  D =Top of Railway (Elev.+13.56m) - Top Elev. of Upper Slab(+12.05m)

  =1.51 m > $D_{min.}$ (1.0m) +thick of plinth (0.50m) ok

- Covering under SSH

  Top Elev. of Upper Slab

Invert Elev. of culvert	Elev.+10.20m
Height of culvert	1.50m
Thickness of slab	0.30m
Total	Elev. +12.00m

  Cover under South Super Highway:D

  D =Top of Road surface (Elev.+13.1m) - Top Elev. of Upper Slab(+12.00m)

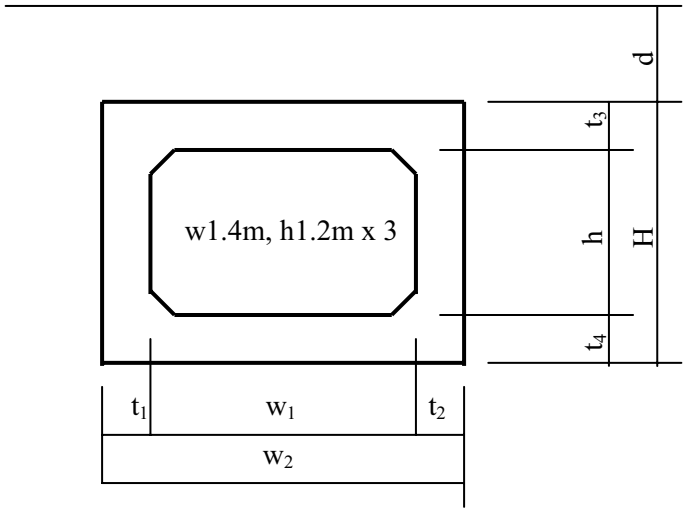
  =1.10 m > $D_{min.}$ (1.0m) ok

A.F.3.5 CASE STUDY OF PRE-CAST CULVERT

(1) Dimension and Weight of Culvert

South Super Highway has always dense traffic. Therefore, a short construction period is required. Regarding the construction method of the culvert under S.S.H., pre-cast culvert may be applicable in order to shorten the construction period. The piece of pre-cast culvert will be less than 5 tons weight considering transportation and installation of the piece of pre-cast culvert. The dimensions of the piece of culvert are obtained considering discharge capacity and structural stability. The required dimensions for the additional discharge (Q=8m ^{3}/s) are as follows.

Cross-Section of Box Culvert



w_1	1400
h	1200
t_1	300
t_2	300
t_3	300
t_4	350
H	1850
w_2	2000

(2) Length of Piece L

weight of culvert per unit meter w

w = γ_c ·section area γ_c unit weight of RC 25kN/m ^{3}

=2.5 x (2.1 x 1.85 -1.2 x 1.4)

=5.1 ton/m

L=5.0 / w =5 / 5.1 =0.98m ----- =1.0m

Therefore the required dimension of additional culvert is

w 1.4m, h1.2m x L=1.0m, x 3 lines

ANNEX F.4

FARADAY DRAINAGE MAIN

ANNEX F.4: FARADAY DRAINAGE MAIN

A.F.4.1 SITE CONDITION

(1) Outlet to Tripa de Gallina No. 3+ 490m

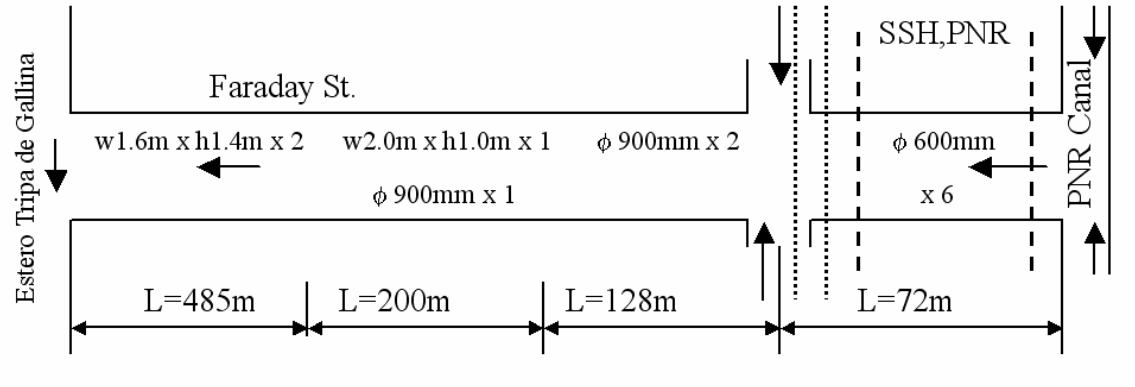
Proposed channel bed:	Elev. + 8.15m
Ground level (sea side):	Elev. +13.1 m
Normal water level:	Elev. +10.45 m
(Water level in rain time):	Elev. +11.5 m

(2) Existing Culvert

Invert level at outlet:	Elevation +10.3 m
Dimensions of culvert:	Width 1.6m x 2 cells to ϕ 42" x 1
	Height 1.2m to ϕ 42"

The dimensions of Existing Culvert are obtained from As-Built Drawings and the site investigation.

Dimensions of Faraday DM



(3) Ground Elevation

On Faraday Street:	Elev. +12.7 m to +13.6m
At South Super Highway:	Elev. +13.0 m to +13.1m
Top of Philippine National Railway:	Elev. +13.6 m

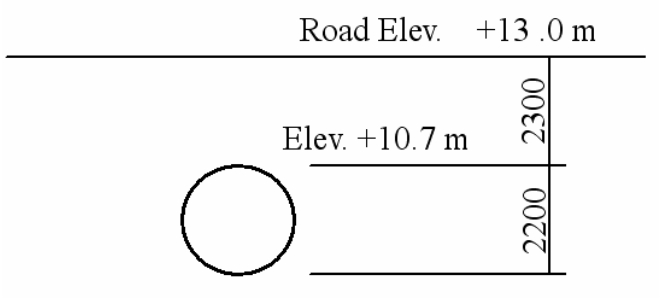
(4) PNR Canal at No. 1+ 340m

Proposed canal bed:	Elev. +10.5 m
Ground elevation:	Elev. +13.2 m

(5) Water Supply Pipe

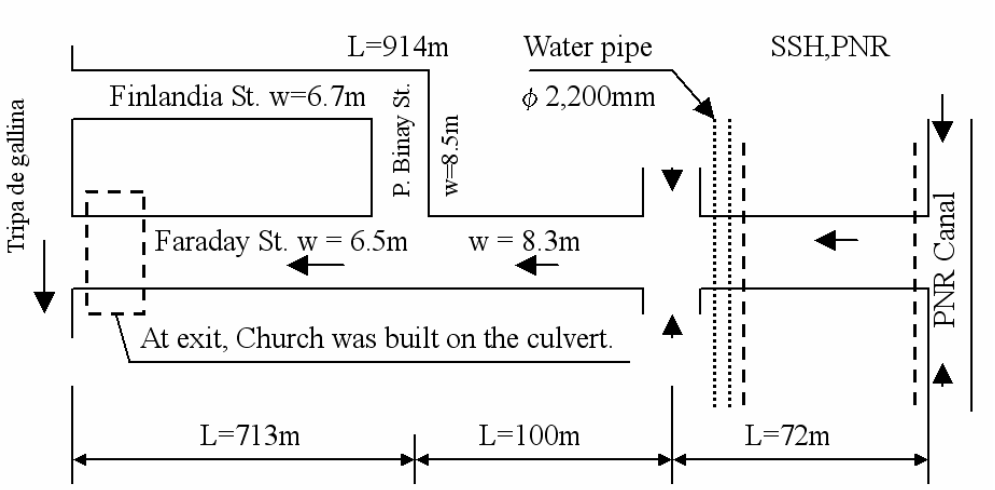
Diameter of steel pipe:	ϕ 2,200mm (under side walk)
Top of pipe:	Elev. +10.7 m (depth of cover = 2.3 m)

Cross Section of Water Pipe



(6) Road Width

Road Width and Section Length



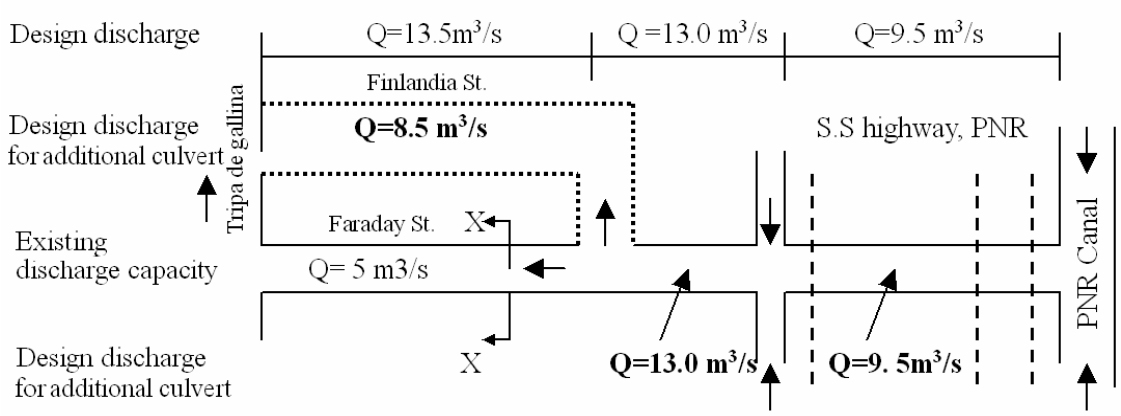
A.F.4.2 DESIGN DISCHARGE

The design discharge of Faraday drainage main will be as follows:

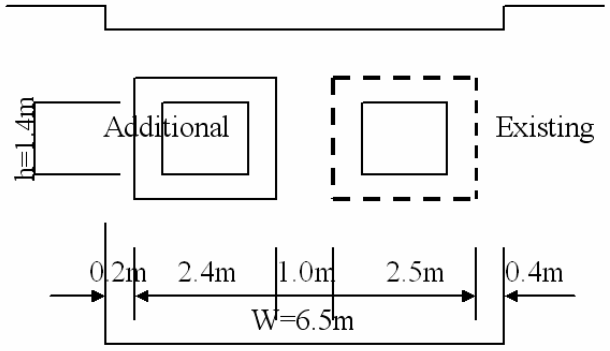
- Lower part: 13.5 m^3/s
- Middle part: 13.0 m^3/s
- Upper part (under SSH): 9.5 m^3/s

From the above, design discharge for additional culvert will be estimated as shown below.

Illustration of Flow (Catchments Area = 0.85 km^2)



Cross-section at X-X section in Faraday Street

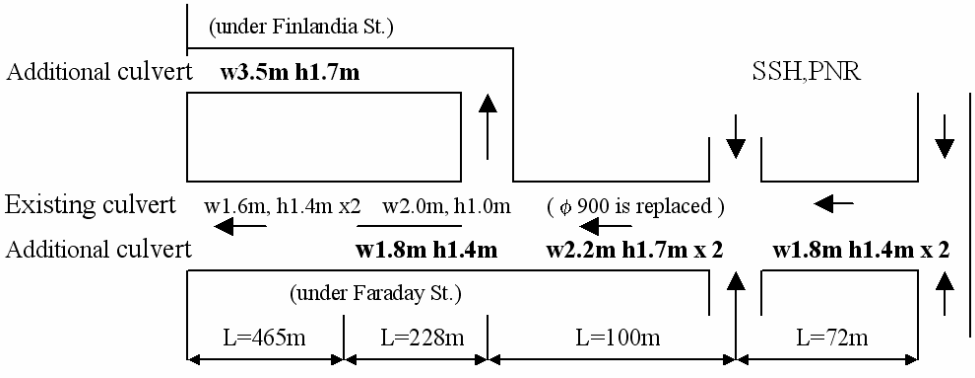


A.F.4.3 DIMENSIONS OF ADDITIONAL CULVERT

(1) Dimensions of Additional Culvert

The dimensions of the additional culvert to be added are assumed as shown below based on the design discharge and width of roads.

Assumed Dimension of Additional Culvert



(2) Head Loss

The head loss due to friction loss of culvert is calculated by using the following formula.

discharge $Q = A \cdot v$
velocity $v = (1/n) \times I^{1/2} \times R^{2/3}$
friction loss $\Delta h = \{ (Q \cdot n) / (A \cdot R^{2/3}) \}^2 \times L$

Calculation of Head loss

Items	Outlet to P.Binay				P.Binay to SSH	SSH to PNR canal
	Faraday St.	Middle Faraday St.		Finlandia St.		
Roughness n		0.015 (concrete)				
Gradient		$\Delta h / L = \{(+13.1m)-(+12.3)\}/890 = 1/1100$				
Mark of culvert	Existing	Existing	Fa-1	Fa-4	Fa-2	Fa-3
Discharge m^3/s	13.5				6.5 x2 =13.0	9.5
	2.6 x 2	2.15	3.05	8.3		
Distance m	485	228		914	100	
Width m	1.6	2.0	1.8	3.5	2.2	1.8
Depth m	1.4	1.0	1.4	1.7	1.7	1.4
Nos. of Cell	2	1	1	1	2	2
Section Area of culvert	2.24 x 2	2.00	2.52	5.95	3.74 x 2	
Friction loss	0.55	0.26	0.26	0.85	0.19	0.20
Δh	0.85				0.19	0.20
Total loss	$\Sigma(\Delta h) = 0.85+0.19+0.20 = 1.25$ m					

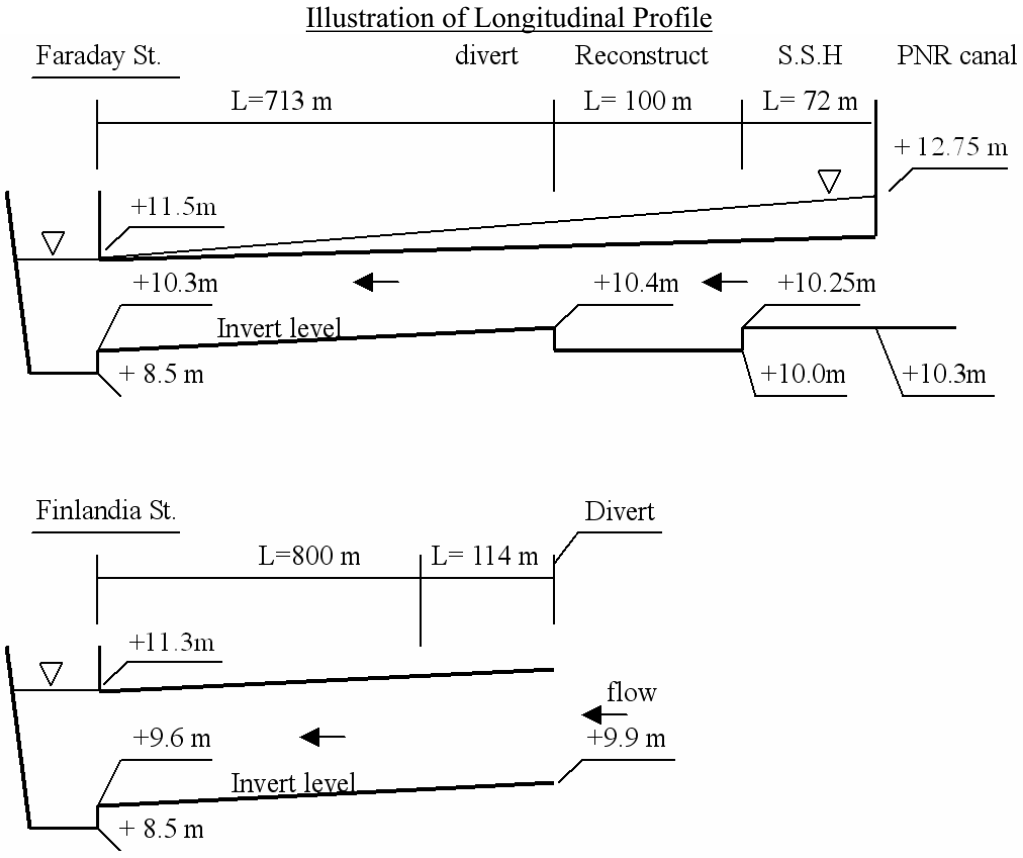
(3) Water level at Upper End

Water Level at Outlet: Elev.+11.5 m
Total Friction Loss: 1.25m
Water Level at Upper End: Elev.+12.75m < ground Elev.+12.9m Ok

A.F.4.4 LONGITUDINAL PROFILE

(1) Assumed Longitudinal Profile

The longitudinal profile of Faraday drainage main are assumed as shown below.



(2) Checking of Covering

- Covering under SSH

  Top Elev. of Upper Slab

Invert Elev. of culvert	Elev. +10.25 m
Height of culvert	1.40 m
Thickness of slab	0.30 m
Total	Elev. +11.95 m

  Covering under South Super Highway: D

  D = Road surface (Elev.+13.0m) - Top Elev. of Upper Slab(+11.95m)

  = 1.05 m > $D_{min.}$ (=1.0m) ok

- Cover under Railway

  Top Elev. of Upper Slab

Invert Elev. of culvert	Elev. +10.30 m
Height of culvert	1.40 m
Thickness of slab	0.30 m
Total	Elev. +12.00 m

  Covering under South Super Highway: D

  D = Top of Railway (Elev.+13.6m) - Top Elev. of Upper Slab(+12.00m)

  = 1.6 m > $D_{min.}$ (=1.0m) + thick of plinth (0.50m) ok

ANNEX F.5

STRUCTURAL STUDY

ANNEX F.5: STRUCTURAL STUDY

A.F.5.1 DESIGN CONDITION

(1) Load , Strength and so on

The loads acting to the culvert made under the road consist of the dead load and the live load. The dead loads consist of soil weight, pavement weight, weight of slab and wall, earth pressure and water pressure. The live loads consist of wheel load, spread load and so on.

The design value such as unit weight of the material is adopted following the design manual and AASHTO.

Reinforcement concrete 24.5 kN/m^3
Back-fill soil 18.0 kN/m^3
Wheel load (18 Truck Load) 72 kN

The strength of concrete and steel bar is as follows:

Concrete compressive strength 21 MPa
Shearing strength 31.5 kN

The diameter of reinforcement Bar is more than 16 mm.

(2) Soil condition

The subject area is covered by the alluvial stratum. The thickness of the alluvial stratum is 4m to 24m. The alluvial stratum consists of sandy soil and silt soil. The tuff stratum exists under the alluvial stratum.

The outline of soil test is shown in the table below.

Outline of Soil Test

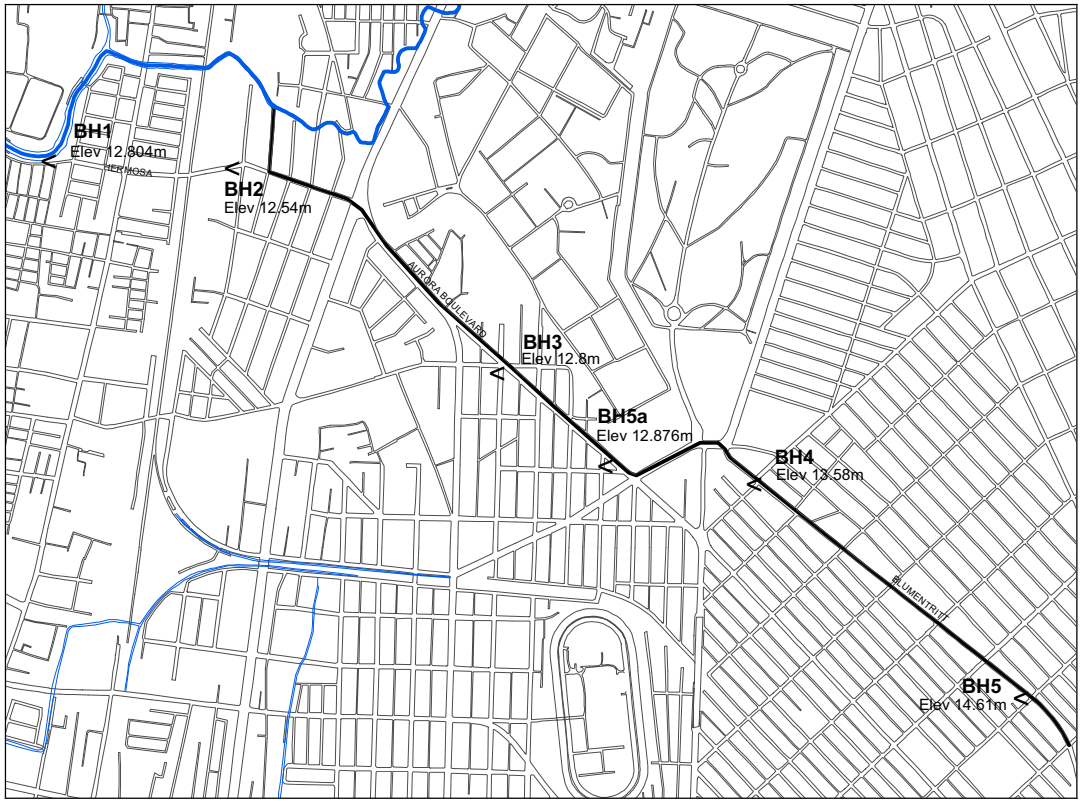
Stratum	N-value	consistency	qu kN/m^2	Remarks
Silty sand	3 to 6	Loose		BH-1,3,6
Sand	2 to 46	loose to dense		BH-1,2,3,4,5A,6,7,8
Sandy silt	2 to 10	soft to stiff		BH-2,5A,7,8
Clayey silt	8 to 22	firm to stiff		BH-5
Tuff			BH-4: > 238 BH-5: > 38 BH-8: > 100	The strength of Tuff on BH-5 and 8 is too weak.

The geological profile of Blumentritt Interceptor, Zobel Roxas DM and Faraday DM are shown in the next figures.

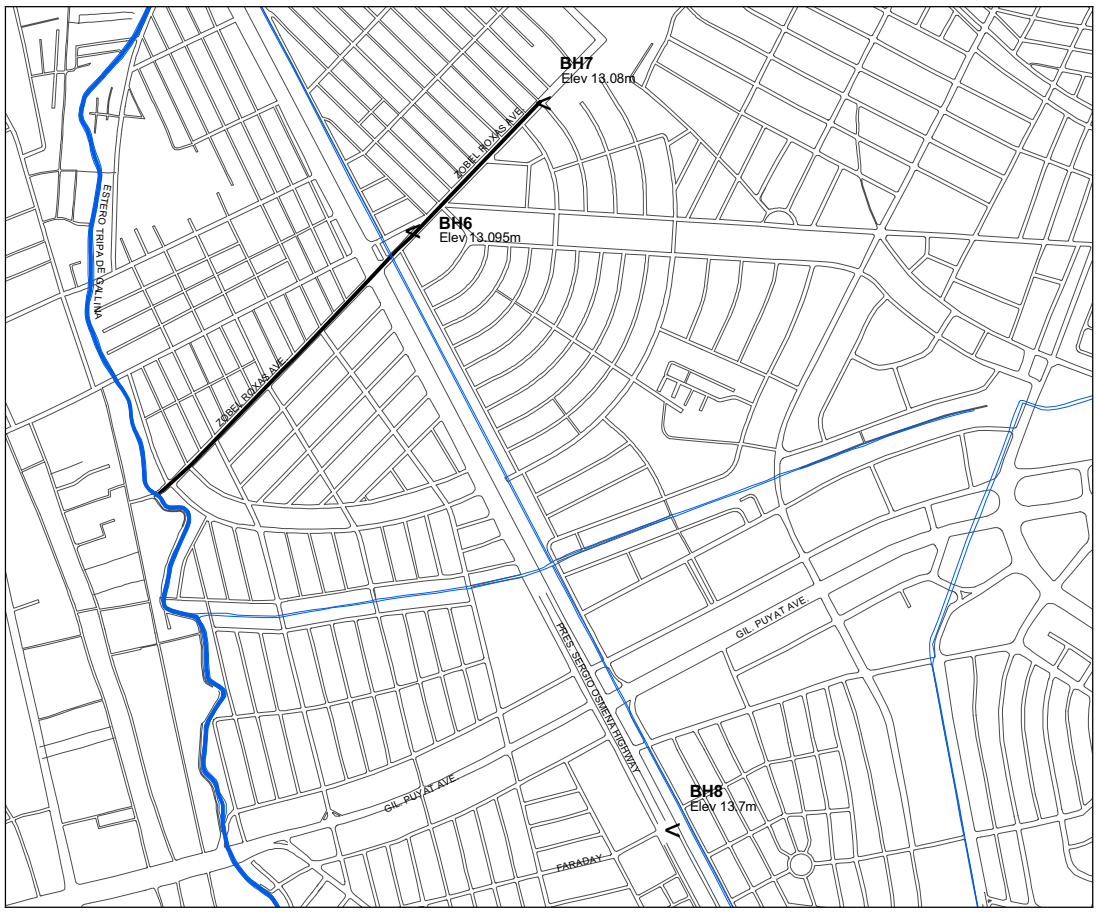
(3) Water table

The water table measured was 1.0m to 2.9m under the ground surface. From the geological profiles, it was known that the top of additional culvert is almost same level as the water table.

Borehole Location Map (North Manila)



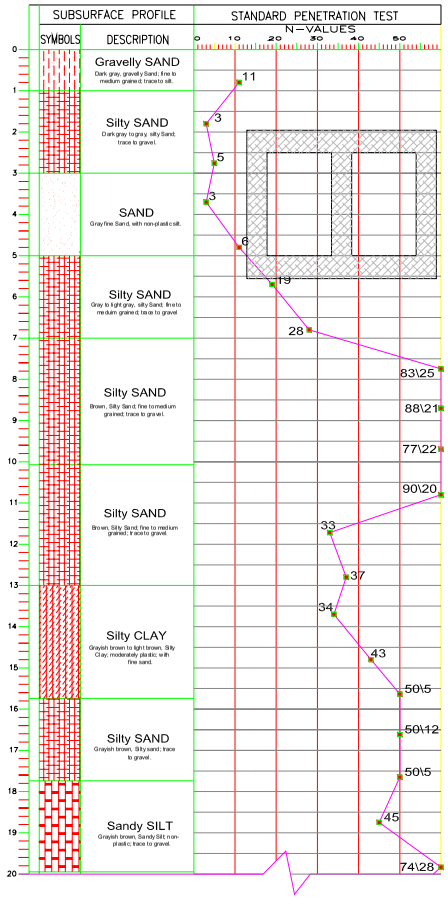
Borehole Location Map (South Manila)



SOIL PROFILE OF BLUMENTRITT INTERCEPTOR (1/2)

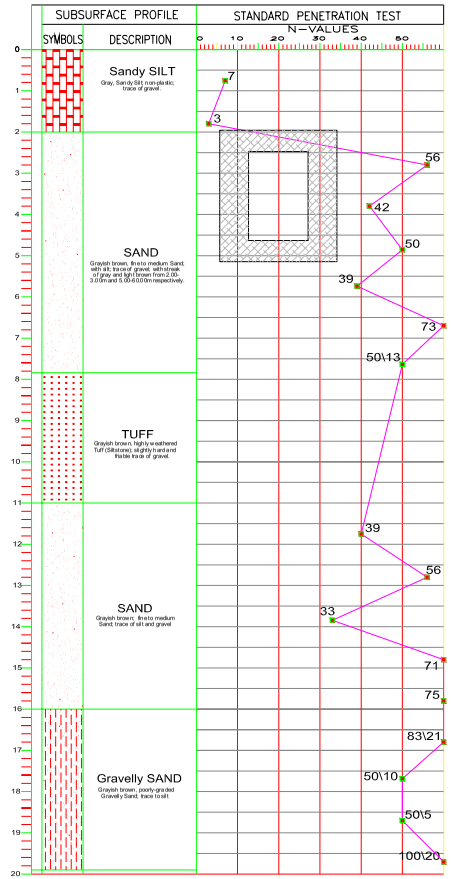
BH-01

FINAL DEPTH = 24.75m.
ELEV. = 12.804
COORDINATES : 496945.356E
1618369.665N



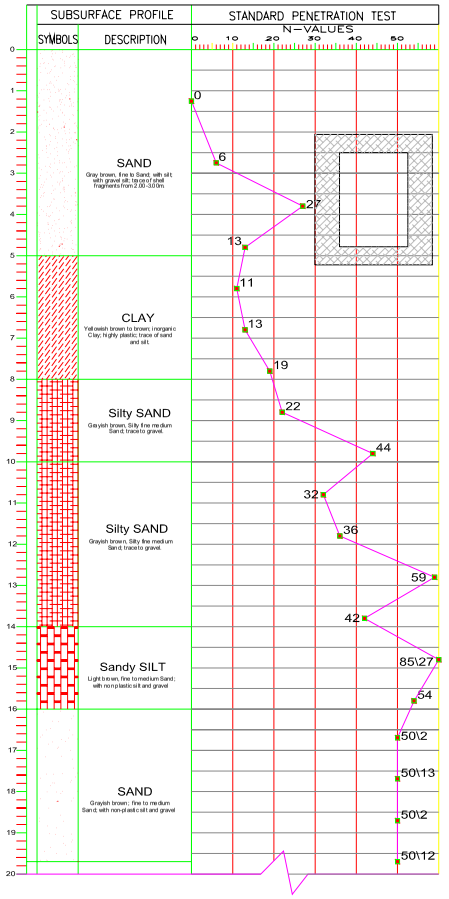
BH-02

FINAL DEPTH = 19.90m.
ELEV. = 12.540
COORDINATES : 497425.805E
1618347.562N



BH-03

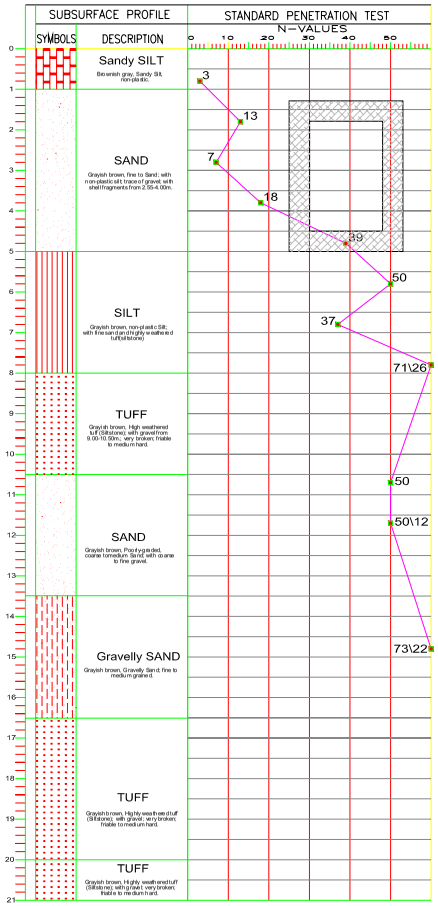
FINAL DEPTH = 22.50m.
ELEV. = 12.860
COORDINATES : 498148.796E
1617796.544N



SOIL PROFILE OF BLUMENTRITT INTERCEPTOR (2/2)

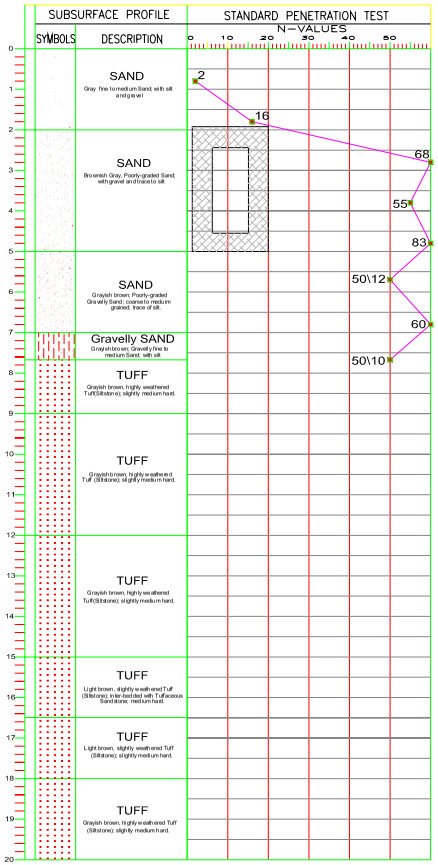
BH-5A

FINAL DEPTH = 21.00m.
ELEV. = 12.876
COORDINATES : 498442.089E
1617542.089N



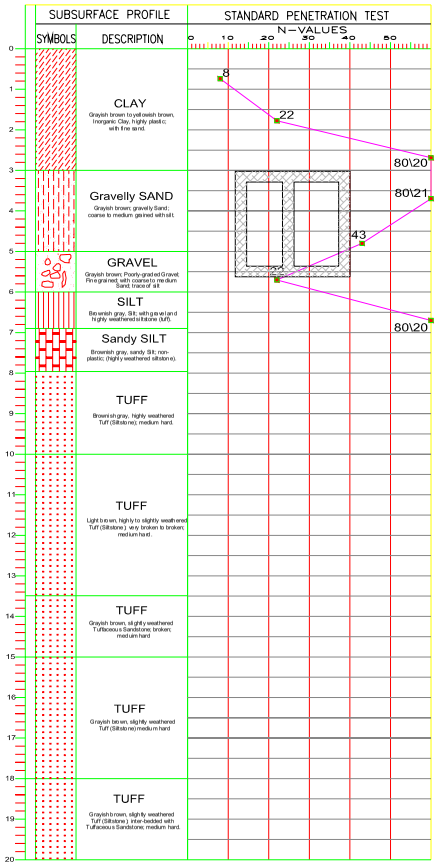
BH-04

FINAL DEPTH = 20.00m.
ELEV. = 13.580
COORDINATES : 498839.436E
1617496.560N



BH-05

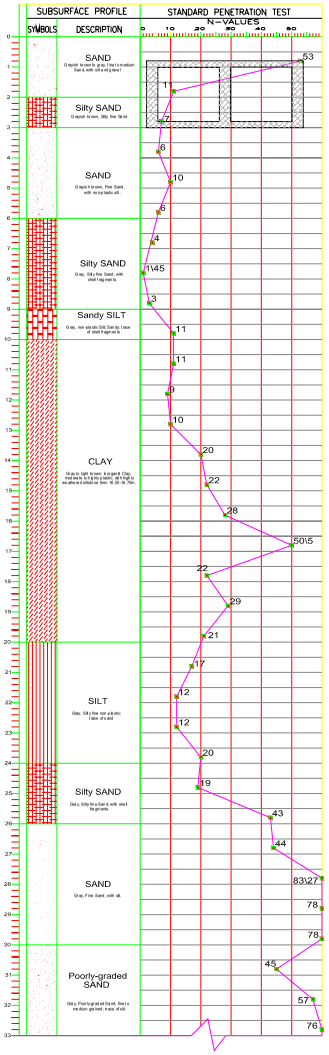
FINAL DEPTH = 20.00m.
ELEV. = 14.610
COORDINATES : 499555.750E
1616920.004N



SOIL PROFILE OF ZOBEL ROXAS AND FARADAY DM

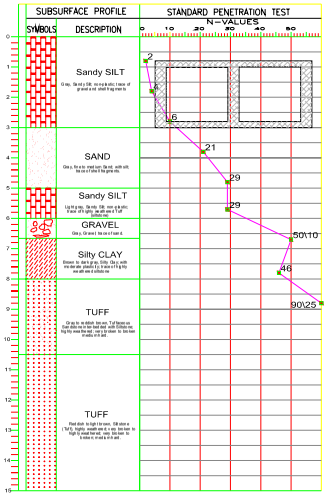
BH-06

FINAL DEPTH = 36.10m.
ELEV. = 13.095
COORDINATES : 500274.792E
1611043.374N



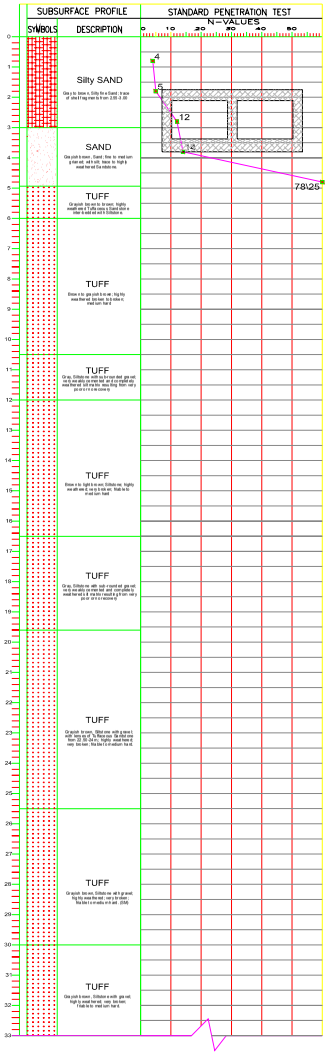
BH-07

FINAL DEPTH = 15.00m.
ELEV. = 13.08
COORDINATES : 500554.831E
1611315.094N



BH-08

FINAL DEPTH = 34.90m.
ELEV. = 13.70
COORDINATES : 500830.068E
1609776.260N



A.F.5.2 STRUCTURAL STUDY

(1) Dimensioning

The additional culverts consist of 1 cell box and 2 cells box made by the reinforcement concrete. These culverts are made under the road with about 1.2m covering.

The dimensions of culvert are decided depending on the site condition as follows.

	1 cell box	2 cells box
Inner width	1.8m to 3.6m	1.7m to 3.4m
Inner height	1.4m to 2.7m	1.4m to 2.6m

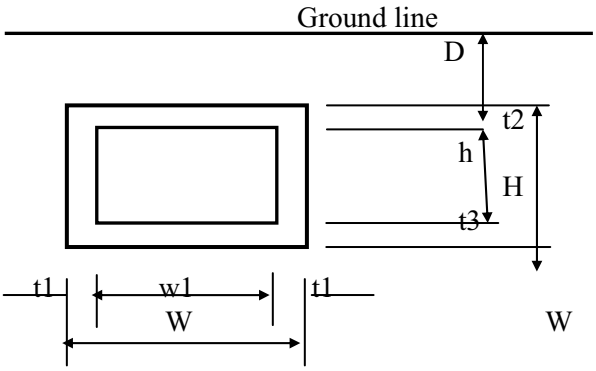
(2) Foundation

The additional culvert will be made under the road. The loads acting to footing of the culvert are weight of the culvert itself and the soil above the culvert. Regarding to the type of Foundation, tow case of small size culvert and big size culvert were tried.

(1) Case of **Culvert w=1.5m, h=1.2m**

This culvert is narrow width with thin covering and is made on the poor foundation (N=6). (see Geological Profiles)

Load



w1 1500 mm
h 1200
t1 300
t2 300
t3 350
D 1000
W 2100, H 1850 mm

Weight of Culvert and Covering Soil : $w=A \cdot (\gamma c - \gamma w) + D \cdot \gamma s$

$w_b = (2.1 \times 1.85 - 1.2 \times 1.5) \cdot (25-10) + 1.0 \cdot 18 \cdot 2.1$

$= 69.1$ kN/m $\rightarrow$ $= 32.9$ kN/m2

where

γc :unit weight of concrete 25kN/m3

γw :unit weight of water 10kN/m3

γs : unit weight of soil 18kN/m3

Allowable soil bearing capacity

The allowable soil bearing capacity (Qa) is derived from the ultimate soil bearing capacity (Qu) using the safety factor as follows:

$$Qa = \frac{Qu}{SF}$$

SF = 3 under the normal condition

SF = 2 under the seismic condition

The ultimate bearing capacity of a foundation ground is calculated by the following formula:

$$Qu = A'\left\{\alpha\, k\, c\, N_c + k\, q\, N_q + \frac{1}{2}\gamma_1\, \beta\, B'\, N_r\right\}$$

Where,

Qu=ultimate bearing capacity (kN)

A' =effective loading area on footing (m^2) (refer to following figure)

α , β = coefficient depending on shape of footing as shown in the following table:

Shape of Footing	α	β
Excessively long rectangle	1.0	1.0
Circle or Square	1.3	0.6
Rectangle or ellipse	1+0.3B'/L'	1-0.4B'L'

C=cohesion of foundation ground (kN/m^2)

q=ground surface surcharge (kN/m^2)

$=\gamma_2 \cdot Df$

γ_1, γ_2=unit weight of soil of ground foundation (kN/m^3)

B',L' =width and length of effective loading areas as shown in following figure (m)

$B' = B - 2e_H$; $L' = L - 2e_L$

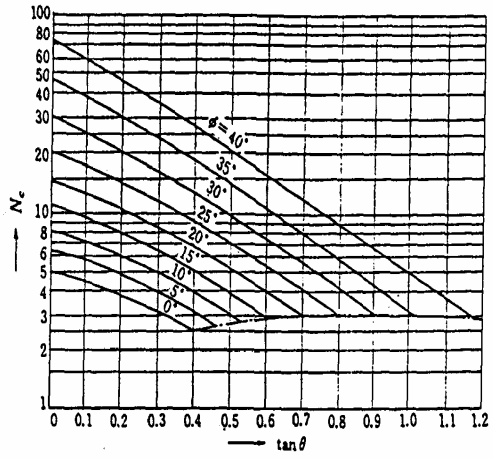
e = distance from center of footing to acting of resultant force on footing as illustrated in following figure (m)

Df = depth from ground surface to bottom of footing (m)

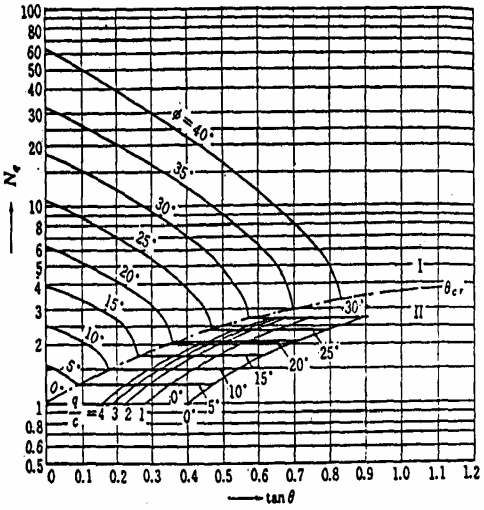
K = coefficient (1+0.3 x Df'/B)

Df' = structure embedded depth into base (m)

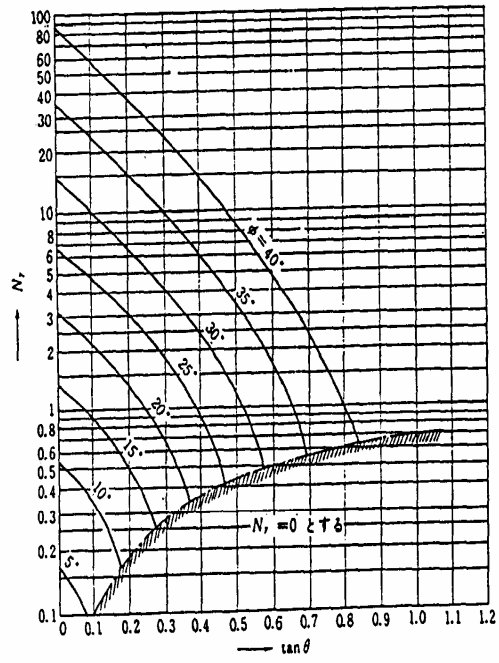
Nc, Nq and Nr = bearing capacity factors (refer to following graphs)



Graph for Bearing Capacity Factor Nc



Graph for Bearing Capacity Factor Nq



Graph for Bearing Capacity Factor Nr

Graphs for Bearing Capacity

adopting the value to Ultimate Bearing Capacity Formula depending on the site,

Internal friction angle : $\phi = 15 + (15N)^{1/2}$

Case of minimum N-value = 6 ← see BH-06.07

$\phi = 15 + (15 \times 6)^{1/2} = 24 \rightarrow = 20$

Area A' = w x l = 2.1 x 1.0 = 2.1 m2

α , β -value = 1.0 ← long rectangle

Cohesion c c= 1kN/m2 ← assumption

Embedded depth Df= D+H =1.0+1.85 =2.85m

Surcharge q= γ s・Df = 18.0x1.0+9.0x1.85 =34.6 kN/m2

Coefficient k = 1+0.3Df/W =1+0.3x2.85/2.1 k=1.4

Bearing capacity factor Nc = 20, Nq =6.1 and Nr=3.1

From these value, bearing capacity is

Qu = A'{ α kc Nc+kqNq+ γ s β WNr}

= 2.1(1.0x1.4x1.0x20 +1.4x34.6x6.1 + 9x1.0x2.1x3.1)

= 802 kN/m

Qa = Qu/ SF(=3) =267 kN/m = 127kN/m2 > w_b = 32.9 kN/m2 ok

(2)Case of culvert **w3.4m, h2.6m x 2cells** (Blumentritt Interceptor)

The dimension and figure of this culvert are shown in next paragraph.

Load

Weight of Culvert and Covering Soil : w=A・(γ c- γ w) +D・ γ s

w_b = (8.2 x 3.65-3.4 x 2.6 x 2) ・(25-10) +1.5・18・8.2

= 184+221 = 405 kN/m → = 49.4 kN/m2

Allowable soil bearing capacity

Adopting the value to Ultimate Bearing Capacity Formula depending on the site,

Internal friction angle : $\phi = 15 + (15N)^{1/2}$

Case of minimum N-value = 6 ← see BH-01

$\phi = 15 + (15 \times 6)^{1/2} = 24 \rightarrow = 20$

Area A' = w x l = 8.2 x 1.0 = 8.2 m2

α , β -value = 1.0 ← long rectangle

Cohesion c c= 1kN/m2 ← assumption

Embedded depth Df= D+H =1.5+3.65 =5.15m

Surcharge q= γ s・Df = 18.0x1.5+9.0x3.65 =59.8 kN/m2

Coefficient k = 1+0.3Df/W =1+0.3x5.15/8.2 k=1.2

Bearing capacity factor Nc = 20, Nq =6.1 and Nr=3.1

From these value, bearing capacity is

Qu = A'{ α kc Nc+kqNq+ γ s β WNr}

= 8.2(1.0x1.2x1.0x20 +1.2x59.8x6.1 + 9x1.0x8.2x3.1)

= 5658 kN/m

Qa = Qu/ SF(=3) =1886 kN/m = 230kN/m2 > w_b = 49.4 kN/m2 ok

Therefore , the spread foundation will be applied for the culvert.

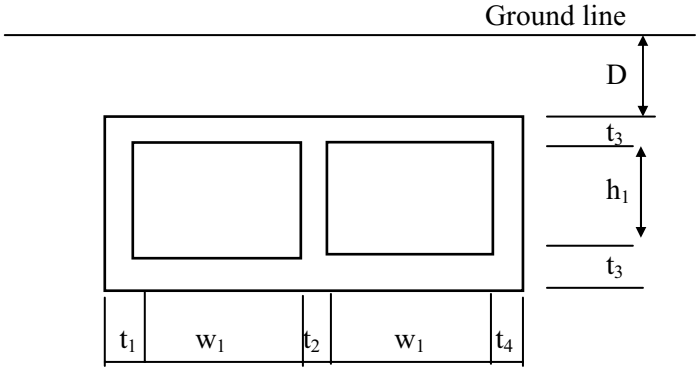
(3) Thickness of Member

The thickness of the member of the culvert was decided by the structural calculation. As sample, tow cases were shown.

(1)Case of Blumentritt Interceptor Culvert Bl –1 (w3.4m, h2.6m x 2cells)

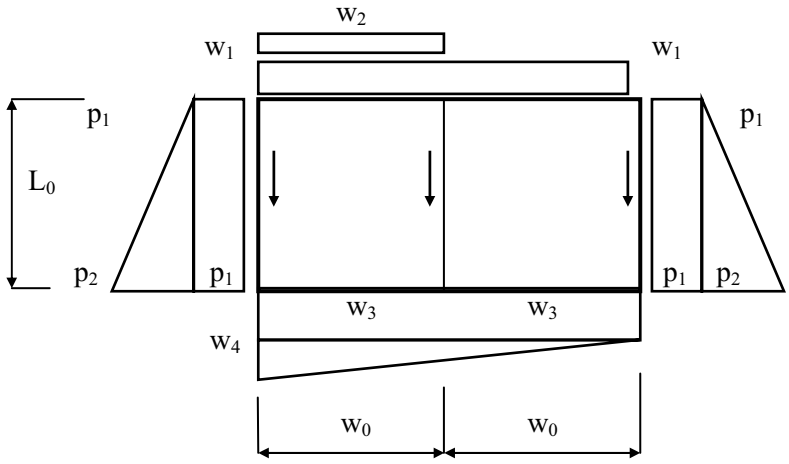
The assumed dimension and loading diagram of the culvert are as follows.

Dimensions



w_1	3400 mm
h_1	2600
t_1	500
t_2	400
t_3	500
t_4	550
D	1500

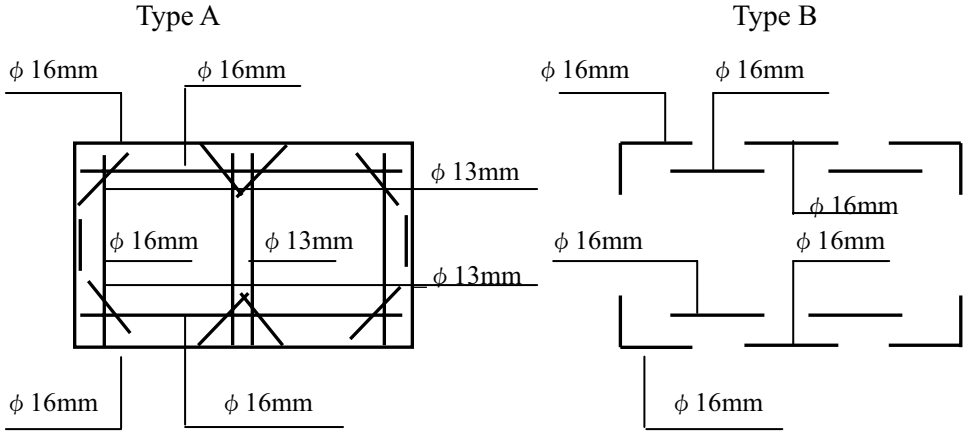
Loading Diagram



w_1	41.0kN/m^2
w_2	20.8
w_3	55.1
w_4	22.4
p_1	16.5
p_2	45.7
L_0	3150 mm
w_0	3850

Based on the structural calculation of above frame work, required bar are obtained as shown below.

Bar Arrangement / Bar schedule

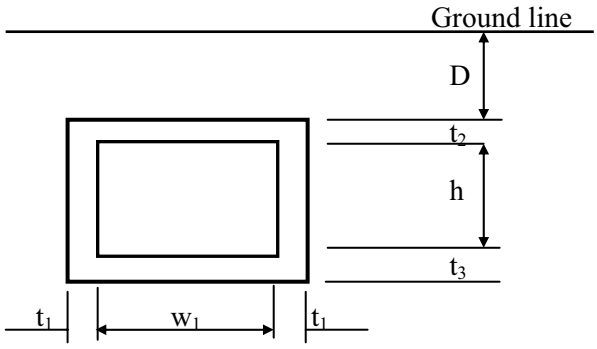


Bar spacing: Type A-100mm – Type B-100mm – Type A-100mm ・・・

(2)Case of Blumentritt Interceptor Culvert Bl –2 (w3.6m, h2.7m)

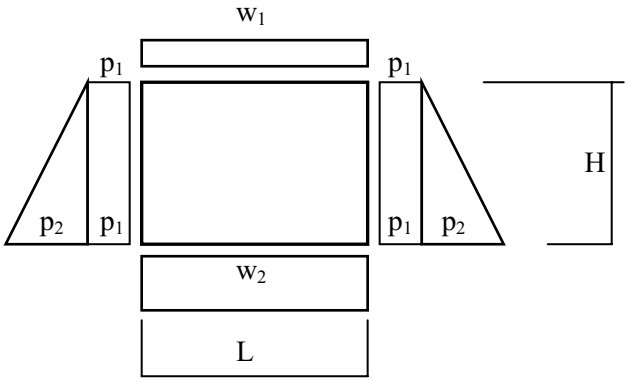
The assumed dimension and loading diagram of the culvert are as follows.

Dimensions



w_1	3600 mm
h	2700
t_1	500
t_2	500
t_3	550
D	2700

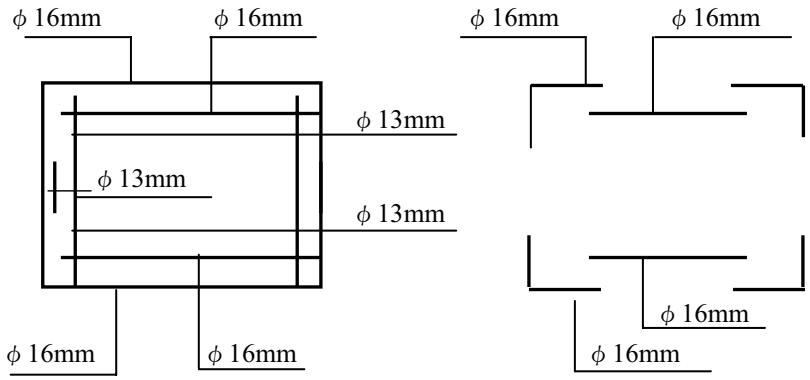
Loading Diagram



w_1	82.1kN/m^2
w_2	101.9
p_1	32.3
p_2	47.1
H	3.75m
L	4.10m

Based on the structural calculation of above frame work, required bar are obtained as shown below.

Bar Arrangement / Bar Schedule



Bar spacing: Type A-100mm – Type B-100mm – Type A-100mm ・・・

G. COST ESTIMATE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Page

G.1 GENERAL

This supporting report explains mainly cost estimate for the main civil works of projects identified in the master plan and priority projects for urgent implementation through the feasibility study. Firstly, preliminary cost estimate for the projects identified in the master plan is explained including objective works, construction plan and schedule as a premise condition. Subsequently, explanation on those of the priority projects for urgent implementation will be similarly made.

G.2 COST ESTIMATE FOR MASTER PLAN PROJECTS

G.2.1 MAJOR WORKS AND PHASING OF MASTER PLAN PROJECTS

Major construction works required for drainage improvement are 1) rehabilitation works of drainage channels, 2) rehabilitation works of 12 drainage pumping stations and 3) additional works in Aviles-Sampaloc area in North Manila and San Isidro-San Antonio-Pio del Pilar area in South Manila, as mentioned in section of proposed plan.

Drainage improvement works are planned to be implemented in 3 phases aiming at the target year of 2020 commencing in the year 2006. Major work items by the respective phases are divided considering effective work priority and cost balance by phases.

(1) 1st Phase for Short- Term Projects

1) Rehabilitation works of drainage channels

- Dredging: 139,000 m^3
- Dredging: 20,000 m^3

2) Rehabilitation works of drainage pumping stations (12 stations)

North Manila

- Quiapo
- Aviles (increase of pump capacity 3 m^3/s)
- Valencia
- Binondo
- Escolta

South Manila

- Tripa de Gallina
- Pandacan
- Paco
- Sta.Clara
- Libertad
- Makati
- Balete

3) Additional works

North Manila

Maypajo-Blumentritt- Balut Drainage Block

- Additional works of Blumentritt Interceptor

South Manila

Libertad-Tripa de Gallina Drainage Block

- Additional works for severe inundation area in South Manila
  - Additional B.C. along Zobel Roxas D.M.
  - Additional B.C. along Faraday D.M.

4) Other required works

- Installation of additional hydrological equipment
- Introduction of emergency operation and maintenance equipment

(2) 2nd Phase for Medium-Term Projects

1) Rehabilitation works of drainage channels

- Dredging: 360,000 m^3
- Dredging: 50,000 m^3

2) Rehabilitation works of drainage pumping stations (3 stations)

North Manila

- Vitas
- Balut

South Manila

- San Andres

3) Additional works

North Manila

Vitas-Binondo-Escolta Drainage Block

- Additional works of south Antipolo canal area
  - Replacement of existing Kabulusan Sub Outfall
  - Additional B.C. along South Antipolo Open Canal

Quiapo-Aviles Drainage Block

- Additional works of channel to Quiapo Pumping Station
- Additional works for Aviles drainage area
- Installation of pump gate (2 m^3/s) at the existing Uli-Uli floodgate

South Manila

Libertad-Tripa de Gallina Drainage Block

- Additional works of Libertad pond
- Additional works for severe inundation area in South Manila
  - Additional B.C. along Makati Diversion Channel

Paco-Pandacan-San Andres Drainage Block

- Installation of pump gate on Perlita Creek

Sta. Clara Drainage Block

- Installation of pump gates in Sta.Clara drainage basin

4) Other required works

- Various management systems for O&M

(3) 3rd Phase for Long-Term Projects

1) Rehabilitation works of drainage channels

- Dredging: 340,000 m^3
- Dredging: 11,000 m^3

2) Additional works

North Manila

Maypajo-Blumentritt-Balut Drainage Block

- Additional works of Estero de Vitas

Vitas-Binondo-Escolta Drainage Block

- Additional works of South Antipolo canal area
  - Additional B.C. along Solis Tescon D.M.

South Manila

Libertad-Tripa de Gallina Drainage Block

- Additional works of Dilain/Maricaban Creek area

Balete Drainage Block

- Additional works in Estero de Balete

G.2.2 COST ESTIMATE FOR MASTER PLAN PROJECTS

(1) Basic Conditions for Construction Plan

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

- Detailed design is to be conducted ahead of construction works.
- Construction works are to be carried out by selected contractors throughout international competitive bidding with prequalification procedure.
- PMO for implementation of the project is established in the DPWH under coordination committee as already explained in Implementation Organization.
- Annual working days of 260 for construction works are assumed.
- Bidding including prequalification is to be completed within 1 year immediately after finishing detailed design.
- Construction period by phases is proposed to be basically 3 years including maintenance period from 6 month (drainage channel) to 1 year(drainage pumping station).
- Informal settlers in the objective channels are to be removed ahead of construction works,
- Resettlement is to be carried out basically by an implementation body in collaboration with the respective LGUs.
- Proposed interceptor is to be constructed in the underground by open excavation method and prefabricated culvert box is to be applied to shorten the construction period not so as to disturb traffic flow in longer duration.
- Average distance to disposal area of dredged materials is assumed to be 10 km.
- Cleaning of laterals are to be conducted throughout daily maintenance activities by the respective agencies of MMDA and LGUs separately from contracting system.
- The project cost finance is to be shared between national government and LGUs under the condition that main works be made by the national government and resettlement, national government and LGUs under the direction of implementing body, respectively.

In line with the above condition and assumption, construction works by phasing are preliminary scheduled as shown in *Figure G.2.1*.

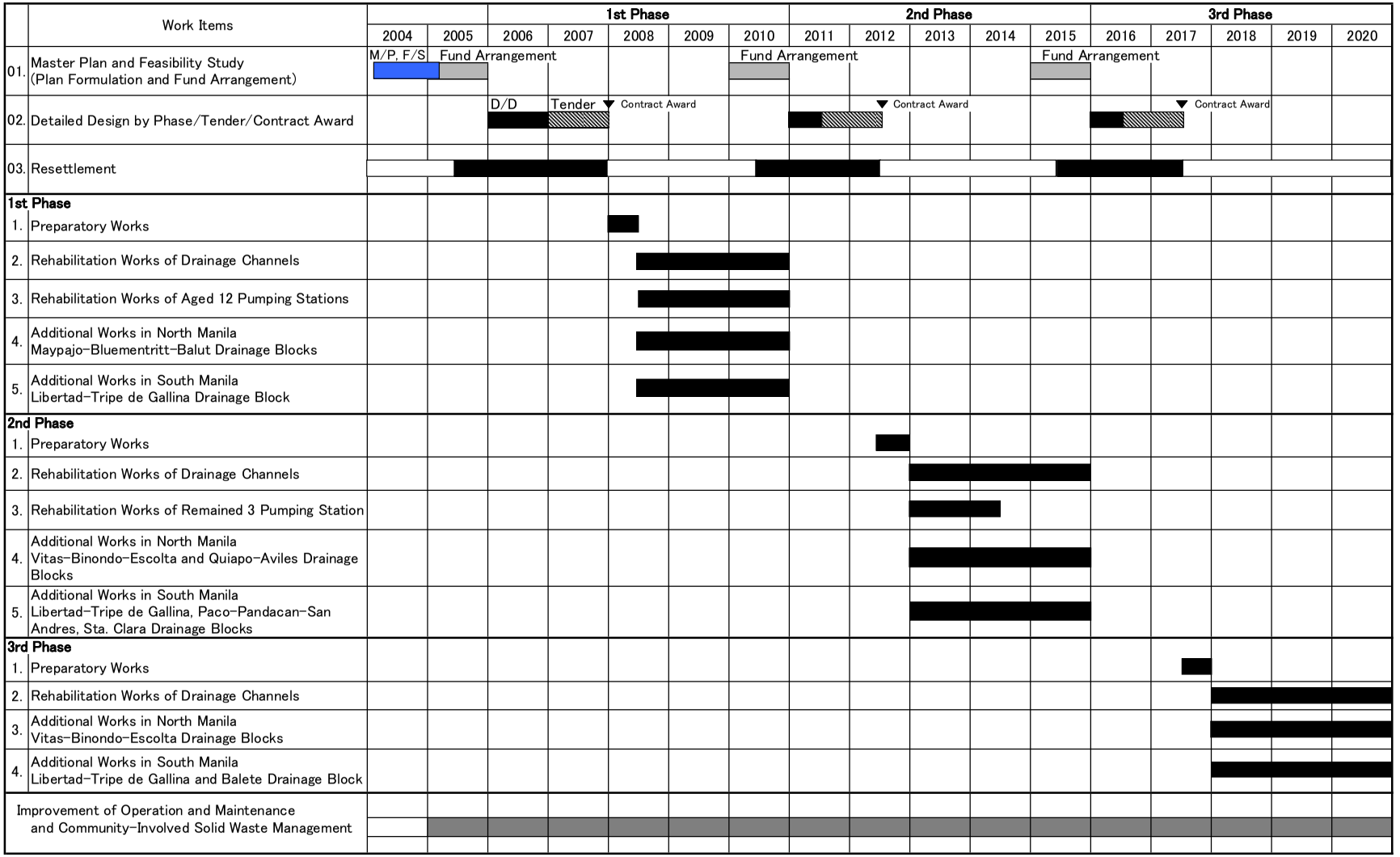


Figure G.2.1 Preliminary Construction Schedule of Master Plan

(2) Basic Conditions for Cost Estimate

The project cost consists of costs of main works, compensation, engineering services, administration by government staff, and contingency. The following are the basic conditions of cost estimate.

- Unit cost is estimated referring to the recent unit prices obtained from DPWH and similar projects in Metropolitan Manila.
- Price level is July 2004 with exchange rate of US1$=Pesos 55 = JY 110.
- Classification of local and foreign currencies is assumed as follows.

  Local currency portion (L/C)
  - Labor cost
  - Cost 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
- The following ratio 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 %) : L/C (35 %)
  - Rehabilitation and additional works of drainage pumping stations:

    F/C (70 %) : L/C (30 %)

(3) Applied Unit Cost

As already explained, the unit price for works is estimated referring to the recent unit prices obtained from DPWH and similar ongoing projects in Metropolitan Manila. The major applied unit prices are summarized in *Table G.2.1*.

Table G.2.1 Unit Price for Major Works

Work Item	Unit	Unit Price (peso)
Dredging of open channel	m^3	1,200
Declogging of closed channel(box culvert)	m^3	1,650
Excavation (exclude wall by steel sheet piling)	m^3	572
Backfill	m^3	514
Steel sheet piling for excavation works	m^2	3,200
Concrete	m^3	5,140
Reinforced bar	ton	29,500
Repair/replace of pump equipment and appurtenant facilities	LS	-
Improvement of bridge	m^2	60,000
Pump gate	m^3/s	80,000,000

(4) Direct Construction Cost

Table G.2.2 shows work quantity, unit price and direct construction cost of master plan projects by phases. The detailed cost estimate is shown in *Annex G.1*. The total direct construction cost is estimated at Php 8.2 billion and broken down into the following respective phases.

- 1st phase: Php 3,258.8 million
- 2nd phase: Php 2,839.5 million
- 3rd phase: Php 2,134.1 million
- Total direct cost: Php 8,232.4 million

Table G.2.2 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 Kabulusan 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 España 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 Sampaloc 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	Heightenning of river wall in the lower Estero 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 existing 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 Marcelino 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.

(5) Resettlement Cost

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

Resettlement cost required in "Pasig River Environmental Management and Rehabilitation Sector Development Program (March 2000)" is applied in the present study. The resettlement 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. The total amount is estimated at Php 212,000/family. It should be noted that the cost for land acquisition is not included.

Considering price increase during 2000 to 2004 (price escalation is 110.6%), unit price of the cost for resettlement excluding land acquisition cost is calculated as follows.

Php 212,000 / family x 1.106 = Php 234,472 / family

Land Acquisition cost for relocation site is calculated as shown in *Table G.2.3*.

Table G.2.3 Land Acquisition Cost for Resettlement Site

Informal Settler (Receiving Site)			
Residential Area			
Average housing lot (m^2)		Number of Affected Household	
A-type	40	3,000	120,000 m^2
B-type	20	2,500	50,000 m^2
Sub Total			170,000 m^2
Roads & Public Area			
30 % of Residential Area			51,000 m^2
Total Land Required			221,000 m^2
			22.1 ha
Unit Cost for Acquisition			Php 1,000 /m^2
Subtotal			Php 221,000,000

In the table, unit cost for acquisition based on DPWH policy framework (Aug. 2001) shown in *Table G.2.4* is applied in the present study.

Table G.2.4 Unit Cost for Acquisition for Resettlement Site

Unit : Php

DPWH policy framework Aug 2001		
Acquisition Cost		
Project Site(Sending Site)	8,250 /m^2	North Caloocan, (Zonal Vlalue 7,500 +10%, based on Administrative Order No. 50)
	12,000 /m^2	North Caloocan, Asking Price of Owner
Relocation Site(Receiving Site)	817 /m^2	San Jose Del Monte, Bulacan, 45km form Metro Manila (KAMANAVA Project)
	1,000 /m^2	Paran, Marikina Bridge Project
	750 /m^2	Baludad, Marikina Bridge Project
Livelihood Program	1 day	Meat Processing and food preservation
	1 day	Food trade and Novelty Items
	17 days	Isan gunting, Isan Suklay
	1 day	Food processing training
	1 day	Cooperative Development Orientation
Material Assistance	3 weeks until their houses were constructed at the new relocation sites.	
Food Assistance	1 week after relocation	
Pasay City Interview, July 2004		
Acquisition Cost		
Relocation Site(Receiving Site)	500 /m^2	Silan Cavite Resettlement Site, Cavite Province, 35km from Manila
NHA Interview, July 2004		
Acquisition Cost		
Relocation Site(Receiving Site)	240 /m^2	Caluan Resettlement Area, Laguna Province

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

Table G.2.5 Resettlement Cost

Unit : Php million

Phase	Percent of Resettles	Resettlement (excl. land acquisition)	Land Acquisition	Total
1st phase	15%	193.4	33.1	226.5
2nd phase	35%	451.4	77.4	528.8
3rd phase	50%	644.8	110.5	755.3
All Phase	100%	1,289.6	221.0	1,510.6

(6) Compensation Cost

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

The details are shown in *Table G.2.6*.

Table G.2.6 Compensation Cost for Additional Works (1st Phase)

Items	Unit	Quantity	Unit Price (Php)	Amount (Php million)
1.Land acquisition	L.S	1		0.8
1.1 Blumentritt drainage main	m^2	250	2,000	0.5
1.2 Faraday drainage main	m^2	160	1,650	0.3
2.House compensation	nos	10	300,000	3.0
Total				**3.8**

(7) Supporting Measures Cost

The cost for BEM and Team ESTERO activities and IEC campaign are estimated as follows.

- **Total cost for BEM and Team ESTERO activities: Php 417.8 million**
- **Total cost for IEC campaign: Php 71.1 million**

Table G.2.7 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

.

The detailed cost estimation is presented in *Tables G.2.8* and *G.2.9*.

Table G.2.8 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 G.2.9 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***

(8) Other Supporting Measures Cost

To support and sustain structural measures to be recovered and newly constructed, various supporting measures are taken up.

- **Total other supporting measures cost:** **Php 177.6 million**
- Various management systems: Php 138.5 million
- Additional hydrological equipment: Php 1.5 million
- Emergency operation and maintenance equipment: Php 37.6 million

The above supporting measures cost is allocated as follows.

1st phase: Php 39.1 million
(additional hydrological equipment: Php 1.5 million and emergency operation and maintenance equipment: Php 37.6 million)

2nd phase: Php 138.5 million
(various management systems: Php138.5 million)

Table G.2.10 Cost for Equipment and Facilities for Effective Operation and Maintenance

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

The detailed cost is shown in *Table G.2.11*. For the required specification of each equipment and facility, please refer to *Chapter 4.5 of Main Report.*

(9) 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 of Main Report*.

- **Total O&M cost:** **Php 241.0 million per annum**

Table G.2.11 Detailed Cost for Equipment and Facilities

				Unit ($)	Cost	
					US$	Php
(1)	**Document Management System**					
	Server, MMDA	Set	2	10,000	20,000	1,100,000
	Software	Set	1	10,000	10,000	550,000
	PC with software	Set	15	4,000	60,000	3,300,000
	Ethernet	Set	17	1,000	17,000	935,000
	Setting of Equipment (5% of Total)	Set	1	5,350	107,000	294,250
	Total				112,350	6,179,250
(2)	**Pumping Stations Management System**					
	Base Computer		1	20,000	20,000	1,100,000
	Server, MMDA	Set	3	10,000	30,000	1,650,000
	Management Software	Set	1	1,500,000	1,500,000	82,500,000
	Scaner, Printer MMDA, PS	Set	16	1,000	16,000	880,000
	Firewall, OP Console, UPS		1	20,000	20,000	1,100,000
	PC at PS MMDA, PS	Set	30	5,000	150,000	8,250,000
	Server at PS	Set	15	3,000	45,000	2,475,000
	Video PS	Set	15	1,000	15,000	825,000
	Ethernet	Set	15	1,000	15,000	825,000
	Interface	Set	15	20,000	300,000	16,500,000
	Setting of Equipment (5% of Total)	Set	1	104,550	2,091,000	5750250
	Total				2,195,550	120,850,250
(3)	**Solid Waste Transportation Supporting System**					
	Server, PC MMDA	Set	6	10000	60000	3,300,000
	Software	Set	1	50,000	50000	2,750,000
	PDA(with GPS)	Set	50	500	25000	1,375,000
	Setting of Equipment (5% of Total)	Set		6,750	135000	371250
	Total				141,750	7,796,250
(4)	**Empowerment of Pump Diagnostic System**	Set				
	Diagnostic Machine with PC	Set	2	10000	20,000	1,100,000
	Software	Set	1	30000	30,000	1,650,000
	AC Sensor and Amplifier	Set	2	3000	6,000	330,000
	Displacement, Pressure Sensors and Amplifier	set	2	5000	10,000	550,000
	Rolling Sensor	Set	2	1000	2,000	110,000
	Case Goods	Set	2	3000	6,000	330,000
	Total				74,000	4,070,000
(5)	**Manpower Resources Development**					
	Workshop 4 time/year	Set				
	Expert (F) 4P*4	Set	16	2000	32,000	1,760,000
	Material 80*4	Set	320	20	6,400	352,000
	Conffearance 60*4	set	240	20	4,800	264,000
	Site Training 4 time/year					
	Expert (F) 4P*4	Pers.	16	2000	32,000	1,760,000
	Hardware Material	set	1	1000	1000	55,000
	Consumption	set	1	1000	1000	55,000
	Total				77,200	4,246,000
(6)	**Installation of Additional Hydrological Eqipment**					
	Tipping Bucket Rain Gauge	Set	4	6000	24000	1,320,000
	Setting of Equipment (5% of Total)	Set		1200	1200	66,000
	O&M Equipment				1200	66,000
	Total				26,400	1,452,000
(7)	**Introduction of Emergency Operation and Maintenance Equipment**					
	Trailer Type Mobile Pump	Set	10	65000	650,000	35,750,000
	O&M Equipment 5%				32,500	1,787,500
	Total				682,500	37,537,500

(10) Project Cost

The total project cost is Php 15.4 billion as summarized in *Table G.2.12.* It should be noted that the total project cost shown here does not include the operation and maintenance cost (*Php 241.0 million per annum*).

Table G.2.12 Project Cost for Master Plan Projects

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: Php 5,503.9 million
2nd phase projects: Php 5,419.4 million
3rd phase projects: Php 4,444.0 million

G.3 COST ESTIMATE FOR PRIORITY PROJECTS

G.3.1 OBJECTIVE WORKS OF PRIORITY PROJECTS

(1) Rehabilitation and Additional Works of Drainage Channel Facilities in North Manila

The priority projects in north Manila are summarized below.

Estero de Sunog Apog

- Dredging (Clearing): 91,600 m^3

Blumentritt Interceptor

- Declogging of existing interceptor and related works: 9,800 m^3
- Construction of additional interceptor by box culvert and remedial works: 2,570 m in length

(2) Rehabilitation and Additional Works of Drainage Channel Facilities in South Manila

The priority projects in south Manila are summarized below.

Estero de Tripa de Gallina, PNR Canal and Calatagan Creek I

- Dredging (Clearing): 47,000 m^3

Buendia Outfall

- Declogging and related works: 7,200 m^3

Zobel Roxas Drainage Main

- Declogging: 2,200 m^3
- Construction of additional box culvert: 495 m in length

Pasong Tamo Drainage Main

- Declogging: 900 m^3

Faraday Drainage Main

- Declogging: 100 m^3
- Construction of additional box culvert: 1,314 m in length

(3) Rehabilitation and Additional Works of Drainage Pumping Stations

The priority projects for the drainage pumping stations in the core area of Metropolitan Manila are summarized below.

Drainage Pumping Station in North Manila

- Repair/replacement of pump equipment and appurtenant facilities: 5 drainage pumping stations

Drainage Pumping Station in South Manila

- Repair/replacement of pump equipment and appurtenant facilities: 7 drainage pumping stations

G.3.2 PACKAGING AND CONSTRUCTION SCHEDULE OF OBJECTIVE WORKS

(1) Packaging of Project

With due consideration of the respective work natures of the priority projects, the project works are divided into 3 lots with 11 packages carried out by contractors selected through local (LCB) and/or international (ICB) competitive biddings. Those are as follows.

1) Rehabilitation and Additional Works of Drainage Channel Facilities in North Manila (Lot I)

- Estero de Sunog Apog I (lower part): LCB
- Ester de Sunog Apog II (remained): LCB
- Blumentritt interceptor: ICB

2) Rehabilitation and Additional Works of Drainage Channel Facilities in South Manila (Lot II)

- Estero de Tripa de Gallina, PNR canal and Calatagan creek I: LCB
- Buendia outfall: ICB
- Zobel Roxas drainage main: ICB
- Pasong Tamo drainage main: LCB
- Faraday drainage main: ICB

3) Rehabilitation and Additional Works of Drainage Pumping Stations (Lot III)

- First group (Aviles, Quiapo, Valencia and Tripa de Gallina): ICB
- Second group (Pandacan, Paco, Sta. Clara, Libertad, Makati and Binondo): ICB
- Third group (Balete, Escolta): ICB

(2) Construction Schedule

For implementation of the priority projects in the core area of Metropolitan Manila, the fund arrangement including loan procedure and establishment of implementation organization of PMOs are firstly needed in the pre-construction stage. Subsequently, a selection of consultant is to be made for conducting detailed design for preparation of tender document and then, contractors are to select for carrying out construction works through local and/or international competitive biddings.

Considering such preparatory works, the construction time schedule is proposed as shown in *Figure G.3.1*. The preparatory works are to be started in early 2005 immediately after finishing of the feasibility study. The total construction period including the detailed design, procurement of contractors and maintenance period after completion of the respective projects is proposed at 5 years from 2006 to 2010.

As already mentioned, the rehabilitation works of the open channel of estero, especially in the dredging of estero de Sunog Apog is of simple and conventional works and that no resettlement of the formal and informal settlers is required in carrying out the object dredging works. In order to mobilize the project smoothly while waiting fund arrangement including loan procedure, it is proposed to commence the works in early 2005 immediately after finishing the feasibility study through a selection of local contractor or by means of force account system by MMDA. The drawings for dredging works prepared by the feasibility study are available and enough for carrying out the dredging works. However, the resettlement of informal settlers is needed for the same nature works of dredging of estero de Tripa de Gallina and other canal/creek I, prior to the commencement of the dredging works.

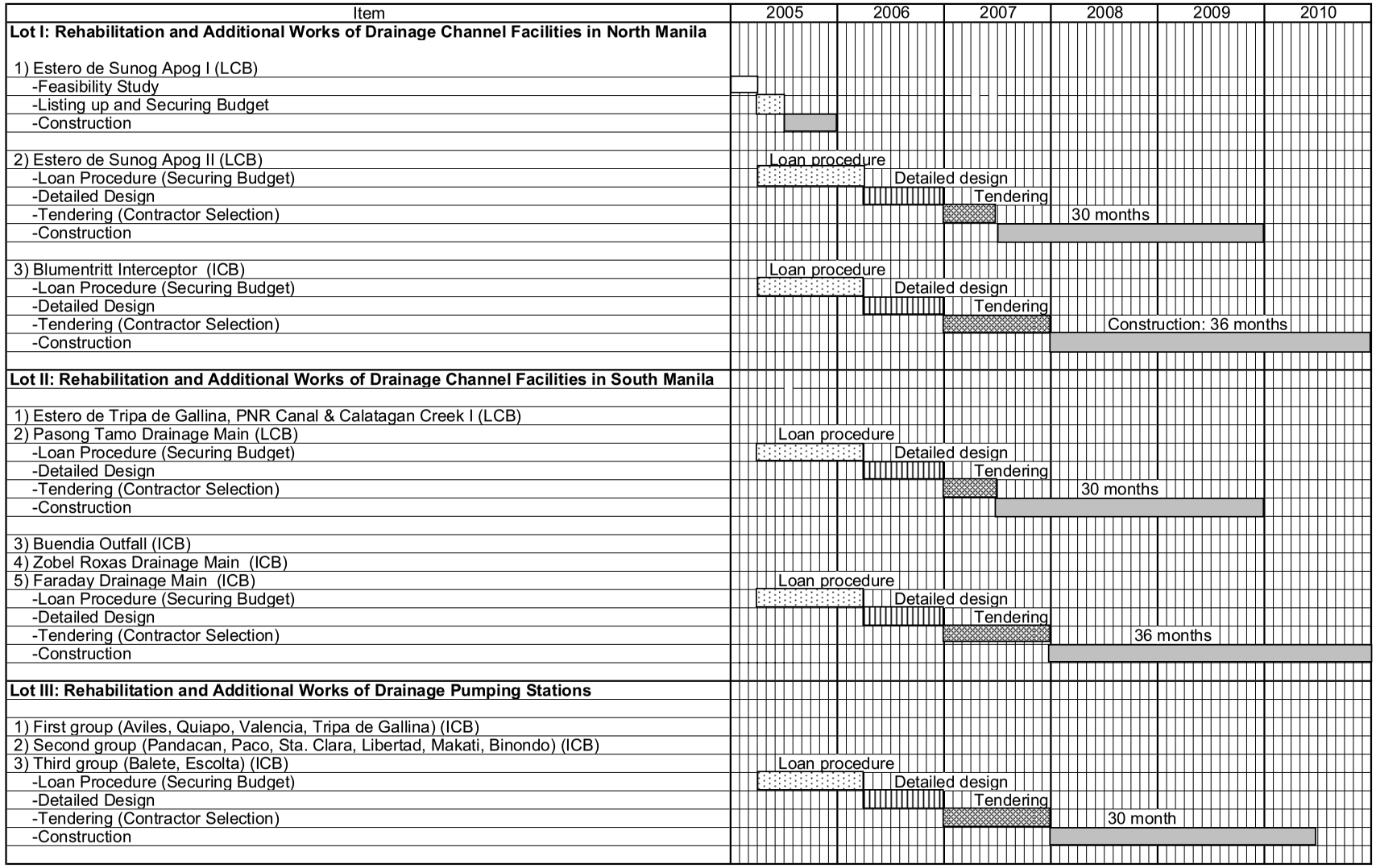


Figure G.3.1 Construction Time Schedule

G.3.3 COST ESTIMATE FOR PRIORITY PROJECTS

(1) Basic Conditions for Cost Estimate

Construction cost is estimated for the priority projects and the basic conditions of cost estimate applied in the master plan are used as they are in principle.

A dumping site designated in the ongoing KAMANAVA Project is available for the priority projects. The dumping area is approximately 5 hectare having around volume of 150,000 m^3. The dumping site is located 15 to 20 km from the project area in the core area. *Figure G.3.2* shows the location of proposed dumping site.

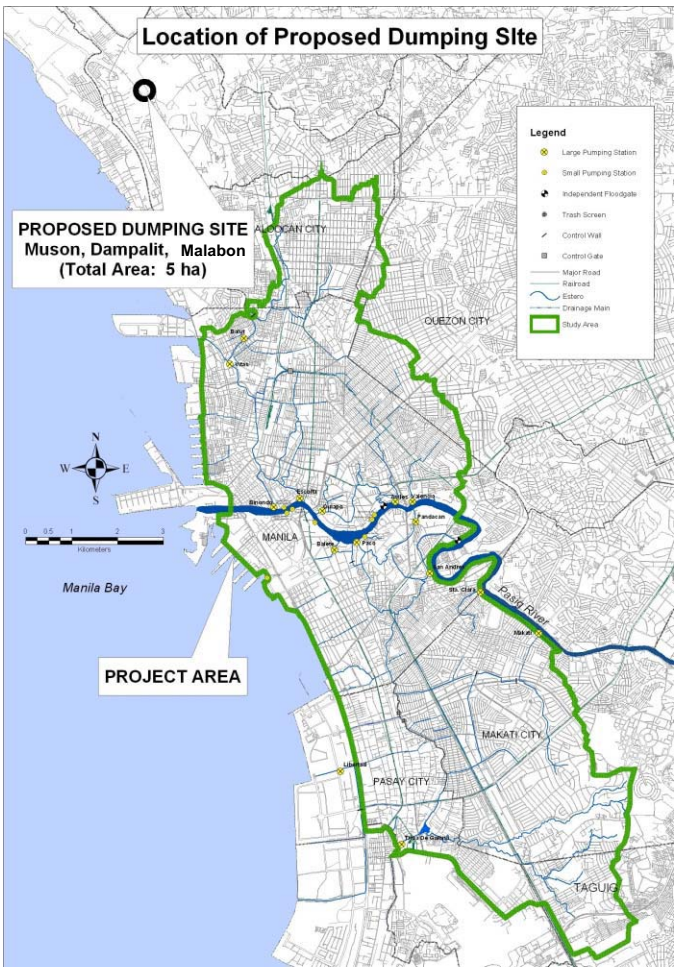


Figure G.3.2 Location of Dumping Site

Further, the composition of main civil works cost is as summarized below in the priority projects.

- Main works cost including temporary works with 3～10% of the total cost of civil works depending on work natures and site conditions
- Installation cost for equipment and facilities for effective O&M activities
- Miscellaneous cost with 5% of the total costs of main works cost and installation cost

(2) Unit Price

Unit price for major works are estimated on the basis of required equipment cost, labor cost and material cost considering transport distance to the designated dumping site in KAMANAVA area and the respective site conditions. The estimated unit price is summarized in *Table G.3.1*. The detail is shown in *Annex G.2*.

Table G.3.1 Unit Price of Major Works

Work Item	Unit	Unit Price (pesos)		
		Foreign	Local	Total
Unit Price for Works in North Manila				
Dredging of estero	m^3	1,484	499	1,983
Declogging of box culvert channel	m^3	1,614	650	2,264
Excavation works	m^3	1,128	316	1,444
Backfill	m^3	38	689	727
Unit Price for Works in South Manila				
Dredging of small estero	m^3	1,286	517	1,803
Declogging of box culvert channel	m^3	2,213	834	3,047
Excavation	m^3	1,350	373	1,723
Backfill		38	689	727
Other Unit Prices				
Concrete	m^3	66	4,718	4,784
Reinforced bar	ton	20,746	12,813	33,559
Reinforced concrete	m^3	1,726	5,742	7,468
Demolishing of pavement	m^3	137	50	187
Pavement	m^2	450	150	600
Repair/replace of pump equipment and appurtenants facilities	LS	-	-	-

(3) Direct Construction Cost

By using estimated unit prices, the total direct construction cost for the priority projects is estimated at Php 3.25 billion as shown in *Table G.3.2*. The detail is shown in *Annex G.3*.

Table G.3.2 Civil Works Costs of Respective Works

Sub Project	Civil Works Cost (million Pesos)	Procurement of Contractor /Equipment
Lot I: Rehabilitation and Additional Works for Drainage Channel Facilities in North Manila		
1. Estero de Sunog Apog I	20.4	LCB
- Dredging	20.4	
2. Estero de Sunog Apog II	166.7	LCB
- Dredging	166.7	
3. Blumentritt Interceptor	563.2	ICB
- Declogging of existing Blumentritt Interceptor	43.6	
- Construction of additional Blumentritt Interceptor	519.6	
4. Sub total	**750.3**	
Lot II: Rehabilitation and Additional Works for Drainage Channel Facilities in South Manila		
1. Estero de Tripa de Gallina, PNR canal and Calatagan creek I	87.5	LCB
- Dredging	87.5	
2. Buendia outfall	43.5	ICB
- Declogging	43.5	
3. Zobel Roxas drainage main	54.9	ICB
- Declogging	7.5	
- Construction of additional box culvert	47.4	
4. Pasong Tamo drainage main	2.9	LCB
- Declogging	2.9	
5. Faraday drainage main	269.3	ICB
- Declogging	0.3	
- Construction of additional box culvert	269.0	
6. Sub total	**458.1**	
Lot III: Rehabilitation and Additional Works of Pumping Stations		
1. Rehabilitation of 12 pumping stations	2,005.0	ICB
- Group 1 (Aviles,Quiapo,Valencia,Tripa de Gallina)	1,057.0	
- Group 2 (Pandacan, Paco, Sta. Clara, Libertad, Makati, Binondo)	880.0	
- Group 3 (Escolta and Balete)	68.0	
2. Sub total	**2,005.0**	
Installation of Equipment and Facilities for Effective O&M Activities	39.1	ICB
1. Emergency O&M equipment	37.6	
2. Rainfall and water level observation facilities	1.5	
3. Sub total	**39.1**	
Grand Total	**3,252.5**	

(4) Resettlement Cost

The same unit cost estimated in Master Plan stage is applied.

The required direct cost for the resettlement of the informal settlers residing in the objective channels is estimated at Php192.2 million, assuming that the number of families to be resettled is 700.

- **Total resettlement cost:** **Php192.2 million**
- Resettlement cost excluding land acquisition cost: Php164.1 million
- Land acquisition cost for relocation site: Php28.1 million

(5) Compensation Cost

Compensation cost during the construction stage of the additional works is estimated at Php 19.1 million and broken down as follows.

- **Total compensation cost for additional works:** **Php19.1 million**
- Land acquisition: Php2.3 million
- House compensation: Php16.8 million

The details are shown in *Table G.3.3*.

Table G.3.3 Compensation Cost for Additional Works

Item	Unit Price (Php)	Quantity	Amount (Php)	Amount (Php mil.)
Total Cost			19,057,560	19
1.Land acquisition			2,268,000	2
1.1 Bluementritt drainage main	3,240	500 m2	1,620,000	1.6
1.2 Barangay Hall	3,240	200 m2	648,000	0.6
2.House compensation			16,789,560	17
2.1 Bluementritt (buildings at the corner, oppposite of Manila North Cemetery)				
2.1.1 Demolition & Disposal Cost	1,270	300 m2 x 2 floors	762,000	0.8
2.1.2 Construction of New Buildings	12,000	300 m2 x 2 floors	7,200,000	7.2
2.1.3 Disturbance Fee & Temporary Relocation Fee				
- House Rent	8,000	5 H.H. x 36 months	1,440,000	1.4
- Cost for Relocation (Rental Truck)	2,000	2 cars x 5 trips	20,000	0.0
- Lost Income	10,000	5 H.H. x 36 months	1,800,000	1.8
2.2 Barangay Hall (Brgy 183, 18m x 7m)				
2.2.1 Demolition & Disposal Cost	1,270	126 m2 x 2 floors	320,040	0.3
2.2.2 Construction of New Buildings	12,000	126 m2 x 2 floors	3,024,000	3.0
2.2.3 Disturbance Fee & Temporary Relocation Fee				
- House Rent	6,000	3 units x 6 months	108,000	0.1
- Cost for Relocation (Rental Truck)	2,000	1 cars x 10 trips	20,000	0.0
2.3 DPWH Temporary Office & 5 Houses along PNR canal				
2.3.1 Demolition & Disposal Cost				
- DPWH Temporary Office(7m x 4m)	1,270	28 m2 x 2 floors	71,120	0.1
- 5 houses	280	3 labors x 5 houses x 2days	8,400	0.0
2.3.2 Construction of New Buildings for DPWH office	12,000	28 m2 x	336,000	0.3
2.3.3 Compensation for informal settlers	210,000	8 H.H.	1,680,000	1.7

(6) Cost for Community-Involved Solid Waste Management

For the sustainability of the drainage system in view of daily operation and maintenance activities, community-involved solid waste management including IEC has been proposed in the Priority Projects. The cost estimated in Master Plan stage is applied. The required cost for this item is Php 87.4 million and broken down as follows.

- **Total cost for community-involved SWM: Php87.2 million**
- Cost for BEM and Team ESTERO activities: Php63.3 million
- Cost for IEC: Php23.9 million

(7) Cost for Installation of Equipment and Facilities for Effective O&M Activities

The break down of this item is given below.

- **Total cost for installation of equipment and facilities: Php39.1 million**
- Cost for emergency O&M equipment: Php37.6 million
- Cost for additional hydrological equipment: Php1.5 million

(8) Annual O&M Cost

The same annual cost for O&M estimated in Master Plan stage is applied.

- **Annual cost for operation and maintenance activities: Php241.0 million**

(9) Project Cost

The project cost of the priority projects except price contingency is estimated at Php 4,952.0 million as shown in *Table G.3.4*. It should be noted that the above total cost does not include annual costs for annual operation and maintenance. Furthermore, the ratio of preparatory works/temporary works cost for the main works which was estimated multiplying the main works cost by 5% in the master plan stage, was, in this stage, counted in the main works cost with 3% to 10%, considering site conditions and natures of objective works, while the ratio of miscellaneous for the civil works cost was decreased to 5%, considering further study depth in this stage from 10% applied in the master plan stage.

Table G.3.4 Project Cost for Priority Projects

Item	Amount (million Pesos)	Remarks
1. Civil Works cost	3,415.1	
1.1 Main works	3,252.5	incl. preparatory/temporary cost
1.2 Miscellaneous	162.6	5 % of (1.1)
2. VAT	341.5	10 % of (1)
3. Resettlement and Compensation Cost	221.9	
3.1 Resettlement cost	192.2	
3.2 Compensation cost for additional works	19.1	
3.3 Miscellaneous	10.6	5 % of (3.1+3.2)
4. Government administration cost	102.5	3 % of (1)
5. Engineering services cost	341.5	10 % of (1)
6. Physical contingency	442.3	10 % of (1+2+3+4+5)
7. Supporting measures cost	87.2	
7.1 BEM and Team ESTERO	63.3	
7.2 IEC	23.9	
8. Total project cost	4,952.0	

Note: US$1.0=Php55=JY110 (July 2004)

ANNEX G.1

COST ESTIMATE FOR WORKS PROPOSED IN MASTER PLAN

Annex G.1.1 : Cost Estimate for Additional Box Culvert and River Wall Proposed in Master Plan

3. Additional works of South Antipolo area

3-1 Replacement of existing Kabulusan Sub Outfall

3-2 Additional B.C. along South Antipolo Open Canal

3-3 Additional B.C. along Solis Tescon D.M.

unit: peso/m

Items	Unit	Unit Price	3-1 Box Culvert		3-2 Box Culvert (1)		3-2 Box Culvert (2)		3-3 Box Culvert	
			Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Concrete	m^3	5,140	8.00	41,120	7.00	35,980	6.00	30,840	5.90	30,326
Bar	ton	29,500	0.64	18,880	0.56	16,520	0.48	14,160	0.48	14,160
Excavation	m^3	572	34.00	19,448	30.00	17,160	26.00	14,872	30.00	17,160
Back Fill	m^3	514	16.00	8,224	14.00	7,196	13.00	6,682	14.00	7,196
S. Sheet Pile	m^2	3,200	18.00	57,600	16.00	51,200	16.00	51,200	15.00	48,000
Deck	m^2	5,950	6.80	40,460	6.00	35,700	5.30	31,535	5.20	30,940
Pavement	m^2	2,000	6.80	13,600	6.00	12,000	5.30	10,600	5.20	10,400
Demolish	m^3	1,020	0.00	0	0.00	0	0.00	0	2.00	0
Sub-total				199,332		175,756		159,889		158,182
Other %	0.25			49,833		43,939		39,972		39,546
Total (peso)				249,165		219,695		199,861		197,728
Round				250,000		220,000		200,000		200,000
Dimensions			w3.8m x h2.7m		w3.3m x h2.7m		w2.6m x h2.7m		w3.0m x h1.5m	

4. Additional works of channels to Quiapo Pumping Station

4-1 Extension of B.C.along España Street

4-2 Extension of B.C.along España Street

unit: peso/m

Items	Unit	Unit Price	4-1 Box Culvert		4-2 Box Culvert					
			Quantity	Amount	Quantity	Amount				
Concrete	m^3	5,140	6.00	30,840	6.00	30,840				
Bar	ton	29,500	0.48	14,160	0.48	14,160				
Excavation	m^3	572	25.00	14,300	25.00	14,300				
Back Fill	m^3	514	12.00	6,168	12.00	6,168				
S. Sheet Pile	m^2	3,200	17.00	54,400	17.00	54,400				
Deck	m^2	5,950	5.60	33,320	5.60	33,320				
Pavement	m^2	2,000	5.60	11,200	5.60	11,200				
Demolish	m^3	1,020	0.00	0	0.00	0				
Sub-total				164,388		164,388				
Other %	0.25			41,097		41,097				
Total (peso)				205,485		205,485				
Round				205,000		205,000				
Dimensions			w2.8m x h2.5m		w2.8m x h2.5m					

5. Additional works for Aviles drainage area

5-1 Additional B.C. along Margal

(5-3) Improvement of Est. de Sampaloc II and Espanto-Gov.Forbes D.M

unit: peso/m

Items	Unit	Unit Price	5-1 Box Culvert				(5 -3) Box Culvert*			
			Quantity	Amount			Quantity	Amount		
Concrete	m^3	5,140	6.00	30,840			8.00	41,120		
Bar	ton	29,500	0.45	13,275			0.64	18,880		
Excavation	m^3	572	26.00	14,872			34.00	19,448		
Back Fill	m^3	514	13.00	6,682			16.00	8,224		
S. Sheet Pile	m^2	3,200	15.00	48,000			18.00	57,600		
Deck	m^2	5,950	5.80	34,510			6.80	40,460		
Pavement	m^2	2,000	5.80	11,600			6.80	13,600		
Demolish	m^3	1,020	0.00	0			0.00	0		
Sub-total				159,779				199,332		
Other %	0.25			39,945				49,833		
Total (peso)				199,724				249,165		
Round				200,000				250,000		
Dimensions			w3.8m x h2.1m				w3.8m x h2.7m			

*Note: * For the cost estimation, equivalent box culvert for neccesary additional discharge capacity is considered for 1,050m, considering the case that Estero de Sampaloc II is not available to be utilized. This is costly, which gives safer estimation.*

6. Additional work for Estero de Vitas

6-1 Heightenning of river wall in the lower estro de Vitas

unit: peso/m

Items	Unit	Unit Price	6-1 River Wall							
			Quantity	Amount						
Concrete	m^3	5,140	0.80	4,112						
Bar	ton	29,500		0						
Excavation	m^3	572		0						
Back Fill	m^3	514		0						
S. Sheet Pile	m^2	3,200		0						
Deck	m^2	5,950		0						
Pavement	m^2	2,000		0						
Demolish	m^3	1,020	0.00	0						
Sub-total				4,112						
Other %	0.25			1,028						
Total (peso)				5,140						
Round				5,000						
Dimensions			h=0 to 1 m							

7. Additional works of Blumentritt interceptor

7-2 Construction of Additional Interceptor

unit: peso/m

Items	Unit	Unit Price			7-2 Box Culvert (1)		7-2 Box Culvert (2)		7-2 Box Culvert (3)	
					Quantity	Amount	Quantity	Amount	Quantity	Amount
Concrete	m^3	5,140			10.00	51,400	7.50	38,550	4.00	20,560
Bar	ton	29,500			0.80	23,600	0.60	17,700	0.30	8,850
Excavation	m^3	572			40.00	22,880	33.00	18,876	21.00	12,012
Back Fill	m^3	514			17.00	8,738	16.00	8,224	13.00	6,682
S. Sheet Pile	m^2	3,200			18.00	57,600	18.00	57,600	15.00	48,000
Deck	m^2	5,950			4.00	23,800	6.00	35,700	5.00	29,750
Pavement	m^2	2,000			4.00	8,000	6.00	12,000	5.00	10,000
Demolish	m^3	1,020			0.00	0	3.00	3,060	0.00	0
Sub-total						196,018		191,710		135,854
Other %	0.25					49,005		47,928		33,964
Total (peso)						245,023		239,638		169,818
Round						245,000		240,000		170,000
Dimensions					w2.5m x h3.3m x 2		w3.2m x h3.3m		w2.3m x h2.4m	

8. Additional works for severe inundation area in South Manila

8-1 Additional B.C. along Ñbel Roxas D.M .

8-2 Additional B.C. along Faraday D.M.

8-3 Additional B.C. along Makati Diversion Channel

unit: peso/m

Items	Unit	Unit Price	8-1 Box Culvert (1)		8-1 Box Culvert (2)		8-2 Box Culvert (1)		8-2 Box Culvert (2)	
			Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Concrete	m^3	5,140	5.50	28,270	8.00	41,120	6.00	30,840	5.20	26,728
Bar	ton	29,500	0.44	12,980	0.64	18,880	0.48	14,160	0.42	12,272
Excavation	m^3	572	22.00	12,584	36.00	20,592	26.00	14,872	23.00	13,156
Back Fill	m^3	514	11.50	5,911	15.00	7,710	13.00	6,682	14.00	7,196
S. Sheet Pile	m^2	3,200	14.00	44,800	15.00	48,000	15.00	48,000	14.00	44,800
Deck	m^2	5,950	6.80	40,460	0.00	0	7.40	44,030	4.00	23,800
Pavement	m^2	2,000	6.80	13,600	14.00	28,000	7.40	14,800	4.00	8,000
Demolish	m^3	1,020	0.00	0	3.00	3,060	2.00	2,040	0.00	0
Sub-total				158,605		167,362		175,424		135,952
Other %	0.25			39,651		41,841		43,856		33,988
Total (peso)				198,256		209,203		219,280		169,940
Round				200,000		210,000		220,000		170,000
Dimensions			w1.8m x h1.4m x2		w1.5m x h1.4m x 3		w2.2m x h1.7m x2		w1.5m x h1.4m x2	

unit: peso/m

Items	Unit	Unit Price	8-3 Box Culvert							
			Quantity	Amount						
Concrete	m^3	5,140	6.50	33,410						
Bar	ton	29,500	0.52	15,340						
Excavation	m^3	572	30.00	17,160						
Back Fill	m^3	514	15.00	7,710						
S. Sheet Pile	m^2	3,200	17.00	54,400						
Deck	m^2	5,950	7.50	44,625						
Pavement	m^2	2,000	7.50	15,000						
Demolish	m^3	1,020	0.00	0						
Sub-total				187,645						
Other %	0.25			46,911						
Total (peso)				234,556						
Round				235,000						
Dimensions			w2.2m x h2.1m x2							

10. Additional Works of Dilain/Maricaban Creek area

10-1 Construction of Maricaban Interceptor

10-2 Improvement of Dilain Pond

unit: peso/m

Items	Unit	Unit Price	10-1 Box Culvert (1)		10-1 Box Culvert (2)		10-1 Tunnel		10-2 Wall	
			Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Concrete	m^3	5,140	14.00	71,960	8.50	43,690		0	1.80	9,252
Bar	ton	29,500	0.19	5,605	0.09	2,508		0		0
Excavation	m^3	572	61.00	34,892	37.00	21,164		0	3.00	1,716
Back Fill	m^3	514	21.00	10,794	17.00	8,738		0	2.00	1,028
S. Sheet Pile	m^2	3,200	22.00	70,400	21.00	67,200		0		0
Deck	m^2	5,950	10.40	61,880	6.60	39,270		0		0
Pavement	m^2	2,000	10.40	20,800	6.60	13,200		0		0
Demolish	m^3	1,020	0.00	0	0.00	0	0.00	0	0.00	0
Sub-total				276,331		195,770		0		11,996
Other %	0.25			69,083		48,942		0		2,999
Total (peso)				345,414		244,712		0		14,995
Round Up				345,000		245,000		370,000		15,000
Dimensions			w3.5m x h3.3m x2		w3.7m x h3.3m		w4.0m x h4.0m			

Alternative Study

a. Additional works of Aviles drainage area Alternative-2 (Construction of Sampaloc Interceptor)

unit: peso/m

Items	Unit	Unit Price	Culvert 1		Culvert 2		Culvert 3			
			Quantity	Amount	Quantity	Amount	Quantity	Amount		
Concrete	m^3	5,140	10.00	51,400	9.00	46,260	7.00	35,980		
Bar	ton	29,500	0.80	23,600	0.72	21,240	0.56	16,520		
Excavation	m^3	572	58.00	33,176	55.00	31,460	38.00	21,736		
Back Fill	m^3	514	34.00	17,476	32.00	16,448	23.00	11,822		
S. Sheet Pile	m^2	3,200	25.00	80,000	23.00	73,600	21.00	67,200		
Deck	m^2	5,950	8.60	51,170	8.50	50,575	6.10	36,295		
Pavement	m^2	2,000	8.60	17,200	8.50	17,000	6.10	12,200		
Demolish	m^3	1,020	0.00	0	0.00	0	0.00	0		
Sub-total				274,022		256,583		201,753		
Underpin %	0.15			41,103		38,487		30,263		
Other %	0.25			68,506		64,146		50,438		
Total (peso)				383,631		359,216		282,454		
Round Up				385,000		360,000		284,000		
Dimensions			w2.8m x h2.7m x2		w2.7m x h2.6m x2		w3.2m x h2.7m			

b. Improvement of Dilain/Maricaban Creek area Alternative-1
(Improvemnet of Dilain Creek and Increase of Pump Capacity)

unit: peso/m

Items	Unit	Unit Price	Improvement of Dilain Creek Parapet Wall							
			Quantity	Amount						
Concrete	m^3	5,140	3.30	16,962						
Bar	ton	29,500	0.30	8,850						
Excavation	m^3	572	5.00	2,860						
Back Fill	m^3	514	3.00	1,542						
S. Sheet Pile	m^2	3,200		0						
Deck	m^2	5,950		0						
Pavement	m^2	2,000		0						
Demolish	m^3	1,020	1.00	1,020						
Sub-total				31,234						
Other %	0.25			7,809						
Total (peso)				39,043						
Round Up		1,000		40,000						
Dimensions			h=2.6 m							

Annex G.1.2 Cost Estimate for Rehabilitation Works of Drainage Pumping Stations in North and South Manila

Unit:Peso

Description	Drainage Capacity		Total
1. Group 1 Rehabilitation Works			
1.1 Aviles (*1)	18.6	m^3/s	330,000,000
1.2 Quiapo	10.8	m^3/s	169,000,000
1.3 Valencia	11.8	m^3/s	172,000,000
1.4 Tripa de Gallina	57	m^3/s	386,000,000
Sub total			1,057,000,000
2. Group 2 Rehabilitation Works			
2.1 Pandacan	4.4	m^3/s	87,000,000
2.2 Paco	7.6	m^3/s	138,000,000
2.3 Sta. Clara	5.3	m^3/s	90,000,000
2.4 Ibertad	42	m^3/s	298,000,000
2.5 Makati	7	m^3/s	102,000,000
2.6 Binondo	11.6	m^3/s	165,000,000
Sub total			880,000,000
3. Group 3 Rehabilitation Works			
3.1 Balete	3	m^3/s	34,000,000
3.2 Escolta	1.5	m^3/s	34,000,000
Sub total			68,000,000
4. Group 4 Rehabilitation Works			
4.1 Vitas	32	m^3/s	52,000,000
4.2 Balut	2	m^3/s	20,000,000
4.3 San Andres	19	m^3/s	52,000,000
Sub total			124,000,000
Total			2,129,000,000

Note:(*1) Cost for increase of pump capacity (3m^3/s) is included.

ANNEX G.2

UNIT PRICE FOR MAJOR WORKS OF PRIORITY PROJECTS

Annex G.2 : Unit Price for Major Works of Priority Projects

Dredging (Clearing) for Estero in North Manila

				Amount	Portion	
		nos・h	Peso/h	Peso	Foreign	Local
I. Equipment						
	Clamshell	1	900	900	720	180
	Barge	1	400	400	280	120
	Bottom door type hopper	1	250	250	150	100
	Tugboat	1	300	300	210	90
	Truck crane 25t	1	1,800	1,800	1,440	360
	Dumptruck 8t	3	1,700	5,100	4,080	1,020
	Sub-total			8,750	6,880	1,870
II. Labor						
	Foreman	1	52	52		52
	Operator	7	38	266		266
	Laborer	5	30	150		150
	Sub-total			468		468
III. Material						
	Fuel			300	240	60
	Sub-total			300	240	60
	Dewatering of dumping area	15%		1,428	1,071	357
	Mark- etc	10%		952	712	240
	Total			11,898	8,903	2,995
	Output	6m ^{3}/h				
		Direct unit cost		1,983	1,484	499

Declogging (Clearing) for Box Culvert in North Manila

				Amount	Portion	
		nos・h	Peso/h	Peso	Foreign	Local
I. Equipment						
	Clamshell	1	900	900	720	180
	Submersible pump	1	150	150	105	45
	Air compressor	0.3	1,800	400	320	80
	Fan	1	300	300	240	60
	Dumptruck 8t	3	1,700	5,100	4,080	1,020
	Truck crane 25t	0.8	1,800	1,440	1,152	288
	Generator	1	400	400	320	80
	Sub-total			8,690	6,937	1,753
II. Labor						
	Foreman	1	52	52		52
	Operator	4	38	152		152
	Laborer	30	30	900		900
	Sub-total			1,104		1,104
III. Material						
	Fuel			500	400	100
	Sub-total			500	400	100
	Dewatering of dumping area	15%		1,544	1,158	386
	Mark- etc	10%		1,029	734	295
	Total			11,323	8,071	3,252
	Output	5m ^{3}/h				
		Direct unit cost		2,264	1,614	650

Excavation for Box Culvert in North Manila

				Amount	Portion	
		nos・h	Peso/h	Peso	Foreign	Local
I. Equipment						
	Backhoe	1	1,700	1,700	1,360	340
	Bulldozer	0.5	2,000	1,000	800	200
	Pile driving hammer	0.5	1,500	400	320	80
	Dump truck	3	1,700	5,100	4,080	1,020
	Sub-total			8,200	6,560	1,640
II. Labor						
	Foreman	1	52	52		52
	Operator	5	38	190		190
	Laborer	10	30	300		300
	Sub-total			542		542
III. Material						
	Fuel			500	400	100
	Sheet pile & deck plate	150%		13,863	11,090	2,773
	Sub-total			14,363	11,490	2,873
				23,105		
	Dewatering of dumping area	15%		3,466	2,708	758
	Mark- etc	10%		2,311	1,805	506
	Total			28,881	22,563	6,319
	Output	20m ^{3}/h				
		Direct unit cost		1,444	1,128	316

Backfill in North Manila

			Amount	Portion	
	nos・h	Peso/h	Peso	Foreign	Local
I. Equipment					
Plate compactor	1	130	130	104	26
II. Labor					
Foreman	1	52	52		52
Laborer	10	30	300		300
Sub-total			352		352
III Material					
Sand	3	500	1,500		1,500
Mark- etc	10%		198	10	188
Total			2,180	114	2,066
Output	3m ^{3}/h				
	Direct unit cost		727	38	689

Concrete Works

			Amount	Portion	
	nos・h	Peso/h	Peso	Foreign	Local
I. Equipment					
Concrete vibrator	10	750	7,500	6,000	1,500
II. Labor					
Foreman	30	416	12,480		12,480
Carpenter	60	300	18,000		18,000
Plaster	4	300	1,200		1,200
Labour	180	240	43,200		43,200
Sub-total			74,880		74,880
III. Material					
Concrete, 5000psi	100	2,700	270,000		270,000
Form-lumber	2,500	30	75,000		75,000
Nail etc.			7,500		7,500
Sub-total			352,500		352,500
Mark- etc	10%		43,488	600	42,888
Total			478,368	6,600	471,768
Output	100m ^{3}/h				
	Direct unit cost		4,784	66	4,718

Reinforcing Bar

			Amount	Portion	
	nos・h	Peso/h	Peso	Foreign	Local
I. Equipment					
Bar cutter	1	1,150	1,150	230	920
Bar bender	1	1,150	1,150	230	920
Sub-total			2,300	460	1,840
II. Labor					
Foreman	3	416	1,248		1,248
Re-bar worker	6	300	1,800		1,800
Labour	9	240	2,160		2,160
Sub-total			5,208		5,208
III. Material					
Re-bar	1	23,000	23,000	18,400	4,600
Mark- etc	10%		3,051	1,886	1,165
Total			33,559	20,746	12,813
Output	1ton				
	Direct unit cost		33,559	20,746	12,813

Dredging (Clearing) for Small Estero in South Manila

			Amount	Portion	
	nos・h	Peso/h	Peso	Foreign	Local
I. Equipment					
Bottom door type hopper	1	250	250	150	100
Submersible pump	1	150	150	105	45
Truck crane 25t	1	1,800	1,800	1,440	360
Dumptruck 8t	3	1,700	5,100	4,080	1,020
Generator	1	400	400	320	80
Sub-total			7,700	6,095	1,605
II. Labor					
Foreman	1	52	52		52
Operator	4	38	152		152
Laborer	15	30	450		450
Sub-total			654		654
III. Material					
Fuel			100	80	20
Sandbag			200		200
Sub-total			300	80	220
Dewatering of dumping area	15%		1,298	926	372
Mark- etc	10%		865	617	248
Total			10,817	7,718	3,099
Output	6m ^{3}/h				
	Direct unit cost		1,803	1,286	517

Declogging (Clearing) for Box Culvert in South Mlanila

				Amount	Portion	
		nos･h	Peso/h	Peso	Foreign	Local
I. Equipment						
	Clamshell	1	900	900	720	180
	Submersible pump	1	150	150	105	45
	Air compressor	0.3	1,800	500	400	100
	Fan	1	300	300	240	60
	Dumptruck 8t	4	1,700	6,800	5,440	1,360
	Truck crane 25t	0.8	1,800	1,480	1,184	296
	Generator	1	400	400	320	80
	Sub-total			10,530	8,409	2,121
II. Labor						
	Foreman	1	52	52		52
	Operator	5	38	190		190
	Laborer	30	30	900		900
	Sub-total			1,104		1,104
III. Material						
	Fuel			550	440	110
	Dewatering of dumping area	15%		1,828	1,327	500
	Mark- etc	10%		1,218	885	333
	Total			15,231	11,062	4,169
	Output	5m ^{3}/h				
		Direct unit cost		3,047	2,213	834

Excavation for Box Culvert in South Manila

				Amount	Portion	
		nos･h	Peso/h	Peso	Foreign	Local
I. Equipment						
	Backhoe	1	1,700	1,700	1,360	340
	Bulldozer	0.5	2,000	1,000	800	200
	Pile driving hammer	0.5	1,500	400	320	80
	Dump truck	4	1,700	6,800	5,440	1,360
	Sub-total			9,900	7,920	1,980
II. Labor						
	Foreman	1	52	52		52
	Operator	6	38	228		228
	Laborer	10	30	300		300
	Sub-total			580		580
III. Material						
	Fuel			550	440	110
	Sheet pile & deck plate	150%		16,545	13,236	3,309
	Sub-total			17,095	13,676	3,419
				27,575		
	Dewatering of dumping area	15%		4,136	3,239	897
	Mark- etc	10%		2,758	2,160	598
	Total			34,469	26,995	7,474
	Output	20m ^{3}/h				
		Direct unit cost		1,723	1,350	373

Reinforced Concrete for Box Culvert

		Amount	Portion	
		Peso	Foreign	Local
	Concrete (Peso/cu･m)	4,784	66	4,718
	Reinforcing bar (Peso/ton)	33,559	20,746	12,813
	Reinforcing bar (80kg) (Peso/cu･m)	2,685	1,660	1,025
	Reinforced concrete	7,468	1,726	5,742

Demolishing for Pavement

				Amount	Portion	
		nos･h	Peso/h	Peso	Foreign	Local
I. Equipment						
	Concrete braker	0.5	2,700	1,350	1,080	270
	Payloader	0.2	1,250	250	200	50
	Dump truck	0.2	1,700	340	272	68
	Sub-total			1,940	1,552	388
II. Labor						
	Operator	0.7	38	27		27
	Foreman	1	52	52		52
	Labour	3	30	90		90
	Sub-total			169		169
	Mark- etc	15%		316	233	83
	Total			2,425	1,785	640
	Output	13m ^{3}/h				
		Direct unit cost		187	137	50

ANNEX G.3

COST ESTIMATE FOR RESPECTIVE REHABILITATION AND ADDITIONAL WORKS OF PRIORITY PROJECTS

Annex G.3 : Cost Estimate for Respective Rehabilitation and Additional Works of Priority Project

1. Rehabilitation and Additional Works of Drainage Channels in North Manil

UnitPeso

Description	Dimension	Unit	Quantity	Unit Price		Amount		Total
				Foreign	Local	Foreign	Local	
1. Estero de Sunog Apog I (LCB)								
1.1 Temporary Works		%	3			445,200	149,700	594,900
1.2 Dredging (Clearing) of Sunog Apog		m^3	10,000	1,484	499	14,840,000	4,990,000	19,830,000
					Total Cost			**20,424,900**
2. Estero de Sunog Apog II (LCB)								
2.1 Temporary Works		%	3			3,632,832	1,221,552	4,854,384
2.2 Dredging (Clearing) of Sunog Apog		m^3	81,600	1,484	499	121,094,400	40,718,400	161,812,800
					Total Cost			**166,667,184**
3. Blumentritt Interceptor (ICB)								
3.1 Temporary works (office, diverting sewer water including relocation of supply pi		%	10			26,023,059	23,597,959	49,621,018
3.2 Related Works of Existing Blumentritt Interceptor								
1) Raising maintenance hole cover plate		nos	18	135,400	46,000	2,437,200	828,000	3,265,200
2) Demolishing and modification of maintenance hole including paving around fla		nos	8	135,400	46,000	1,083,200	368,000	1,451,200
3) Stoplog		ton	25	400,000	100,000	10,000,000	2,500,000	12,500,000
3.3 Declogging of Existing Blumentritt Interceptor								
1) Declogging of interceptor		m^3	9,800	1,614	650	15,817,200	6,370,000	22,187,200
3.4 Remedial Works of Existing Blumentritt Interceptor								
1) Inlet for road surface flow (9 nos)								
i)Excavation		m^3	312	1,128	316	351,936	98,592	450,528
ii)Reinforced concrete		m^3	99	1,726	5,742	170,874	568,458	739,332
iii)Backfill		m^3	213	38	689	8,094	146,757	154,851
2) New box culvert for widening,	1.8m(w)x2.1m(h)x1cell	m	200					
i)Re-Concrete		m^3	963	1,726	5,742	1,662,138	5,529,546	7,191,684
ii)Backfill		m^3	3,390	38	689	128,820	2,335,710	2,464,530

3.5 Construction of Additional Blumentritt Interceptor								
1) Excavation		m^3	112,133	1,128	316	126,486,024	35,434,028	161,920,052
2) New Box Culvert,	3.4m(w)x2.6m(h)x2cells	m	564					
i)Reinforced concrete		m^3	6,909	1,726	5,742	11,924,934	39,671,478	51,596,412
ii)Backfill		m^3	12,713	38	689	483,094	8,759,257	9,242,351
3) New Box Culvert,	3.6m(w)x2.7m(h)x2cells	m	1,567					
i)Reinforced concrete		m^3	11,753	1,726	5,742	20,285,678	67,485,726	87,771,404
ii)Backfill		m^3	34,239	38	689	1,301,082	23,590,671	24,891,753
4) New Box Culvert,	2.3m(w)x2.4m(h)x1cell	m	439					
i)Reinforced concrete		m^3	1,726	1,726	5,742	2,979,076	9,910,692	12,889,768
ii)Backfill		m^3	7,608	38	689	289,104	5,241,912	5,531,016
5) New concrete pipe	Diameter:900 mm	m	400					
i)Reinforced concrete		m^3	460	1,726	5,742	793,960	2,641,320	3,435,280
ii)Backfill		m^3	2,864	38	689	108,832	1,973,296	2,082,128
3.6 Construction of maintenance manhole		nos	8					
i)Excavation		m^3	4,080	1,128	316	4,602,240	1,289,280	5,891,520
ii)Reinforced concrete		m^3	800	1,726	5,742	1,380,800	4,593,600	5,974,400
iii)Backfill		m^3	2,144	38	689	81,472	1,477,216	1,558,688
3.7 Water supply pipe including relocation	Diameter:2,200 mm	m	25	2,400,000	600,000	60,000,000	15,000,000	75,000,000
3.8 Railway rail strengthening		m	10	70,000	30,000	700,000	300,000	1,000,000
3.9 Pavement								
i)Demolishing		m^3	840	137	50	115,080	42,000	157,080
ii)Paving		m^2	23,467	450	150	10,560,150	3,520,050	14,080,200
						Total Cost		**563,047,595**

2. Rehabilitation and Additional Works of Drainage Channels in South Manil Unit:Peso

Description	Dimension	Unit	Quantity	Unit Price		Amount		Total
				Foreign	Local	Foreign	Local	
1. Esteros de Tripa de Gallina, PNR Canal and Calatagan Creek I (LCB)								
1.1 Temporary works		%	3			1,817,118	730,521	2,547,639
1.2 Dredging (Clearing) of Estero deTripa de Gallina		m^3	28,900	1,286	517	37,165,400	14,941,300	52,106,700
1.3 Dredging (Clearing) of Calatagan creek I		m^3	13,200	1,286	517	16,975,200	6,824,400	23,799,600
1.4 Dredging (Clearing) of PNR canal		m^3	5,000	1,286	517	6,430,000	2,585,000	9,015,000
					Total Cost			**87,468,939**
2. Buendia Outfall (ICB)								
2.1 Temporary works		%	10			2,972,480	979,280	3,951,760
2.2 Related Works of Buendia Outfall								
1) Raising of maintenance manhole		nos	22	135,400	46,000	2,978,800	1,012,000	3,990,800
2) Demorishing and modification of maintenance hole		nos	6	135,400	46,000	812,400	276,000	1,088,400
3) Stoplog		ton	25	400,000	100,000	10,000,000	2,500,000	12,500,000
2.3 Declogging of Buendia Outfall								
1) Declogging of Buendia outfall		m^3	7,200	2,213	834	15,933,600	6,004,800	21,938,400
					Total Cost			**43,469,360**
3. Pasong Tamo Drainage Main (LCB)								
3.1 Temporary works		%	3			59,670	22,599	82,269
3.2 Declogging of Pasong Tamo drainage main		m^3	900	2,210	837	1,989,000	753,300	2,742,300
					Total Cost			**2,824,569**

4. Zobel Roxas Drainage Main (ICB)								
4.1 Temporary works		%	10			2,592,159	2,392,267	4,984,426
4.2 Declogging of Zobel Roxas Drainage Main		m^3	2,200	2,213	834	4,868,600	1,834,800	6,703,400
4.3 Construction of Box Culvert								
1) Excavation		m^3	11,158	1,350	373	15,063,300	4,161,934	19,225,234
2) New Box Culvert	1.7m(w)x1.6m(h)x2cells	m	270					
i)Reinforced concrete		m^3	1,144	1,726	5,742	1,974,544	6,568,848	8,543,392
ii)Backfill		m^3	3,092	38	689	117,496	2,130,388	2,247,884
3) New Box Culvert	1.8m(w)x1.5m(h)x2cells	m	65					
i)Reinforced concrete		m^3	239	1,726	5,742	412,514	1,372,338	1,784,852
ii)Backfill		m^3	743	38	689	28,234	511,927	540,161
4) New Box Culvert	2.3m(w)x1.5m(h)x2cells	m	160					
i)Reinforced concrete		m^3	930	1,726	5,742	1,605,180	5,340,060	6,945,240
ii)Backfill		m^3	2,048	38	689	77,824	1,411,072	1,488,896
4.4 Pavement								
i)Paving		m^2	3,942	450	150	1,773,900	591,300	2,365,200
						Total Cost		**54,828,685**

5. Faraday Drainage Main (ICB)								
5.1 Temporary works		%	10			10,011,970	7,651,744	17,663,714
5.2 Declogging of Faraday Drainage Main		m^3	100	2,213	834	221,300	83,400	304,700
5.3 Construction of Box Culvert								
1) Excavation		m^3	61,543	1,350	373	83,083,050	22,955,539	106,038,589
2) New Box Culvert	1.8m(w)x1.4m(h)x1cell	m	228					
i)Reinforced concrete		m^3	548	1,726	5,742	945,848	3,146,616	4,092,464
ii)Backfill		m^3	2,182	38	689	82,916	1,503,398	1,586,314
3) New Box Culvert	2.2m(w)x1.7m(h)x2cells	m	100					
i)Reinforced concrete		m^3	575	1,726	5,742	992,450	3,301,650	4,294,100
ii)Backfill		m^3	1,758	38	689	66,804	1,211,262	1,278,066
4) New Box Culvert	1.8m(w)x1.4m(h)x2cells	m	72					
i)Reinforced concrete		m^3	302	1,726	5,742	521,252	1,734,084	2,255,336
ii)Backfill		m^3	951	38	689	36,138	655,239	691,377
5) New Box Culvert	3.5m(w)x1.7m(h)x1cell	m	914					
i)Reinforced concrete		m^3	5,219	1,726	5,742	9,007,994	29,967,498	38,975,492
ii)Backfill		m^3	15,136	38	689	575,168	10,428,704	11,003,872
5.4 Pavement								
i)Demolishing		m^3	259	137	50	35,483	12,950	48,433
ii)Paving		m^2	10,114	450	150	4,551,300	1,517,100	6,068,400
5.5 Water supply pipe including relocation		m	25	2,400,000	600,000	60,000,000	15,000,000	75,000,000
					Total Cost			**269,300,857**

3. Rehabilitation Works of Drainage Pumping Stations in North and South Manila

UnitPeso

Description	Drainage Capacity					Foreign	Local	Total
1. Group 1 Rehabilitation Works (ICB)								
1.1 Aviles (*1)	18.6	m^3/s				231,000,000	99,000,000	330,000,000
1.2 Quiapo	10.8	m^3/s				118,300,000	50,700,000	169,000,000
1.3 Valencia	11.8	m^3/s				120,400,000	51,600,000	172,000,000
1.4 Tripa de Gallina	57	m^3/s				270,200,000	115,800,000	386,000,000
Sub total								1,057,000,000
2. Group 2 Rehabilitation Works (ICB)								
2.1 Pandacan	4.4	m^3/s				60,900,000	26,100,000	87,000,000
2.2 Paco	7.6	m^3/s				96,600,000	41,400,000	138,000,000
2.3 Sta. Clara	5.3	m^3/s				63,000,000	27,000,000	90,000,000
2.4 Ibertad	42	m^3/s				208,600,000	89,400,000	298,000,000
2.5 Makati	7	m^3/s				71,400,000	30,600,000	102,000,000
2.6 Binondo	11.6	m^3/s				115,500,000	49,500,000	165,000,000
Sub total								880,000,000
3. Group 3 Rehabilitation Works (ICB)								
3.1 Balete	3	m^3/s				23,800,000	10,200,000	34,000,000
3.2 Escolta	1.5	m^3/s				23,800,000	10,200,000	34,000,000
Sub total								68,000,000
						Total Cost		2,005,000,000

Note:(*1) Cost for increase of pump capacity (3m^3/s) is included.

H. ECONOMIC EVALUATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

H.1 ECONOMIC EVALUATION FOR MASTER PLAN

H.1.1 BACKGROUND OF ECONOMIC EVALUATION

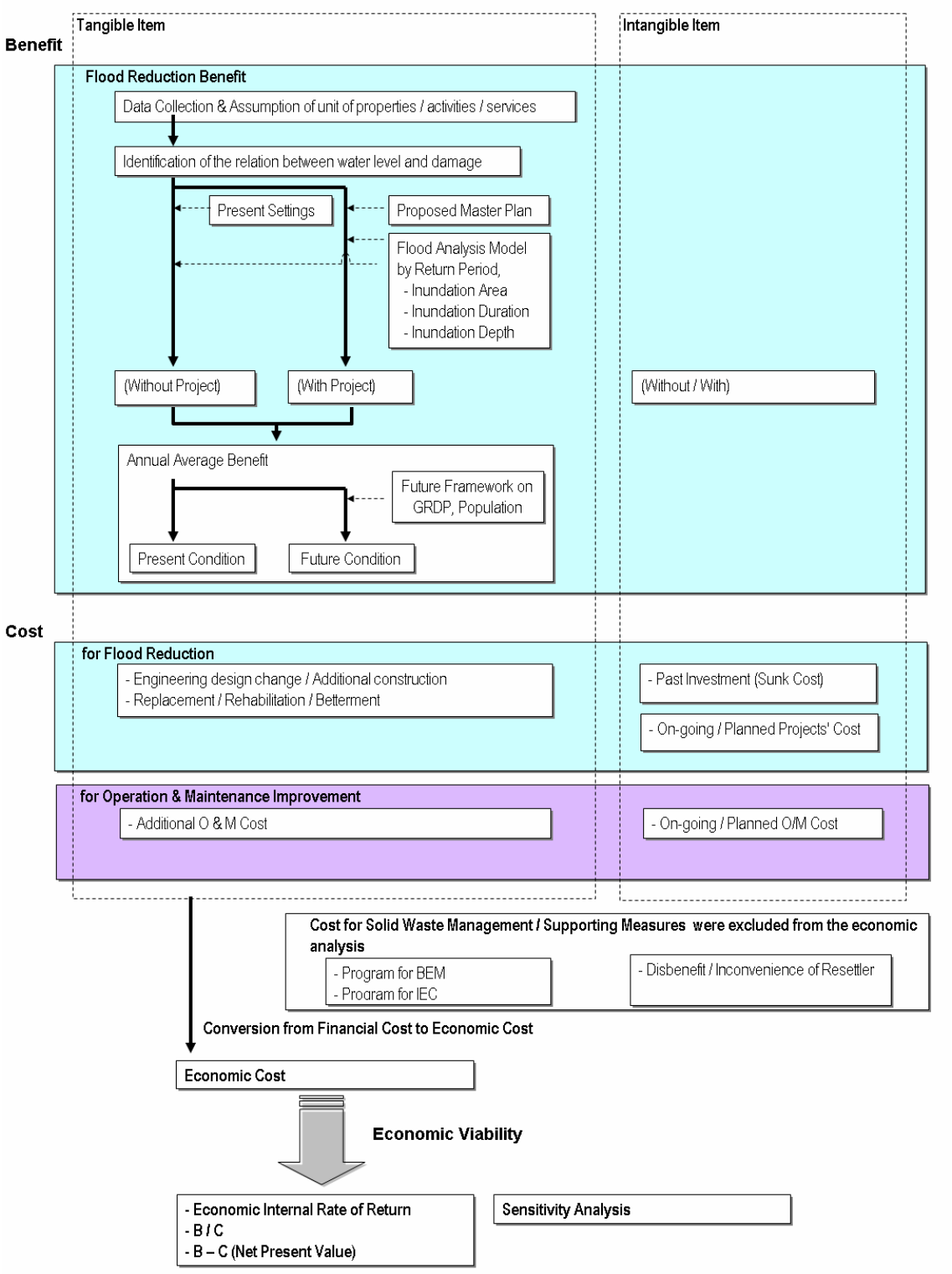
The economic analysis focused on the study areas serviced by the proposed programs/projects in the master plan.

Estimation of the benefit derived from the proposed programs/projects is worked out by the equation,

Net Benefit of the Programs/ Projects = Benefit – Cost

or follows the flow as shown in *Figure H.1.1*.

Explanations of "benefit" and "cost" are found in *Chapter H.1.2* and *H.1.3,* respectively and then, economic viability derived from "net benefit" is analyzed in *Chapter H.1.4*. In *Chapter H.1.5*, financial investment plans are considered.



Source: The Study Team

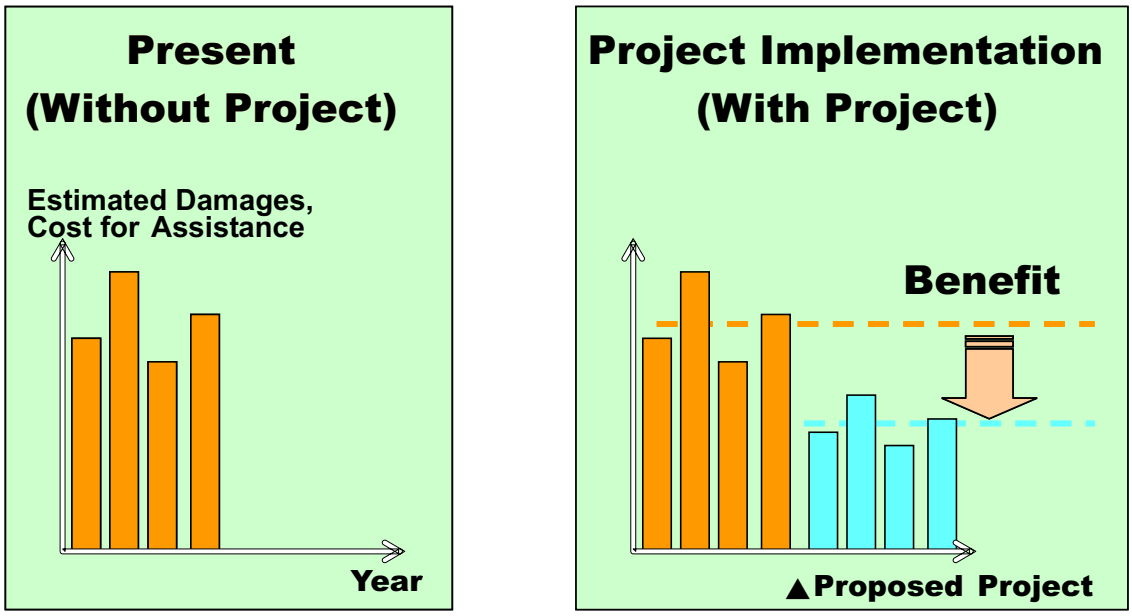
Figure H.1.1 Flow of Analysis of Economic Evaluation

H.1.2 BENEFIT OF THE M/P PROJECT

(1) Structure of Project Benefits

Flood control benefit is generally defined as the reduction of potential flood damage attributed to the proposed and designed works/projects/programs. The flood damages, i.e. the project benefit, are different from the area and depth of inundation. Since it is impossible to predict the timing and magnitude of future floods, analysis of the flood control benefit is undertaken based on deriving and expected annual damage under present socio-economic conditions and indexing this value by way of analyzing the growth rate of annual flood damage to reflect expected future socio-economic change. In this analysis, the prediction of future flood was made to access the flood risk using the hydrodynamic simulation model. (See details in *Chapter 3.2*) This model generated the expedient inundation area and depth in the study area by floods of 2-year, 3-year, 5-year, 10-year, 20-year, and 30-year return periods, thereby eventually making it possible to draw a risk curve associating probability with damages. Damage rates as numerically defined in correspondence with inundation area, depth, ground slope, etc. in the past reports and guidelines in the Philippines and abroad had been applied in this analysis.

The value of flood control benefit is obtained as the difference between the estimated flood damages under the "with" project and "without" project situations.



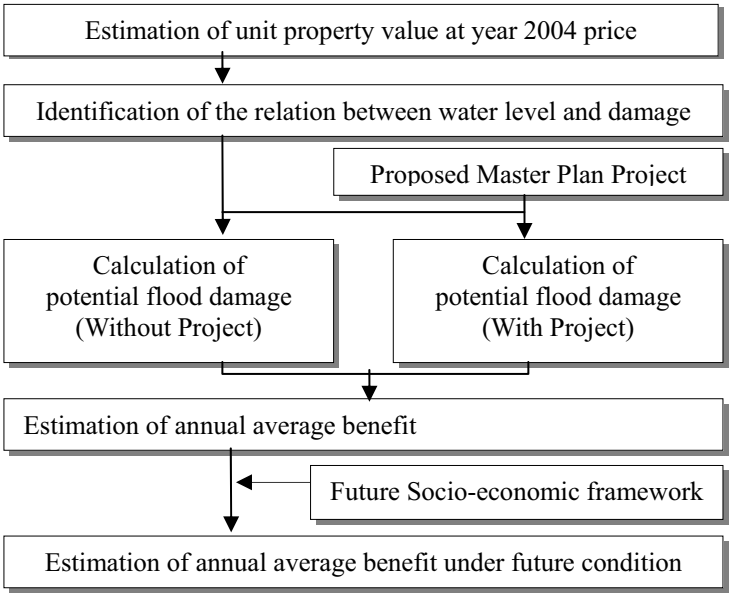
Source: The Study Team

Figure H.1.2 Project Benefit

Correspondingly, the average or expected project benefit would be calculated from the difference between "with" project and "without" project, while considering the expected degree of flood protection from the project.

In addition to these tangible damages, it is apparent that there are other intangible damages both economic and social (effects) associated with those floods. Therefore, the result of this analysis is regarded in a lower, or conservative tier of benefits for the project.

An analysis on annual average benefit is actually carried out following the work flow shown below.



Source: The Study Team

Figure H.1.3 Work Flow of Annual Average Benefit

The next item to identify is what kind of flood damage should be adopted for the analysis. In general, flood damage is classified as shown in the following table.

Table H.1.1 Classification of Flood Damage

Category of Damageable Assets and Activities					Damages Mitigated by Flood Control Project
Benefit of Flood / Inundation Mitigating	Direct Damages	Primary Damages	General Assets	Building Unit	Damage to residential and business sites and buildings due to inundation
				Household Effects	Damage to Furniture and movables such as automobile, electric appliance
				Depreciable Assets of Business Establishments	Damage to depreciable assets of Business establishments except their sites and buildings
				Inventory Stocks of Business Establishments	Damage to inventory stocks of business establishments due to inundation
				Depreciable Assets for Farming and Fishery	Damage to depreciable assets for farming or fishery or business establishments except their sites and buildings
				Inventory Stocks for Farming and Fishery	Damage to inventory stocks for farming or fishery or business establishments except their sites and buildings
			Agricultural Production		Damage to crop production due to inundation
			Public Infrastructures	Road, Bridge, Railway, River Facility, Sewerage, Water Supply, Electric Power, Gas, Telephone, Irrigation Facility, Medical Facilit, Educational Facility, etc.	Damage to infrastructures supporting livelihood, business activities and Pulic Service Facilities
			Human Lives		Damage to living space, causing death, injury or illness
		Secondary Damages			Weed growth, etc.
	Indirect Damages	Primary Damages	Trade Loss (Daily Maintenance and Business Activities)	Household Economy	Damage to daily housekeeping tasks and community activities due to inundation
				Industrial Production	Stoppage or decrease of business and production activities, decrease of tourists due to inundation
				Public Services	Stoppage or decrease of public services
		Secondary Damages	Expenses for State of Emergency	Household Economy	After inundation, cleaning and repairing houses damaged by flood/inundation, and extra expenses for state of emergency
				Industrial Production	After inundation, cleaning and repairing buildings and offices damaged by flood/inundation, and extra expenses for state of emergency
				Public Services	Expenses for emergency activities to casualties in addition to the works above
			Traffic Disruption		Disruption of traffic systems spreading to surrounding areas
			Lifeline Services Disruption	Water supply, Electric Power, Gas, Telephone, etc.	Disruption of public utility services
			Spreading Effect of Stagnation and Decrease of Daily Activities		Decrease of production due to lack of raw and semi finished materials, Stoppage of public services and utilities.
			Mental shock and inconvenience		Mental Influence due to damages to general assets, business losses, casualties, aftereffects and influence over surrounding areas
			Environmental Quality		
			Aesthetic Value	Planting, Historical Building	Decrease of value of Historical buildings/assets, Damage to townscape
Benefit of Landuse Development					Land appreciation owing to improvement of flood control

Source: Various sources compiled by the Study Team

Unfortunately, there is no standard method for estimation of flood damages because characteristics of damages depend on geopolitical, socio-economic, and demographical conditions of each country, city and area. In the past studies on flood damage, examples and manuals/guidelines of some agencies are summarized as shown in the table below.

Table H.1.2 Samples of Methods and Elements included as Flood Control Benefit in the Past Reports and Guidelines

				Japan		Philippines			The Study
				Ref.1	Ref.2	Ref.3	Ref.4	Ref.5	
Benefit of Flood / Inundation Mitigating	Direct Damages	Primary Damages	General Assets	☺	☺	☺	☺	☺	☺
			Agricultural Production	☺	☺	☺	☺		No
			Public Infrastructures	$☺_R$	☺	$☺_R$	$☺_R$		☺
			Human Lives	●	●	●	●	●	●
		Secondary Damages	Weed growth etc.						●
	Indirect Damages	Primary Damages	Trade Loss	☺	●	$☺_R$	$☺_R$	$☺_R$	☺
		Secondary Damages	Emergency Assistance		●	$☺_R$	$☺_R$	$☺_R$	●
			Cleaning	☺	●				☺
			Traffic Disruption	●	●	●	●	☺	☺
			Lifeline Services Disruption				●	$☺_R$	$☺_R$
			Environmental Quality		●		●	●	●
			Aesthetic Value					●	●
Benefit of Land Use Development				●	NG	☺	●	☺	●

Source: The Study Team

Note : ☺ Quantified based on survey and/or inventory/statistical data

$☺_R$ Quantified as ratio to other index

● Defined as intangible benefit

NG : exclusion recommended because of double counting or method unestablished

Ref.1 : "Manual for Economic Study on Flood Control", May 2000, Ministry of Construction of the Japanese Government

Ref.2 : "Economic Analysis for Social Development Study, 13 Flood Control & Sabo", 2002, JICA

Ref.3 : "Technical Standards and Guidelines for Planning and Design (Draft), Volume I Flood Control", March 2002, DPWH & JICA

Ref.4 : "Detailed Engineering Design of Pasig-Marikina River Channel Improvement Project", March 2002, DPWH & JBIC

Ref.5 : Metro Manila Drainage System Rehabilitation Project", August 1986, MPWH & OECF

The components of benefit in this analysis were selected considering inventories of existing facilities and data availability in Metropolitan Manila. They are as follows:

Direct Damage

- Building Unit
  (Residential Houses and Buildings of Business Establishments, Educational and Health Facilities)

- Assets
  (Household Effects, Depreciable Assets of Business Establishments, Inventory Stocks of Business Establishments)
- Public Infrastructure

Indirect Damage

- Trade Loss (Household and Business)
- Public Service Disruption
- Traffic Disruption
- Cleaning at Household & Business

(2) Direct Damage to Buildings and Assets

In terms of building property such as residence, industrial facilities including buildings, durable assets and inventory stocks, the flood damage is calculated using the following formula:

Flood Damage = Unit property value x Inundated area x Damage rate

Detail is provided in the following:

$$DD_{BA} = \sum_{i} (Vh_i \bullet R_b + Vm_i \bullet R_m) + \sum_{j} (Vb_j \bullet R_b + Va_j \bullet Ra + Vs_j \bullet R_s)$$

Where,	DD_{BA}	:	Direct Damage to Building & Assets
	Vh	:	Value of Housing Unit
	Vm	:	Value of household effects
	Vb	:	Value of business establishments' buildings including public service such as educational and health facilities
	Va	:	Value of depreciable assets such as equipment and machinery in the respective buildings
	Vs	:	Value of inventory stocks such as raw materials, products and semi-products in the respective buildings or premises
	R_b	:	Damage rate of buildings
	R_m	:	Damage rate of residential indoor movables (household effects)
	R_a	:	Damage rate of depreciable assets
	R_s	:	Damage rate of inventory Stocks
	i	:	Floor area in inundated area by city/municipality, by type of construction material, by construction year, by ground slope
	j	:	Number of business establishments' buildings in inundated area by industrial sector, by city/municipality, by type of construction material, by construction year, by ground slope

Value of Housing Unit

Properties which are vulnerable to flood damage consist of house, household effects, building for business purpose, and its assets including indoor/outdoor movables. In general, values of buildings are measured using construction cost in this analysis. The following table is being used for evaluating real property tax by Assessors' Office of LGUs. Incidentally, the values show basic unit cost of structure with simple finishing. An actual house or building unit generally installs finishes on floors, walls, and ceilings for setting up living conditions and decoration purpose. These costs are said to be about 20% to 30% of the basic unit cost in general. In this analysis, 25% was adopted after the example of DPWH report.[1] Thus, the unit value of new house is set at Php 813/m^2 to Php 9,938/m^2 by type of construction materials.

Table H.1.3 Unit Construction Cost and Unit Value of House

Unit : Php/m^2

	Basic Construction Cost							Finishing Cost	Base Cost + Finishing Cost
Type of Building	Residential Condominium	Commercial Condominium	Apartment	One-Family Dwelling	Duplex Dwelling /	Boarding House	Median		
Type I-A	10,700 - 11,000	10,200 - 10,500	9,400 - 9,700	7,600 - 7,900	7,300 - 7,600	6,600 - 6,900		25%	
Type I-B	10,000 - 10,300	9,500 - 9,800	8,700 - 9,000	6,900 - 7,200	6,600 - 6,900	5,900 - 6,200	7,950		9,938
Type I-C	9,300 - 9,600	8,900 - 9,100	8,000 - 8,300	5,200 - 5,500	5,900 - 6,200	5,200 - 5,500			
Type II-A	8,400 - 8,700	7,900 - 8,200	7,100 - 7,400	5,300 - 5,600	5,100 - 5,400	4,400 - 4,700			
Type II-B	7,700 - 8,000	7,200 - 7,500	6,400 - 6,700	4,600 - 4,900	4,400 - 4,700	3,700 - 4,000	5,650		7,063
Type II-C	7,000 - 7,300	6,500 - 6,800	5,700 - 6,000	3,900 - 4,200	3,700 - 4,000	3,000 - 3,300			
Type III-A	-	-	-	3,200 - 3,500	3,100 - 3,400	2,500 - 2,700			
Type III-B	-	-	-	2,500 - 2,800	2,400 - 2,700	2,100 - 2,300	2,350		2,938
Type III-C	-	-	-	1,800 - 2,100	1,700 - 2,000	1,700 - 1,900			
Type III-D	-	-	-	1,100 - 1,400	-	-			
Tyep IV				650			650		813

Sources : - Manila City[2]
- Detailed Engineering Design of Pasig-Marikina River Channel Improvement Project, Main Report Volume II, March 2002, DPWH
- Study on the Flood Control for Rivers in the Selected Urban Centers, February 1995, DPWH

Building Types are as follows.

Type I Reinforced Concrete
- A Structural steel and reinforced concrete columuns, beams, the rest same as I-B
- B Columuns, beams, wall, floors and roofs all reinforced concrete
- C Same as "B" but walls are hollow blocks reinforced concrete or tile roofing

Type II Mixed Concrete
- A Concrete columuns, beams and walls - but wooden floor joists, flooring and roof framing and G.I.(Galvanized Iron) roofing even if walls are in concrete hollow blocks. Kitchen, toilet and bathroom are in reinforced concrete slabs.
- B Concrete columuns and beams - but hollow block walls, wooden floor joist, floor and roof framing and G.I. Roofing and second floor

Type III Strong Materials
- A First grade wooden structural framings, flooring, walls, and G.I. Roofing
- B First grade wooden structural framings, flooring, walls on the first floor and tanguile walls on the second floor and G.I. Roofing
- C First grade wooden posts, girders, girders, window sills and heads, apitong floor joists and roof framing tanguile floor and sliding and G.I. Roofing
- D Third grade wooden structural framing, floorings and sidings, and G.I. Roofing.

Type IV Temporary makeshift structure

Sources : Pasig Marikina Report 2002, Study on the Flood Control for Rivers in the Selected Urban Centers

Floor Area of Inundated Housing Units and Type of Construction Materials

In order to calculate damaged value of housing units in inundated area using the above mentioned unit construction cost, the data on floor area or number of housing units by type of construction materials is necessary. The building inventory data in the GIS developed by the Study Team are neither categorized by type of construction material nor by use of building such as residential, commercial, and industrial because of limitation of study scope and time. In this analysis, enumeration of the floor area of residential houses in inundation area was estimated based on the average figures in the respective LGUs and average floor area of houses in the area (49 m^2/house)[3]. In accordance with the year 2000 census conducted by National Statistics Office (NSO), the shares are as follows.

Table H.1.4 Share of Number of Buildings by Type of Building, by City/Municipality, by Use

Assessors Office Category	Share by City/Municipality					
	Caloocan	Manila	Quezon	Pasay	Makati	Taguig
Type I	51.6%	28.8%	45.9%	34.3%	46.9%	55.4%
Type II	29.8%	42.1%	32.5%	40.5%	32.7%	23.6%
Type III	14.0%	25.5%	16.3%	21.8%	15.5%	16.9%
Type IV	4.6%	3.6%	5.3%	3.4%	4.9%	4.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

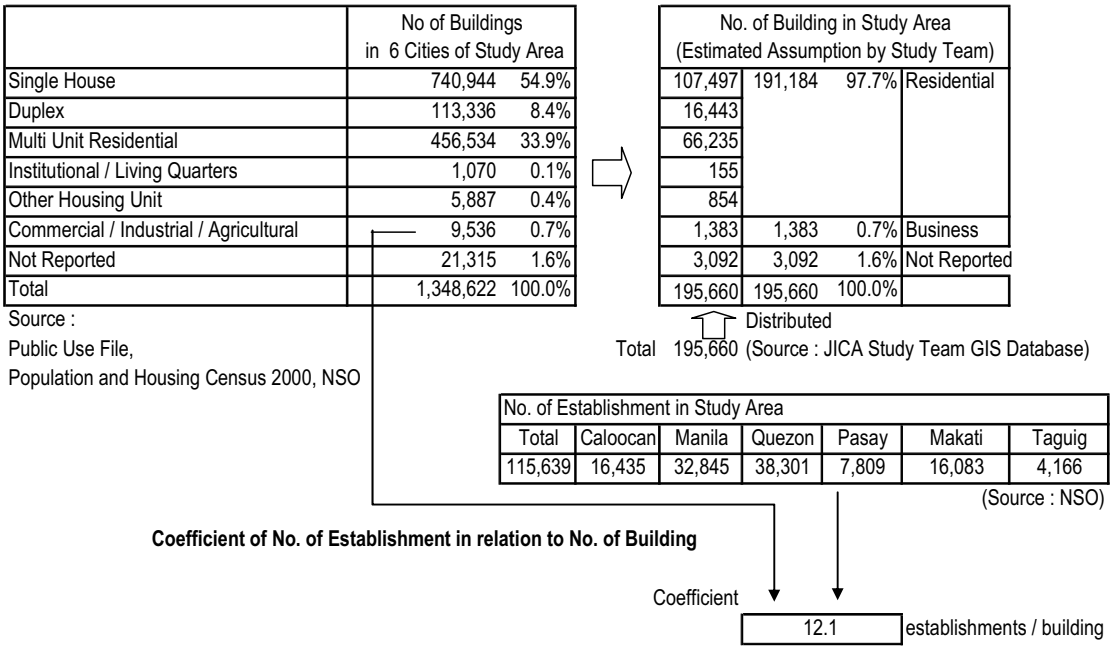


Figure H.1.4 Number of Buildings by Type & by Use of Building

Note: Classification of type of buildings by City Assessor's Office and NSO are different.
Re-categorization for consistency was made by the Study Team.

For the economic analysis, the values of buildings must be depreciated depending on the construction year in order to valuate residual value at present. In accordance with the year 2000 census, construction years of the buildings in the study area are as follows.

Table H.1.5 Construction Year of Buildings in the 5 Cities /Municipality of the Study Area*

Caloocan Unit : Number of Building

Year Building/House was Built	Total	Type I	Type II	Type III	Type IV
Total	249,567	128,716	74,381	34,957	11,513
Adjusted Total	269,398	145,492	77,554	37,740	8,613
2004	10,645	6,274	2,457	1,469	446
2003	10,645	6,274	2,457	1,469	446
2002	10,645	6,274	2,457	1,469	446
2001	10,645	6,274	2,457	1,469	446
2000	2,541	1,509	468	386	178
1999	7,573	4,627	1,397	1,128	421
1998	8,136	4,587	2,026	1,150	373
1997	9,252	5,238	1,966	1,425	623
1996	11,978	6,740	2,739	1,959	540
1991-1995	58,870	35,276	13,982	7,556	2,056
1981-1990	72,784	41,343	20,957	8,662	1,822
1971-1980	23,774	11,090	8,764	3,447	473
1961-1970	15,916	5,683	7,534	2,531	168
1960 or earlier	15,992	4,302	7,894	3,621	175
Not Applicable	286	33	21	61	171
Don't Know	15,923	7,107	5,968	2,584	264
Not Reported	6,542	1,181	665	447	4,249

Pasay

Year Building/House was Built	Total	Type I	Type II	Type III	Type IV
Total	78,180	26,816	31,633	17,053	2,678
Adjusted Total	74,104	26,021	30,244	16,099	1,740
2004	1,579	650	554	338	38
2003	1,579	650	554	338	38
2002	1,579	650	554	338	38
2001	1,579	650	554	338	38
2,000	352	135	110	86	21
1,999	1,457	631	529	264	33
1,998	1,527	624	494	377	32
1,997	1,252	572	271	332	77
1,996	1,719	691	621	360	47
1991-1995	8,254	3,328	3,068	1,707	151
1981-1990	19,048	7,739	7,423	3,656	230
1971-1980	14,073	4,347	6,260	2,823	643
1961-1970	9,689	2,750	4,516	2,170	253
1960 or earlier	10,418	2,606	4,737	2,973	102
Not Applicable	284	6	19	78	181
Don't Know	8,776	3,142	3,402	2,138	94
Not Reported	1,331	245	183	89	814

Manila

Year Building/House was Built	Total	Type I	Type II	Type III	Type IV
Total	333,547	95,951	140,512	85,058	12,026
Adjusted Total	310,264	91,863	129,778	82,040	6,583
2004	6,369	2,336	1,884	1,919	231
2003	6,369	2,336	1,884	1,919	231
2002	6,369	2,336	1,884	1,919	231
2001	6,369	2,336	1,884	1,919	231
2,000	1,600	689	434	357	120
1,999	4,814	2,285	1,152	1,152	225
1,998	5,081	2,373	1,378	1,147	183
1,997	5,206	2,270	1,372	1,387	177
1,996	6,932	2,621	2,058	1,941	312
1991-1995	35,290	11,475	10,993	11,640	1,182
1981-1990	60,837	19,564	24,091	15,717	1,465
1971-1980	49,640	14,768	23,148	10,997	727
1961-1970	42,752	11,562	20,893	9,842	455
1960 or earlier	72,635	14,912	36,724	20,186	813
Not Applicable	2,084	102	114	800	1,068
Don't Know	39,922	12,562	17,188	9,304	868
Not Reported	6,754	768	967	588	4,431

Makati

Year Building/House was Built	Total	Type I	Type II	Type III	Type IV
Total	103,981	48,795	34,050	16,075	5,061
Adjusted Total	100,252	48,176	32,123	16,081	3,872
2004	2,534	1,380	522	457	175
2003	2,534	1,380	522	457	175
2002	2,534	1,380	522	457	175
2001	2,534	1,380	522	457	175
2,000	699	400	90	155	54
1,999	1,993	1,188	316	357	132
1,998	2,849	1,679	457	474	239
1,997	3,141	1,711	436	742	252
1,996	2,233	1,320	457	362	94
1991-1995	12,586	6,518	3,032	2,174	862
1981-1990	23,347	11,801	7,550	3,295	701
1971-1980	15,917	7,740	5,656	2,004	517
1961-1970	13,754	5,754	5,834	1,960	206
1960 or earlier	13,599	4,547	6,207	2,732	113
Not Applicable	326	24	51	107	144
Don't Know	11,438	5,861	3,803	1,608	166
Not Reported	2,099	252	161	105	1,581

Quezon

Year Building/House was Built	Total	Type I	Type II	Type III	Type IV
Total	480,624	220,431	156,412	78,173	25,608
Adjusted Total	493,386	230,205	161,401	81,897	19,883
2004	17,212	8,179	5,019	3,127	887
2003	17,212	8,179	5,019	3,127	887
2002	17,212	8,179	5,019	3,127	887
2001	17,212	8,179	5,019	3,127	887
2,000	3,728	1,793	858	808	269
1,999	11,685	5,836	2,674	2,354	821
1,998	12,563	6,254	3,008	2,532	769
1,997	14,565	7,242	3,725	2,762	836
1,996	20,118	9,391	5,665	4,035	1,027
1991-1995	95,978	44,892	30,097	16,456	4,533
1981-1990	127,603	60,837	41,915	19,953	4,898
1971-1980	71,905	33,033	26,583	10,251	2,038
1961-1970	35,198	15,007	13,887	5,617	687
1960 or earlier	31,195	13,202	12,914	4,623	456
Not Applicable	2,236	300	390	493	1,053
Don't Know	37,395	18,342	11,716	6,574	763
Not Reported	16,455	4,302	2,980	1,715	7,458

Taguig

Year Building/House was Built	Total	Type I	Type II	Type III	Type IV
Total	102,723	56,904	24,219	17,391	4,209
Adjusted Total	114,253	63,678	26,518	20,267	3,790
2004	4,780	2,624	986	977	193
2003	4,780	2,624	986	977	193
2002	4,780	2,624	986	977	193
2001	4,780	2,624	986	977	193
2,000	1,355	752	203	315	85
1,999	3,667	2,135	652	752	128
1,998	4,102	2,456	664	865	117
1,997	3,689	2,150	709	705	125
1,996	5,615	3,227	1,058	1,135	195
1991-1995	25,947	13,648	5,793	5,333	1,173
1981-1990	31,053	17,893	7,849	4,538	773
1971-1980	13,166	7,420	3,596	1,895	255
1961-1970	4,281	2,459	1,251	510	61
1960 or earlier	2,258	1,042	798	312	106
Not Applicable	30	7	3	6	14
Don't Know	5,729	3,178	1,496	901	154
Not Reported	1,831	537	147		1,023

Source: Public Use File for NCR, Population and Housing Census 2000, NSO

*: Include buildings outside of the study area.

In accordance with depreciation rates, the following schedule used by City Assessor's office was adopted in this analysis.

Table H.1.6 Depreciation Table by Type of Building

Unit : %

	Type I		Type II		Type III		Type IV	
	Maintenance		Maintenance		Maintenance		Maintenance	
	Good	Poor	Good	Poor	Good	Poor	Good	Poor
Age								
1	2	12	3	13	5	15	8	18
2	4	14	6	16	10	20	16	26
3	6	16	9	19	15	25	24	34
4	8	18	12	22	20	30	32	42
5	10	20	15	25	25	35	40	50
6	12	22	18	28	30	40	48	58
7	14	24	21	31	35	45	56	66
8	16	26	24	34	40	50	64	74
9	18	28	27	37	45	55	72	82
10	20	30	30	40	50	60	80	90
11	22	32	33	43	55	65		
12	24	34	36	46	60	70		
13	26	36	39	49	65	75		
14	28	38	42	52	70	80		
15	30	40	45	55	75	85		
16	32	42	48	58	80	90		
17	34	44	51	61				
18	36	46	54	64				
19	38	48	57	67				
20	40	50	60	70				
21	42	52	63	73				
22	44	54	66	76				
23	46	56	69	79				
24	48	58	72	82				
25	50	60						
26	52	62						
27	54	64						
28	56	66						
29	58	68						
30	60	70						
31	62	72						
32	64	74						
33	66	76						
34	68	78						
35	70	80						

Sources : LGUs' Assessor's Offices, Study on the Flood Control for Rivers in the Selected Urban Centers, 1995, JICA

Note: For conservative evaluation, figures of "poor" maintenance were adopted in this analysis.

Value of Households Effects

Coefficient of an average value of household effects in relation to the value of houses is set at 35%. This figure is based on the result of the socio-economic survey of "KAMANAVA Area Flood Control and Drainage System Improvement Project".

Value of Buildings and Assets of Business Establishments

Values of buildings and assets of business establishments followed the NSO's census data of establishments. The latest data is as follows.

Table H.1.7 Value of Assets per Establishment

Unit : Php/establishment

	Building	Durable Assets	Stocks	
1 Manufacturing	1,045,000	4,627,000	4,018,000	per establishment at 1995 price
2 Wholesale & Retail Trade	43,000	108,000	1,295,000	per establishment at 1993 price
3 Hotel and Restaurants	1,162,000	1,866,000	90,000	per establishment at 1993 price
4 Financial / Insurance / Real Estate Business	1,242,000	844,000	661,000	per establishment at 1993 price
5 Educational Facilities	15,000,000	3,600,000	450,000	per school at 2001 price
6 Medical Facilities	9,300,000	2,400,000	1,400,000	per school at 2001 price

Source: Pasig-Marikina River Channel Improvement Project, Main Report Volume II, 2002, DPWH

In the Philippines, census of establishment does not cover all sectors at one time. As shown in the above table, since the census is conducted sector by sector, these figures are expressed at the same point of time. In this analysis, these figures were revaluated to the present value (at 2004 price) using official price index of National Capital Region. As is well known, there are slight differences among the major price index such as Consumer Price Index (CPI), Retail Price Index (RPI) and General Wholesale Price Index (GWPI). Since there are almost all sectors except agriculture and fishery and all types of businesses are seen in the study area, the average of these indices was adopted in this analysis.

Table H.1.8 Price Indices in NCR (1991 – 2003)

	CPI, NCR (1994=100)	RPI, NCR (1978=100)	GWPI, NCR (1985=100)	Simple Average (1991=100)
1991	76	609	166	100
1992	84	640	172	107
1993	92	653	172	111
1994	100	699	187	120
1995	108	751	197	128
1996	117	797	215	138
1997	125	812	216	143
1998	138	884	241	158
1999	145	928	255	166
2000	152	956	260	171
2001	163	997	266	180
2002	169	1,008	275	185
2003	174	1,029	289	189

Source: CPI, RPI, GWPI (1991-2002) - 2003 Philippine Statistical Yearbook, and Website, National Statistical Coordination Board / GWPI(2003) - NSO

Damage Rate

The damage rate is derived from the relation between inundation water depth and flood damage. In Metropolitan Manila, there were some studies identifying flood damage. Examples of these damage rates are as follows.

Table H.1.9 Damage Rate of Inundation by Depth (Example 1)

	Damage Rates		
	Residential/Commercial *		Industrial
Inundation Depth	Houses	Indoor Movables	Indoor Movables
0-25 cm	0.043	0.038	0.025
26-50 cm	0.046	0.044	0.053
Above 50 cm	0.054	0.070	0.180

Source: The Study on Flood Control and Drainage Project in Metro Manila, Volume 1 Main Report, 1990, JICA

Note : * Damage rates are against the value of houses.

Table H.1.10 Damage Rate of Inundation by Depth (Example 2)

Inundation Depth	Damage Rates	
	House	Indoor Movables
0-25 cm	0.0690	0.0608
26-50 cm	0.0736	0.0704
51cm -	0.0864	0.1120

Source: Supporting Report, The Study on Flood Control and Drainage System Improvement for Kalookan - Malabon - Navotas - Valenzuela (KAMANAVA) Areas, 1998, JBIC

However, because of the limitation of sample size of the survey and the accuracy, the above damage rates are not used in this analysis, but the rate of "Manual for Economic Study on Flood Control" issued by Japan's Ministry of Construction were applied in this analysis. This Japanese manual based on the large sampled survey has been commonly used in many past studies on flood control in Metropolitan Manila.

Table H.1.11 Damage Rate of Inundation Applied in the Analysis

		Ground Slope	Below Floor	Above Floor				
				-50 cm	51-99 cm	100-199 cm	200-299 cm	300 cm -
Residence								
	House	Less than 1/1,000	0.0320	0.0920	0.1190	0.2660	0.5800	0.834
		1/1,000 to 1/500	0.0440	0.1260	0.1760	0.3430	0.6470	0.870
		Steeper than 1/500	0.0500	0.1440	0.2050	0.3820	0.6810	0.888
	Household Effects		0.0210	0.1450	0.3260	0.5080	0.9280	0.991
			Above Floor					
			0-50 cm		51-99 cm	100-199 cm	200-299 cm	300 cm -
Business Entities								
	Building		0.0920		0.1190	0.2660	0.3800	
	Fixed Assets/Depreciable Assets		0.2320		0.4530	0.7890	0.9660	
	Inventory Stock		0.1280		0.2670	0.5860	0.8970	

Source: "Manual for Economic Study on Flood Control", May 2000, Ministry of Construction (Ministry of Land, Infrastructure and Transport, at present), Japanese Government

In accordance with the manual, the damage rates are defined by depth and by ground slope. For applying this Japanese manual to Metropolitan Manila, the following assumptions were made. In Japan, inundation depths of residential houses are categorized into two kinds, i.e. inundation below floor or above floor, because the highset floor is commonly seen in Japanese houses. Based on these Japanese cultural setting, the level of distinction in the manual is ranged at 50 cm height. In this analysis, the inundation over 20 cm was regarded as "inundation above floor", because it is commonly seen that floor height of houses in Metropolitan Manila is lower than 20 cm. And three categories of depth (20 cm to 50 cm, 50 cm to 100 cm, and 100 cm or deeper.) were adopted at different damage rates in this analysis. Deepest inundation in the mathematical hydrodynamic simulation model in the study area was 130 cm.

The damage rates for business entities and office buildings are applied to the buildings inundated at 5 cm or deeper from the ground elevation in this analysis. Because, if it starts to count the buildings inundated about 5cm or less, all of buildings are to be included in the mathematical hydrodynamic simulation model as being inundated. For this reason, this analysis regards the buildings inundated at 5 cm or shallower as being in dried area.

As a result of the section of 2), the method of the estimation of the direct damage of the building and assets are summarized as follows:

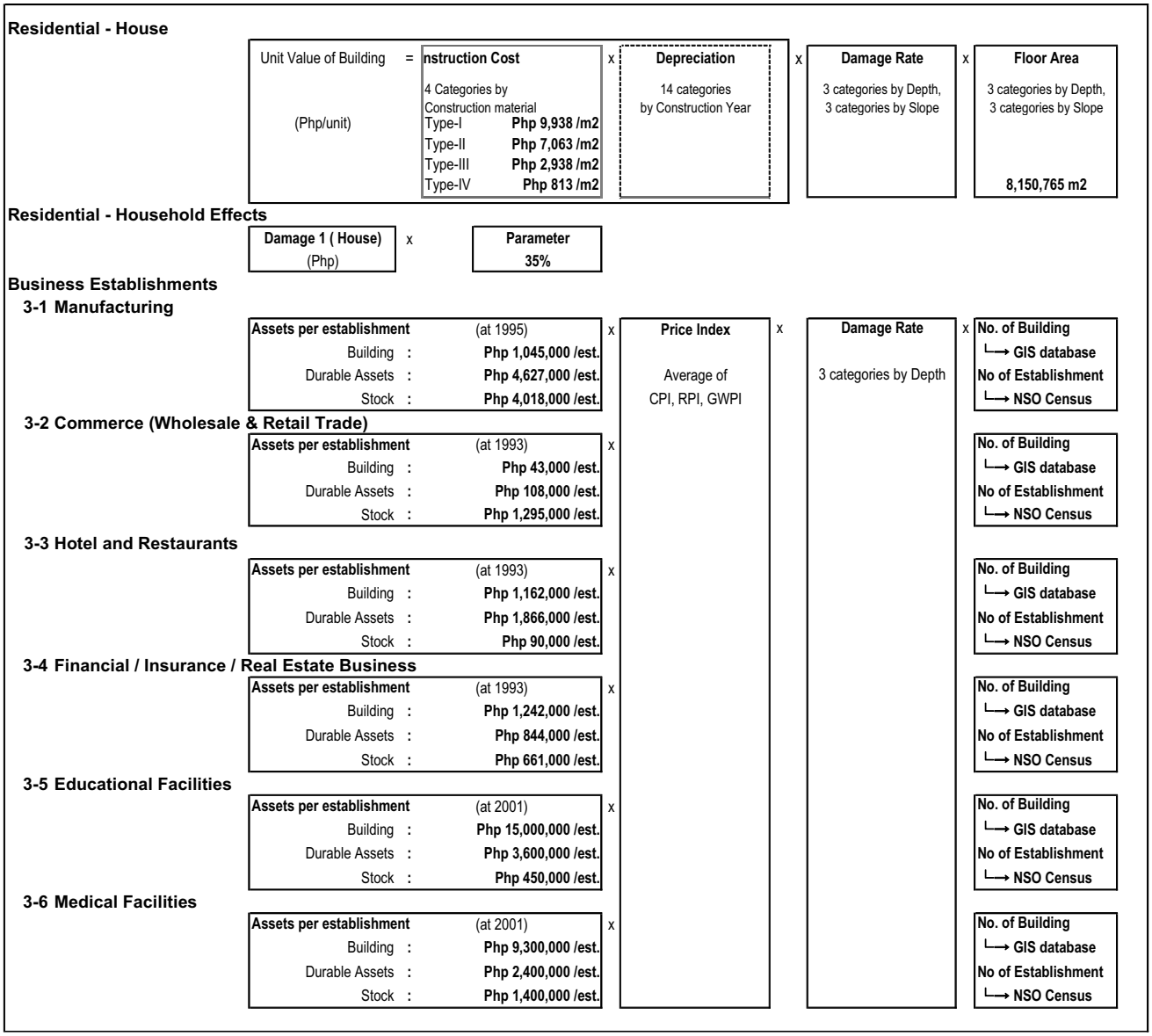


Figure H.1.5 Method and Formula (Damage of Buildings & Assets)

(3) Infrastructure Damage

In general, infrastructure damage has rarely been recorded, although it is said that the damages to infrastructure are usually larger than the building properties'. In the Philippines, the infrastructure damage affected by major typhoon / tropical storm / tropical depression, have been collected by the Office of Civil Defense (OCD). According to the OCD's records, 31% was the average rate of infrastructure damage against the damage of private property by the major typhoons that hit the National Capital Region during 1982 to 2003. In the Japanese manual, the proposed damage rate of infrastructure is 169% of the direct damage. The rate seems to be too large taking into account the past record in the Philippines. The OCD's 31%, which may look conservative as compared with the rate in the Japanese manual, was applied in this analysis.

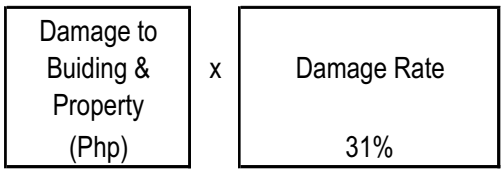


Figure H.1.6 Method and Formula (Damage of Infrastructure)

(4) Indirect Damage

Trade Loss
(Opportunity Loss of Daily Maintenance Activities and Business Activities)

Trade loss is regarded as an opportunity loss of daily maintenance/Household activities and business activities. When flooding would occur and people would be late (or absent) for work, this causes a decrease in their production and services. In addition, during flood / inundation period and just after the flood, people have to clean rooms and furniture damaged and to repair things damaged in their houses. These activities are done by family members of the household in general. Thus, these activities are considered as loss of time on housekeeping, so their labor cost is also estimated as a part of flood damages.

Damaged business establishments are also closed to clean, fix and repair their workspace, furniture and equipment and to dispose of damaged inventory stock. Even after the floodwaters have receded, their businesses may stagnate for some days before returning to their former state because the equipment and supply of intermediate materials necessary for their products are also affected by flood. These losses are considered as trade loss of business activities.

The stoppage of the activities affects not only household and private businesses but also the public service sector such as public utilities, schools, and medical/health services.

These indirect damages can be considerable and must be taken into account in the assessment of total flood damage, although standard method of measurement of many of the indirect damages has not been defined. In accordance with the damages caused by trade loss, the Japanese manual proposes the following calculation method.

$$ID_{TL} = (HH \bullet Sa \bullet Cl) + (E \bullet Va \bullet (Sp + \tfrac{1}{2} St))$$

Where, ID_{TL} : Indirect damage of trade loss
HH : Number of affected people in household
Sa : Salary per person · day
Cl : No. of necessary days for cleaning
E : Number of affected employees
Va : Value added per person · day
Sp : No. of stoppage days
St : No. of stagnant days

Meanwhile, the factors used in "Metro-Manila Integrated Urban Drainage and Flood Control Master Plan, March 1984, DPWH" are commonly accepted as indirect damage factors[4] in relation to direct damages. In this analysis, these damage factors are applied as shown below.[5]

Direct Damage	x	Damage Rate
		Residential - 15%
		Commercial - 37%
		Industrial - 45%
		Utilities - 10%
		Public Property - 34%
		Highways - 25%
		Railways - 23%

Figure H.1.7 Method and Formula (Indirect Damage : Trade Loss)

Unit Cost for alternative activities were applied by applying the time value of people in Metropolitan Manila based on their income for household and actual record of expenses based on the Japanese Guideline.

Inundated Household Number

Inundated Floor Area (m2)			Average Floor Area / House	Inundated Household		
20-50	51-99	100-199	(m2/house)	20-50	51-99	100-199
4,191,664	3,250,119	708,982	49	85,544	66,329	14,469

(1990 Census)

Unit Cost for Alternative Activities at Household (such as purchase of dirinking water/food, transportation fee)

Expenses (Japanese Guideline, 2000) (JPY/household)				Ave. Income in Japan (2002, JPY)	Conver to Php			Ratio	Inundated Household		
					Exchange Rate (JPY/PhP)	Converted Ave. Income in Japan (2002, Php)	Ave. Income in NCR (2002,Php)				
Under Floor	0-50	51-99	100-199						20-50	51-99	100-199
82,500	147,600	206,500	275,900	3,346,800	2.2	1,521,273	130,932	0.086	85,544	66,329	14,469

Not Applicable

US$=JPY110=Php50

Unit Cost for Alternative Activities at Business Establishment

Expenses (Japanese Guideline, 2000) (JPY/household)				Ratio	Inundated Establishment		
Under Floor	0-50	51-99	100-199		20-50	51-99	100-199
47,000	92,500	1,714,000	3,726,000	0.086	3,115	2,396	548

Figure H.1.8 Unit Cost of Trade Loss & Alternative Activities

Disruption of Traffic

Disruption to transportation system including delay time and increased fuel costs can also be counted as flood damage. One of the most adverse effects of the flood perceived by the society is the disruption to urban transportation. Consequences, however, have not been properly studied in the past. Considering that the impact on traffic in Metropolitan Manila is significant and of major concern to the citizens, the Study tried estimating the level of the benefit based on the best combined information derived from vehicular traffic data and the strength of new hydrodynamic simulation model and geographic information system developed by the Study Team.

Flood will disrupt the traffic in the following manner depending upon the depth and duration of inundation:

- Decrease in travel speed of vehicle
- Detour or cancellation of vehicle operation
- Inconvenience in or obstruction to the access to transport routes
- Inducement of mechanical trouble
- Traffic accident

Of the above, it is considered that the first item is the most significant one, which is quantifiable with certain accuracy. The subsequent benefit can be estimated in terms of "reduction of vehicle operating cost" and "savings in travel time". This is shown more specifically in the following formula:

$$\textbf{[Reduction of VOC]} \quad B_{VOC} = (VOC_{without} - VOC_{with}) \bullet Q$$

where,

B_{VOC} : Benefit due to reduction in vehicle operation cost

$VOC_{without}$: Vehicle operating cost at an average travel speed for "without" project situation

VOC_{with} : Vehicle operating cost at an average travel speed for "with" project situation

Q : Traffic volume in Metropolitan Manila expressed in terms of vehicle-km

$$\textbf{[Savings in Travel Time]} \quad B_{TS} = (PH_{without} - PH_{with}) \bullet TV$$

where,

B_{TS} : Benefit due to savings in travel time

$PH_{without}$: Passenger – hours in Metropolitan Manila for "without" project situation

PH_{with} : Passenger – hours in Metropolitan Manila for "with" project situation

TV : Time value of passengers

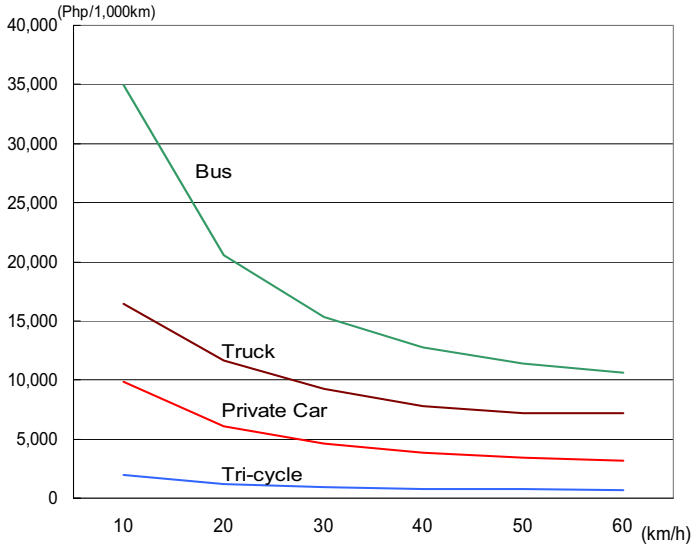
It is a well-known fact that vehicle operating cost varies by travel speed and that the cost drastically increases as the travel speed decreases or stop-and-go is more frequently practiced. As is illustrated in the following figure, vehicle operating costs increase sharply particularly at 10 to 5 km/h or less. This is the major reason why many of the urban transport projects which aim at relieving traffic congestions can be economically justified.

Table H.1.12 Vehicle Operating Cost in Metropolitan Manila

Unit: Php/1,000km

	10km/h	20km/h	30km/h	40km/h	50km/h	60km/h
Try-cycle	1,949	1,185	918	789	741	728
Private Car	9,859	6,075	4,623	3,858	3,411	3,145
Jeepney	11,725	6,864	5,109	4,188	3,640	3,293
Hov/Taxi	9,643	5,561	4,079	3,293	2,809	2,480
Bus	34,959	20,528	15,362	12,720	11,362	10,652
Truck	16,481	11,645	9,222	7,793	7,229	7,167

Source : MMUTIS



Source: MMUTIS Report, 1999, JICA and relevant agencies of the Philippines

Figure H.1.9 Major Vehicle Operating Cost of Vehicle in Metropolitan Manila

The study area extends the core part of Metropolitan Manila to where most of the public transport routes pass or relate directly or indirectly (private transport included). When flood occurs in the study area, the inundation affects not only the vehicles in the area but also outside of the study area. In this analysis, the computer traffic model was simulated covering whole Metropolitan Manila area. Assumptions made are as follows.

- Traffic data is considering the latest road network in year 2003.
- Average travel speed will decrease to 5 km/h in the area of inundation.
- Under the inundation condition, because the differences of driving speed among types of vehicles become small, the categories are integrated into two in this analysis,
  i.e. 1) Private mode (Private Car), and
  2) Public mode (Bus + Jeepney + HOV/Taxi).
- All vehicle trips in Metropolitan Manila are re-distributed or detoured to the fastest route

under the flood situation.

- Cancellation of trip or modal shift (e.g. from vehicle to railway) is not considered.
- Inundation for longer than 6 hours affects the average daily traffic for the 1st day, and for longer than 24 hours, affects traffic for the 2nd day.

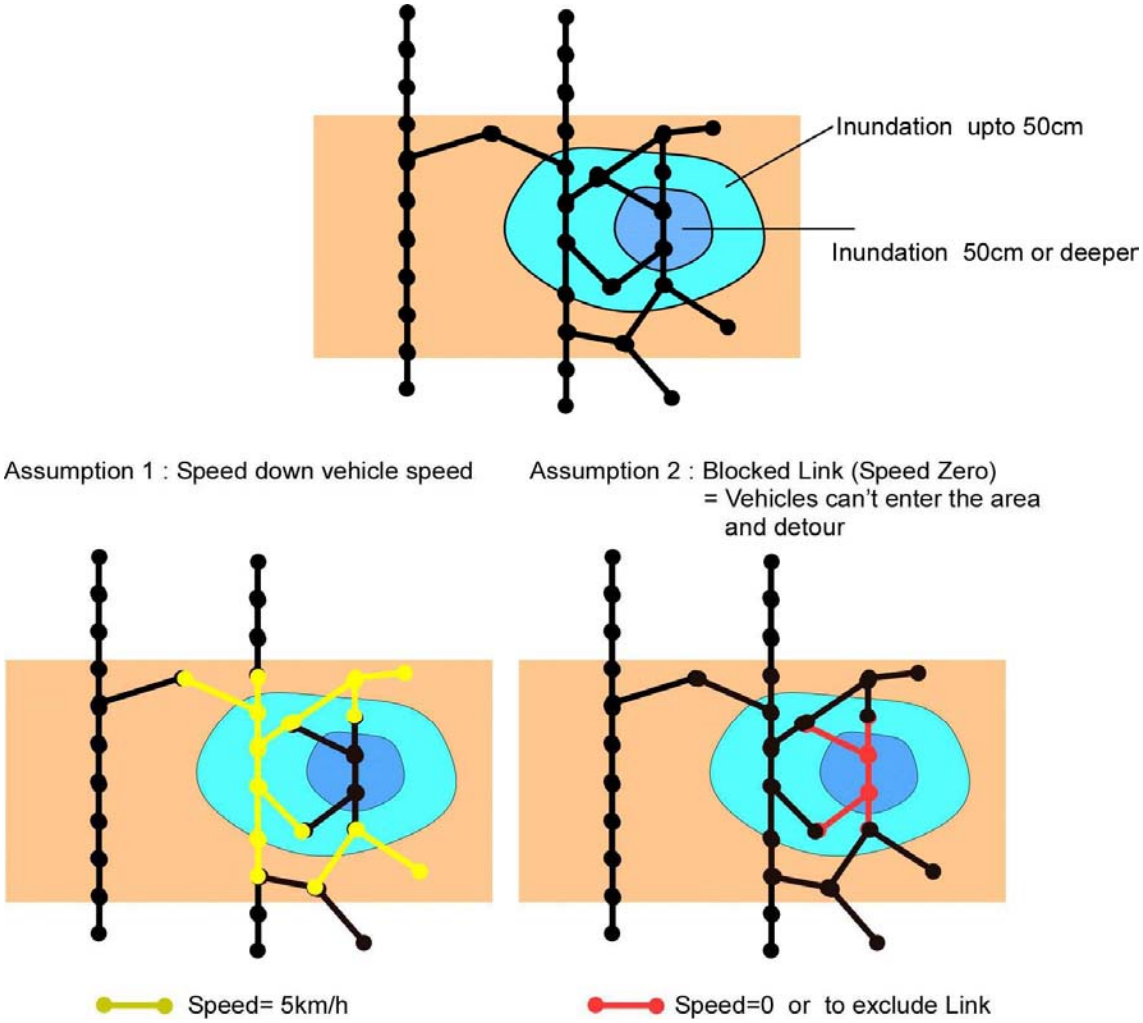


Figure H.1.10 Conceptual Diagram of Traffic Simulation Model

Table H.1.13 Result of Vehicle Operating Cost (VOC) in Metropolitan Manila

Unit : Php

	2 Year Return	3 Year Return	5 Year Return	10 year Return	20 year Return	30 year Return
Without Project	4,950,038	6,965,143	9,020,300	11,880,309	12,016,337	12,881,863
With Project	531,800	748,290	969,083	1,276,344	1,290,958	2,920,947

Source : JICA Study Team

Note : Without Project means ;
= Total VOC in Flood Situation under Without-Project Condition – Total VOC in Normal Situation
With Project means ;
= Total VOC in Flood Situation under With-Project Condition – Total VOC in Normal Situation

(5) Calculation of Potential Flood Damage

Inundation and floodwater levels calculated for several probable rainfalls or discharges are applied to the relation between water level and flood damage mentioned above. In this analysis, the flooding cases of 2-, 3-, 5-, 10-, 20- and 30- year return periods were applied.

(6) Flood Damage by Return Period

The results of the estimates are summarized in the following tables:

Table H.1.14 Flood Damage by Return Period (Without Project, North Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	6,234	7,602	9,625	12,794	15,210	16,120
1. Residence - House	950	1,161	1,450	2,033	2,466	2,615
2. Residence - Household Effects	495	644	807	1,091	1,350	1,445
3. Business Establishments	3,311	3,995	5,086	6,636	7,788	8,238
3-1 Manufacturing	961	1,162	1,474	1,915	2,245	2,375
3-2 Commerce (Wholesale & Retail Trade)	952	1,171	1,518	2,013	2,396	2,543
3-3 Hotel and Restaurants	495	591	742	955	1,110	1,171
3-4 Financial / Insurance / Real Estate Business	422	505	639	831	970	1,024
3-5 Educational Facilities	117	138	173	222	257	270
3-6 Medical Facilities	363	428	540	699	810	854
4. Infrastructure	1,478	1,803	2,282	3,034	3,607	3,822
B. Indirect Damage	2,988	3,668	4,621	6,148	7,349	7,797
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	1,878	2,280	2,893	3,814	4,509	4,774
6. Traffic Disruption	3	4	5	6	6	6
7. Cost for Alternative Activities	1,107	1,384	1,723	2,328	2,834	3,016
C. Total	9,222	11,270	14,245	18,942	22,559	23,917

Source: The Study Team

Table H.1.15 Flood Damage by Return Period (Without Project, South Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	4,562	6,049	8,541	12,273	14,606	15,932
1. Residence - House	885	1,285	1,855	2,876	3,386	3,722
2. Residence - Household Effects	481	667	979	1,563	1,860	2,043
3. Business Establishments	2,113	2,663	3,682	4,923	5,896	6,389
3-1 Manufacturing	427	556	825	1,081	1,319	1,440
3-2 Commerce (Wholesale & Retail Trade)	572	727	1,028	1,417	1,728	1,884
3-3 Hotel and Restaurants	368	465	633	831	982	1,060
3-4 Financial / Insurance / Real Estate Business	428	519	665	902	1,050	1,125
3-5 Educational Facilities	73	91	123	158	186	201
3-6 Medical Facilities	246	305	409	535	631	680
4. Infrastructure	1,082	1,434	2,025	2,910	3,463	3,778
B. Indirect Damage	2,091	2,810	3,983	5,839	6,906	7,510
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	1,295	1,682	2,356	3,295	3,930	4,276
6. Traffic Disruption	2	3	4	6	6	6
7. Cost for Alternative Activities	794	1,125	1,623	2,538	2,970	3,227
C. Total	6,653	8,859	12,524	18,112	21,512	23,442

Source: The Study Team

Table H.1.16 Flood Damage by Return Period (Without Project, All Study Area)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	10,796	13,651	18,165	25,067	29,816	32,051
1. Residence - House	1,836	2,446	3,304	4,909	5,852	6,336
2. Residence - Household Effects	976	1,311	1,786	2,654	3,210	3,488
3. Business Establishments	5,424	6,658	8,767	11,559	13,684	14,627
3-1 Manufacturing	1,388	1,718	2,299	2,996	3,564	3,815
3-2 Commerce (Wholesale & Retail Trade)	1,524	1,898	2,546	3,429	4,124	4,427
3-3 Hotel and Restaurants	863	1,056	1,375	1,786	2,091	2,231
3-4 Financial / Insurance / Real Estate Business	850	1,024	1,304	1,733	2,020	2,149
3-5 Educational Facilities	190	228	295	380	443	471
3-6 Medical Facilities	609	734	949	1,234	1,441	1,534
4 Infrastructure	2,560	3,237	4,308	5,944	7,070	7,600
B. Indirect Damage	5,079	6,478	8,604	11,987	14,255	15,307
5 Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	3,173	3,962	5,249	7,108	8,439	9,051
6 Traffic Disruption	5	7	9	12	12	13
7 Assistance and Calamity Fund Extended	0	0	0	0	0	0
8 Cost for Alternative Activities	1,901	2,509	3,346	4,866	5,805	6,244
C. Total	15,875	20,129	26,769	37,053	44,071	47,359

Source: The Study Team

Table H.1.17 Flood Damage by Return Period (With Master Plan, North Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	615	641	832	1,710	3,883	4,672
1. Residence - House	35	39	43	108	520	671
2. Residence - Household Effects	16	18	21	51	225	296
3. Business Establishments	418	432	571	1,146	2,217	2,598
3-1 Manufacturing	120	124	163	328	635	746
3-2 Commerce (Wholesale & Retail Trade)	118	122	161	321	620	726
3-3 Hotel and Restaurants	64	66	86	174	337	394
3-4 Financial / Insurance / Real Estate Business	55	56	74	149	289	337
3-5 Educational Facilities	15	16	21	43	83	97
3-6 Medical Facilities	48	49	64	131	255	297
4. Infrastructure	146	152	197	406	921	1,108
B. Indirect Damage	253	267	343	709	1,773	2,166
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	208	216	283	574	1,208	1,436
6. Traffic Disruption	1	1	1	1	1	2
7. Cost for Alternative Activities	45	51	60	134	564	729
C. Total	869	909	1,175	2,419	5,656	6,838

Source: The Study Team

Table H.1.18 Flood Damage by Return Period (With Master Plan, South Manila)

Unit : Php Million

Item	Return Period (Year) 2	3	5	10	20	30
A. Direct Damage	11	296	600	957	2,617	3,809
1. Residence - House	0	1	95	198	418	667
2. Residence - Household Effects	0	0	38	92	200	316
3. Business Establishments	8	224	325	440	1,378	1,923
3-1 Manufacturing	2	61	90	108	317	445
3-2 Commerce (Wholesale & Retail Trade)	2	62	89	119	367	521
3-3 Hotel and Restaurants	1	35	50	70	238	326
3-4 Financial / Insurance / Real Estate Business	1	32	45	74	243	339
3-5 Educational Facilities	0	9	12	17	50	68
3-6 Medical Facilities	1	26	38	53	162	224
4. Infrastructure	3	70	142	227	620	903
B. Indirect Damage	4	108	280	461	1,187	1,753
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	4	106	182	271	784	1,121
6. Traffic Disruption	0	0	0	0	1	1
7. Cost for Alternative Activities	0	2	98	190	403	631
C. Total	15	405	880	1,418	3,804	5,561

Source: The Study Team

Table H.1.19 Flood Damage by Return Period (With Master Plan, All Study Area)

Unit : Php Million

Item	Return Period (Year) 2	3	5	10	20	30
A. Direct Damage	626	937	1,432	2,667	6,500	8,481
1. Residence - House	35	40	138	306	939	1,337
2. Residence - Household Effects	16	19	60	143	424	612
3. Business Establishments	427	656	895	1,586	3,595	4,521
3-1 Manufacturing	122	185	253	436	952	1,191
3-2 Commerce (Wholesale & Retail Trade)	120	184	251	440	987	1,247
3-3 Hotel and Restaurants	65	100	136	244	575	721
3-4 Financial / Insurance / Real Estate Business	56	88	119	223	532	676
3-5 Educational Facilities	16	24	33	59	133	165
3-6 Medical Facilities	49	75	103	184	417	521
4. Infrastructure	149	222	340	632	1,541	2,011
B. Indirect Damage	257	376	623	1,170	2,960	3,919
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	212	322	465	845	1,991	2,556
6. Traffic Disruption	1	1	1	1	1	3
7. Cost for Alternative Activities	45	54	157	324	967	1,360
C. Total	884	1,313	2,055	3,837	9,459	12,400

Source: The Study Team

(7) Case of without Pumping Station and Gate Operation Service

In order to verify the effectiveness of existing pumping stations and flood control gates, the Study Team tried an additional sensitivity analysis as a case of without pumping station and gate operation services under the flood size of 10-year return period. As shown in the following table, when pumping stations and gate control in metropolitan Manila were stopped, the flood damage would increase at 50% compared to the existing conditions. This flood damage is equivalent to the damage or bigger than the flood of 30-year return period. As seen in the example of this simulation result, it is apparent that the pumping stations and flood control gates have great function to prevent Metropolitan Manila from severe flood / inundation damage.

Table H.1.20 Effect of Pumping Station & Gate

Unit : Php Million

Item	Existing Condition		Existing + No Pump Condition		Existing Condition	Existing + No Pump Condition
	North Manila	South Manila	North Manila	South Manila	All Study Area	All Study Area
A. Direct Damage	**12,794**	**12,273**	**17,012**	**20,539**	**25,067**	**37,551**
1. Residence - House	2,033	2,876	2,805	5,068	4,909	7,874
2. Residence - Household Effects	1,091	1,563	1,629	2,833	2,654	4,461
3. Business Establishments	6,636	4,923	8,544	7,768	11,559	16,312
3-1 Manufacturing	1,915	1,081	2,501	1,884	2,996	4,385
3-2 Commerce (Wholesale & Retail Trade)	2,013	1,417	2,614	2,343	3,429	4,956
3-3 Hotel and Restaurants	955	831	1,220	1,263	1,786	2,483
3-4 Financial / Insurance / Real Estate Business	831	902	1,055	1,237	1,733	2,291
3-5 Educational Facilities	222	158	279	239	380	518
3-6 Medical Facilities	699	535	876	801	1,234	1,677
4 Infrastructure	3,034	2,910	4,034	4,870	5,944	8,904
B. Indirect Damage	**6,148**	**5,839**	**8,306**	**9,816**	**11,987**	**18,122**
5 Loss of Business Opportunity	3,814	3,295	5,004	5,398	7,108	10,402
6 Traffic Disruption	6	6	6	6	12	12
7 Cost for Alternative Activities	2,328	2,538	3,296	4,412	4,866	7,708
C. Total	**18,941**	**18,112**	**25,318**	**30,355**	**37,053**	**55,673**
Increase of Damage(Adverse Effect by Out of Service of Pump & Gate)			**↑34%**	**↑68%**		**↑50%**

Note :Existing Condition = Case of Without Project

Existing Condition + No Pump Condition = Case of without pumping service & without gate operation

(8) Estimation of Annual Average Benefit

Based on the estimated potential flood damages for each probable rainfall or discharge, the annual average damage was calculated by the following formula:

$$\textbf{Annual Average Benefit} = \textbf{Annual Average Damage}$$

$$= \sum_{i=1}^{n} 1/2 \, (D(Q_{i-1}) + D(Q_i)) \cdot (P(Q_{i-1}) + P(Q_i))$$

Where,

$D(Q_{i-1})$, $D(Q_i)$: Flood damage caused by the floods with Q_{i-1} and Q_i discharges, respectively

$P(Q_{i-1})$, $P(Q_i)$: Probabilities of occurrence of Q_{i-1} and Q_i discharges, respectively

n : Number of floods applied

The annual average benefit, defined as the reduction of probable damage under the “with” and “without” project situations was thus estimated for the proposed plan, i.e., Php 14,639 million in total (North Manila: 7,809, South Manil:6,830) as presented in the table below.

Table H.1.21 Breakdown of Annual Average Benefit (With Master Plan, in Present Condition, North Manila)

Unit : Php million

Flood Return Preod	Flood Damage		Reduction	Average	Expectation Rate	Benefit by Return
	Without Project	With Project				
				4,177	0.5000	2,088
2 year	9,222	869	8,353	9,357	0.1667	1,560
3 year	11,270	909	10,362	11,716	0.1333	1,562
5 year	14,245	1,175	13,071	14,797	0.1000	1,480
10 year	18,942	2,419	16,523	16,713	0.0500	836
20 year	22,559	5,656	16,903	16,991	0.0167	283
30 year	23,917	6,838	17,079	Total (Annual Average Benefit)		7,809

Source: The Study Team

Table H.1.22 Breakdown of Annual Average Benefit (With Master Plan, in Present Condition, South Manila)

Unit : Php million

Flood Return Preod	Flood Damage		Reduction	Average	Expectation Rate	Benefit by Return
	Without Project	With Project				
				3,319	0.5000	1,659
2 year	6,653	15	6,638	7,546	0.1667	1,258
3 year	8,859	405	8,454	10,049	0.1333	1,340
5 year	12,524	880	11,643	14,169	0.1000	1,417
10 year	18,112	1,418	16,694	17,201	0.0500	860
20 year	21,512	3,804	17,708	17,794	0.0167	297
30 year	23,442	5,561	17,881	Total (Annual Average Benefit)		6,830

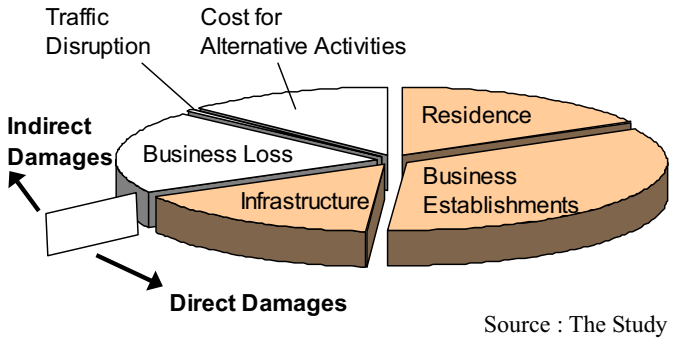
Source: The Study Team

Table H.1.23 Breakdown of Annual Average Benefit
(With Master Plan, in Present Condition, All Study Area)

Unit : Php million

Flood Return Preod	Flood Damage		Reduction	Average	Expectation Rate	Benefit by Return
	Without Project	With Project				
				7,495	0.5000	3,748
2 year	15,875	884	14,991	16,903	0.1667	2,817
3 year	20,129	1,313	18,816	21,765	0.1333	2,902
5 year	26,769	2,055	24,714	28,965	0.1000	2,897
10 year	37,053	3,837	33,216	33,914	0.0500	1,696
20 year	44,071	9,459	34,612	34,785	0.0167	580
30 year	47,359	12,400	34,959	Total (Annual Average Benefit)		14,639

Source: The Study Team



Source : The Study Team

Figure H.1.11 Elements of Annual Average Benefit

(9) Socio-Economic Projection

Future Projection on GDP, Population, and Land Use

(GDP Projection)

The long-term projection of GDP is indispensable for formulating the future framework of the socio-economic structure. Annual growth rate of GDPs 2001 - 2006 is estimated at 5.1% (low case) and 5.6 (high case) in the Medium Term Development Plan. The rate in the past year, 2003, was 4.7%. Under these circumstances, GDP is estimated on the following assumptions in this analysis.

- Until 2010, GDP will increase at the same rate in the present situation.
- Between 2010 and 2015, GDP will grow at a half of the above rate.
- Beyond the year 2015, growth of GDP is not considered.

Table H.1.24 Economic Growth Rate Framework

	Actual Performance*1	MTPDP Target*2	Assumption of this Study		
	2003	2004-2010	2005-2010	2010-2015	After 2015
GDP Annual Growth Rate	4.7%	High 8.0% Low 4.9%	4.70%	2.35%	±0%

Source: *1 NSCB website, *2 NEDA website

(Demographic Projection and Housing Conditions)
National Statistics Office (NSO) provides national population projections, for subdivisions down to municipal level, until 2010, incorporating the results of the 1990 census.

In accordance with the NSO projection, it estimates population decline in Manila and Pasay after 2005 and Makati after 2010. But in the latest 2000 Census, the decline in these three cities has already started.

In this analysis, the future population is projected on the basis of the NSO projection until 2010, and then, after 2010, growth is assumed ±0%. The average number of family members and average floor area per house are assumed to be the same in future.

Table H.1.25 Population Framework

			Assumption of this Study		
	Actual Statistics *1		NSO Projection *2		
	1995	2000	2005	2010	After 2010
Caloocan	1,023,159	1,177,604	1,383,071	1,608,034	
Manila	1,654,761	1,581,082	1,501,077	1,429,674	
Pasay	408,610	354,908	323,374	278,122	
Quezon	1,989,419	2,173,831	2,406,137	2,464,168	
Makati	484,176	471,379	475,531	471,267	
Taguig	381,350	467,375	589,397	732,741	
5 Cities&1Municipality	5,941,475	6,226,179	6,678,587	6,984,006	6,984,006
5-year growth rate		4.79%	**+7.27%**	**+4.57%**	**±0.00%**
annual growth rate		0.94%	**+1.41%**	**+0.90%**	**±0.00%**
NCR	9,454,040	9,932,560	10,505,346	11,074,059	
5-year growth rate		5.06%	5.77%	5.41%	

Source: *1, NSO
*2, NSO, Population and Development in the Philippines, AIM (Asian Institute of Management) Policy Center, 2003

(Land Use Plans)
As mentioned in the *Main Report, Chapter 2.2*, land use plans have been released by the LGUs. In this economic analysis, the proposed land use plans are supposed to be realized immediately after project commencement in order to keep consistency with hydrodynamic simulation model, although the plans are not guaranteed to be realized within the project period, and the land use is transformed gradually in general.

Future Prospects of Damageable Assets

While the structure of damageable properties remains constant, economic value and distribution of the assets and properties in the flood-prone areas are considered to change in the future. Taking the socio-economic projection into consideration, these changes are derived in the following manner:

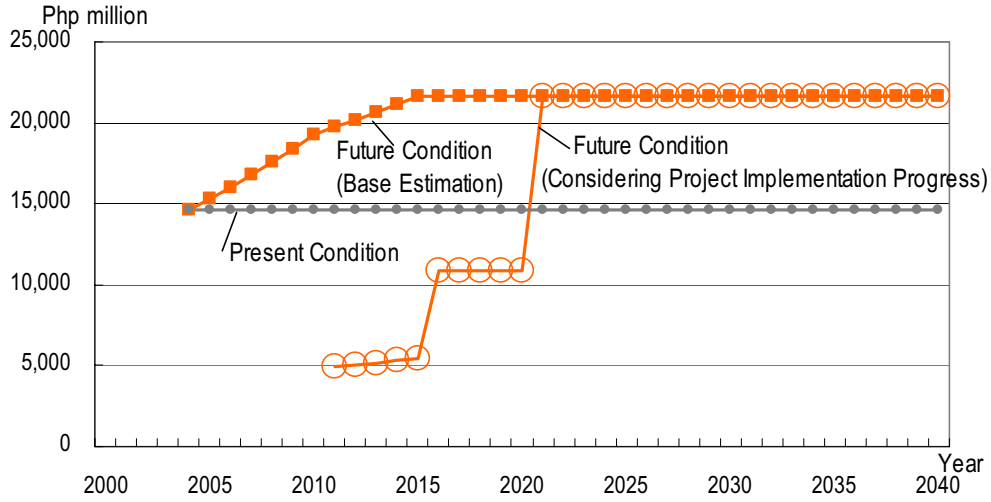
- The number of damageable housing units and buildings is computed as constant to keep consistency with hydrodynamic simulation model.
- The average damageable value of household effects and construction cost of housing units are assumed to increase in consideration of GDP per capita and population growth.
- The total values of both depreciable assets and inventory stock basically increase in consideration of the GDP and GDP per capita growth.
- Increase of damageable assets, which will be caused by increment of the number of business establishments in future, is assumed to be absorbed in the increment of the number of damageable assets of individual establishments. Thus, although the assessed values of an individual establishment are considered to have outwardly larger damageable assets than the actual values, the number of establishments could be frozen in the same number as the present one even in future.

Table H.1.26 Future Framework for Economic Analysis

	2005-2010	2010-2015	2015-
GDP Annual Growth Rate	4.70%	2.35%	0.00%
Population Annual Growth Rate =No. of Households Annual Growth Rate	0.90%	0.00%	0.00%
GDP per capita Annual Growth Rate	3.77%	2.35%	0.00%

Adjusted Annual Average Benefit

In accordance with the future framework mentioned above, flood damages in the future conditions are estimated. The annual average benefits in respective years increase as shown in the following figure (Base Estimation). When the progress of the project implementation is considered, the timing of accruing benefit appears to be delayed. The Study Team's assumption is shown in the following figure as well.



Note: At current prices according to "Considering Project Implementation Progress", see section H.1.4, 1) "Timing of Accruing Benefits"

Source: The Study Team

Figure H.1.12 Annual Average Benefit and Timing of Accruing Benefits (With Master Plan, in Future Condition)

(10) Intangible Benefit

As defined in the section (1), among the variety of flood reduction benefits, this analysis does not deal with the following intangible flood control benefit :

- Direct Damage
  a. Physical damages to human bodies such as injuries, diseases, deaths
  b. Mental influences to people affected
- Direct Damage
  (Secondary damage because of long time inundation such as weed growth or corrosion)
- Indirect Damage
  a. Extra Expenses for Emergency Activities
  b. Degradation of environmental quality such as reverse flow of sediment, solid waste, sewer water,
  c. Deterioration of hygienic safety such as food poisoning or outbreak of communicable diseases,
  d. Increase of crimes such as stealing under the disordered situation,
  e. Deterioration of sophisticated environment such as damage to townscape of street trees or damages to historical buildings, and
  f. Benefit of Land Use Development

As to indirect damage as "a. Extra Expenses for Emergency activities" such as evacuation and relief of flood victims are brought about during flooding period and just after the disaster. These activities are usually executed by the public sector or by social welfare bodies. In the Philippines, the Office of Civil Defense has been compiling such data in cooperation with the Department of Social Welfare and Development and LGUs.

According to records of the Office of Civil Defense, the average rate of infrastructure damage to that of private property by the typhoons that hit the NCR region during 1982 to 2003 was 7.9%.

Table H.1.27 Major Damage by Typhoon and Flood attacked Metropolitan Manila

Year	Cause of Damage	Date of Occurrence	Value of Damages			Assitance Extended					
						By Govenment, NGO,LGU (Mil.Php)	Calamity Fund Releases (Mil.Php)	NDCC Assistance (Mil. Php)			Special Fund released for Dead Victims
			Total (Million Php)	Infrastructure (Million PhP)	Private (Billion PhP)			Cash	Rice	Relief Goods	
1970											
1971											
1972											
1973											
1974	Bidang	Nov 24-29	43.000		0.043						
1975											
1976											
1977											
1978											
1979											
1980											
1981											
1982	Ruping	Sept 5 - 11	199.000	68	0.010	0.173					
1983											
1984											
1985											
1986	T Gading	July 6 -10	676.000	300	0.009	7.046					
	T Miding	Aug 17-18, 24-25, Aug 27 to Sept 4	263.000	99	0.001	2.114					
	TS Oyang	Oct 6 - 7	54.000		0.043	0.802					
1987											
1988	T Biring	May 3-31 to June 3	27.000	24		0.704					
	T Unsang	Oct 21-26	5,636.000	811	0.018	103.750	1.600				
	T Yoning	Nov 5-8	2,748.000	348	0.187	7.875					
1989	TS Bining	May 15-19	74.000	66		0.192	6.640				
	T Goring	July 14-17	1,363.000	440		3.862	0.200				
	T Openg	Sept. 7-12	580.000	289	0.003	3.829					
	TS Saling	Oct 9-10	1,394.000	258	0.012	10.729	42.000				
	T Tasing	Oct 14-20	883.000	105	0.000	2,239.000					
	TS Unsing	Nov 16-22	8.000	4	0.002	1.353	0.500				
1990	T Bising	June 18-23	200.000								
	T Gading	Aug 15-20	25.000								
	T Iliang	Aug 28-30	1,502.000								
	T Ruping	Nov 10-14	10,846.000	1,214		3.676	344.600				
1991											
1992	TD Ditang	July 17-21	471.000	213	0.009	1.872	9.745				
	TS Gloring	Aug 16-18	1,347.000	434		5.104	5.931				
1993	T Goring	Jun 23-27	2,774.453	995	0.045	1.806	218.020				
	TS Rubing	Aug 16-19	98.347			1.007	3.274				
	Monang	Dec 3-6									
1994	DTD Gading	Jun 21-24				0.385	16.000				
	KT Katring	Oct 18-21	1,433.180	213	0.273	3.956	210.109				
1995	TS Mameng	Sep 27 - Oct 1	3,172.725	1,297		23.074	325.788				
	T Rosing	Oct 31 - Nov 3	10,828.772	1,727	0.066	0.033	890.637				
1996	T Gloring	Jul 21-27	2,120.254	723		3.417	187.120				
	T Huaning	Jul 27- 31	18.000	18		0.692	31.552				
1997	T Bining	May 26-28	104.843	80	0.020	1.309	0.500				
	Huling	July 30-Aug 7									
	T Ibiang	Aug 21-28	476.534	173	0.023	20.226	3.000				
1998	T Emang	Sept 16-17	3,795.400	544		13.689	38.220				
1999	T. Helming	Jul 21-26	24.000	21			3.000				
2000	Biring	May 18-22	50.085	16					0.040		0.01
	Edeng	Jul 3-8	1,112.573	469	0.001	13.649	8.000	0.240	1.581		0.13
	TS Maring	Sept 2-7									
	Reming	Oct 26-Nov 1	3,944.436	963	0.119	9.557	76.781	0.085	0.148		0.08
	Seniang	Nov 1-5	733.195	315	0.034			0.040	0.148		0.05
2001	TY Feria	July 2-5	3,586.000	1,854	0.383	46.055	42.020	19.000	8.480	0.247	1.88
	TY Nanang	Nov 6-10	3,246.000	1,668	0.014	14.277	26.500	10.308	0.200		0.06
2002	TY Florita, Gloria, Inday & TS Hambalos	June 28-July 3 July 7-9 & July 12-14	521.890	177	0.001	28.899	0.500		5.280		0.215
	TD Milenyo	Aug 11-14	172.000	88	0.001	1.096					0.13
2003	TY Chedeng	May 25-29	538.046	291	0.084	9.113		13.140	3.280		0.02
	TY Onyok	Aug 30-Sept 2							0.688		

Source :
- Office of Civil Defense, National Disaster Coordination Council, Department of National Defence (OCD-NDCC-DND)
- Dep. of Sosial Welfare and Development (DSWD)
- Directorate for Special Operation - Public Safety Office, MMDA
- "Database of Water-Related Projects in the Republic of the Philippines", Mr. Kagawa, JICA Expert

Note : T= Tyhoon, TS= Tropical Storm, TD= Tropical Depression

These intangible benefits of flood reduction mentioned above represent the adverse social effects of flood and inundation. Although their substantiality, quantification of these intangible benefits are difficult in the absence of detailed surveys which should be carried out over a long period, as such it would be more likely intuitive in so doing. With this in view, and coupled with the preceding analyses undertaken by other international development assistance agencies, no attempt was made to include these items as tangible benefit (or should not be included) to avoid double counting same benefit as separate elements.

Physical damages to human bodies

Regarding physical damages to human bodies, there are some research papers report water-borne diseases caused by mal-maintained drainage system and revealing relationships between water-borne diseases and typhoon and flood in Philippines.

(Example 1)

"TYPHOID FEVER IN MAHARLIKA VILLAGE, TAGUIG, METRO MANILA : A WATERBORNE DISEASE OUTBREAK", Internal Report, Revelyn U. Rayray and et al., March 1990 reports the outbreak of typhoid fever in Maharlika village Taguig, Metropolitan Manila caused by contaminated water supply. The epidemic was caused by a clogged sewer overflowing to a water main as the cause of contamination. Based on the survey, 93 suspected cases were identified with onset of illness from November to first week of December 1988. There was one mortality.

The village is supplied by a village water system. Water was pumped from two deep wells, stored in two elevated tanks and supplied to the different households twice a day. By review of the water and the sewer systems in the village, a broken sewer was found. The sewer overflowed with sewage material into a nearby water main contaminating the water supply at that point. Geographically, those blocks around the clogged sewer which were most likely served by the contaminated water main. In laboratory test, Salmonella typhi was isolated in 14 rectal swab samples of 63 cases.

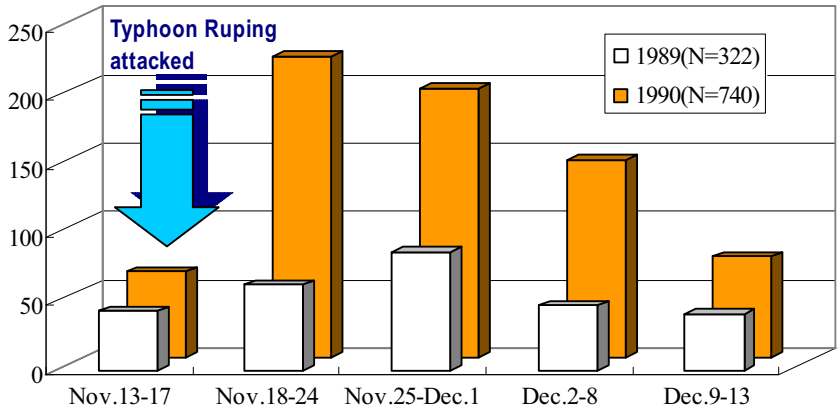
The sudden and sustained increase in the number of typhoid cases points to a common source disease outbreak. Common source type of vehicle transmission is usually caused by ingestion of either contaminated food or drink. The explosive increase favors a waterborne outbreak. Interview with some of the cases in the village revealed no common source of food. The only identifiable common exposure was the water supply from November to December 1988 in Maharlika Village. Epidemiologic, environmental and laboratory data also pointed to a waterborne transmission. The isolation of Salmonella typhi from 17 % of the cases confirmed the diagnosis in this outbreak.

(Example 2)

"MANAGEMENT OF DIARRHEA BY THE CONTROL OF DIARREHEAL DISEASE PROGRAM DURING A CHOLERA OUTBREAK", Journal of the Philippine Medical Association, Ilya P. Abellanosa and et al., October 1992 reports the rapid increase of diseases immediately after the typhoon Ruping of November 1990.

The Typhoon Ruping hit the Philippines on November 13, 1990. According to the data of

Southern Islands Medical Center (SIMC), 740 persons met the case definition in 1990 compared to 322 in 1989. The majority of patients were below 5 years old and the cases were in a more advanced stage of dehydration in 1990. Stool cultures were done in 331 cases in 1990, 96 cases (29%) of which grew Vibrio Cholera. In 1989, stool cultures were done on only two suspected cholera cases, and both were negative for V. Cholera. Unless quickly treated, Cholera can result in severe and rapidly progressive dehydration and death in a matter of hours.



Source: SIMC(Southern Islands Medical Center),
Management of Diarrhea by the Control of Diarreheal Disease Program during a Cholera Outbreak", Journal of the Philippine Medical Association, Ilya P. Abellanosa and et al. October 1992

Figure H.1.13 Diarrhea Cases, Nov 13-Dec.13, 1989 & 1990

Benefit of Land Use Development

In accordance with benefit of land use development, this benefit is characterized as the value added opportunity cost of scarce resources, or change of productivity of the land derived from the flood-free environment. Metropolitan Manila plays an important role in the economy of the Philippines, and land shortage is one of the major constraints of development. It is considered that converting the flood/inundation-prone area into a flood-free area will accelerate utilization of the land. The benefit of land enhancement (including change of land use) is measured in terms of the increase of the land value. HDM (hednic method) approach is one of the methods of quantification of land enhancement benefit based on the land capitalization hypothesis. This theory states that all benefits of investment resolve itself into the land, and growth of land value is regarded as benefit of the investment.[6]

To determine the impact of the project onto the land value requires a detailed survey on the area and structure of the economic environment surrounding the project. In accordance with a past spot survey in Metropolitan Manila conducted by a consultant team with the assistance of a realtor, the impact onto flood prone area resulted in a 20 to 30% decrease in price than higher ground on the same street.[7]

Meanwhile, for low and sunken areas, city assessor's offices in core area of Metropolitan Manila define a reduction within 30% from the base value of land assessment for taxation of real property tax.[8] Taking these conditions into account, it is considered reasonable that about 20 to 30% of land value is regarded as land enhancement benefit from being flood-free.

However, as mentioned above, this land enhancement benefit is excluded from the total annual average benefit for this economic analysis.

H.1.3 COST OF THE M/P PROJECT

(1) Basic Conditions for Economic Analysis

Economic cost differs from financial cost in the sense of value judgment since the former is nominal figures that duly reflect the true economic value of goods and services involved (or also called "opportunity cost") and the latter is resource value at market prices. All the costs involved in every project have to be measured as economic costs, although this economic cost is used only for the economic evaluation of the project which requires the evaluation from the viewpoint of the national (in some cases, regional) economy. The measurement of economic cost of a commodity depends on how likely it is to be procured – whether by increasing import, decreasing export, expanding domestic production or diverting.

Prior to economic evaluation of the projects, all (financial) costs need to be expressed in terms of economic cost by using conceivable adjustment, i.e.,

Financial Cost	x	Conversion Factors	=	Economic Cost
(Actual cost in market value)				

"Sunk Costs" are defined as all those cost incurred on the projects prior to the preparation of the economic analysis. Since these expenses have already been incurred, they are no longer subject to investment decision making. As such, sunk cost should not be included in the analysis.[9]

(2) Conversion Factor and Elements for Real Economic Value

The elements of the adjustment are as follows.

Conversion Factor 1 : Transfer Payments

Transfer items such as taxes and duties imposed on construction materials and equipment, including government subsidy and contractor's profit, are to be excluded from the elements of financial cost. Because tax payment is just the change of money in ownership, the change does not produce any added value to national economy. These taxes are transferred to the government which acts on behalf of the society as a whole and are not treated as costs. Conversely, a government subsidy is an expenditure of resources that the economy incurs to operate the project. The parameter of DPWH Guideline is adopted in this analysis:[10]

Economic Cost = 86% of Financial cost

Where the cost for land acquisition is also converted at same rate, in this analysis, it is assumed that the necessary lands for right-of-way and resettlement site would be acquired from private sector.

Conversion Factor 2 : Foreign Exchange Shadow Price Rate (or Shadow Exchange Rate, SER)

Since the central bank foreign exchange guiding rate is not reflective of the actual exchange rate due to balance of payments disequilibrium and the projection structure, in this analysis, 1.2 times of the official rate is adopted for Foreign Currency Portion. This rate is based on NEDA guideline.[11]

Economic Cost = 120% of Financial cost

Based on these assumptions and conversion factors, financial costs for civil works were converted to economic costs. Land acquisition cost, social cost such as resettlement cost, supporting cost, and non-structural measures' cost are converted only by factor 1 of transfer payments because major items of these costs are domestic costs.

(3) Operations and Maintenance (O/M) Costs

Being subject to the guidance from and discussions with the engineering experts of agencies concerned and the Study Team, annual operation cost is assumed to be 110% of current expenditure of MMDA for 2005 – 2020 to hold the status quo. After project period (year 2020), these cost are excluded from this economic analysis, because these costs are necessary under both "with" and "without" project situation. After 2020, only the maintenance cost for additional civil works proposed in the Master Plan is considered for 2005 - 2040 in economic analysis.

And also, the project costs for supporting measures are excluded from this economic analysis. Though the costs were identified in the previous chapter, it was excluded from economic analysis because there was not enough information to quantify the effect and benefit derived from the supporting measures.

As a result of adjustment, economic cost for Master Plan is calculated as follows.

Table H.1.28 Project Cost (Master Plan)

Unit : Php million

Item	Financial Cost	Economic Cost
1. Civil Work	9,703.8	9,430.2
2. VAT	970.4	0.0
3. Resettlement and Compensation Cost	1,590.1	1,367.5
4. Government Administration Cost	291.1	250.3
5. Engineering Services	970.4	942.9
6. Physical Contingency	1,352.6	1,282.6
7. Supporting Measure Cost	488.9	0.0
8. Operation Cost (2005-2020)	0.0	3,316.2
9. Maintenance Cost (2005-2040)	0.0	1,269.4
Total	15,367.3	17,859.1

Source: The Study Team

Note : Costs for Supporting Measures are excluded. Details may not add up to totals due to rounding.

Table H.1.29 Disbursement Schedule for Economic Analysis (Master Plan Project, Financial Price)

Work Item	Project Cost				Phase 1					
	Phase 1	Phase 2	Phase 3	Total	2005	2006	2007	2008	2009	2010
Civil Works	3,806.9	3,432.0	2,464.9	9,703.8	0.0	0.0	0.0	2,315.3	756.1	735.5
VAT	380.7	343.2	246.5	970.4	0.0	0.0	0.0	231.5	75.6	73.6
Resettlement and Compensation Cost	241.8	555.2	793.1	1,590.1	95.1	95.1	51.6	0.0	0.0	222.1
Government Administration Cost	114.2	103.0	73.9	291.1	0.0	0.0	0.0	69.4	22.7	22.1
Engineering Services	380.7	343.2	246.5	970.4	0.0	0.0	0.0	231.5	75.6	73.6
Physical Contingency	492.4	477.7	382.5	1,352.6	9.5	9.5	5.2	284.8	93.0	112.7
Total	**5,416.7**	**5,254.3**	**4,207.4**	**14,878.4**	104.6	104.6	56.8	3,132.5	1,023.0	1,239.6

Work Item	Phase 2					Phase 3					Total
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Civil Works	0.0	156.2	1,160.2	1,069.3	1,046.3	0.0	117.4	782.7	782.5	782.3	9,703.8
VAT	0.0	15.6	116.1	106.9	104.6	0.0	11.7	78.3	78.3	78.2	970.4
Resettlement and Compensation Cost	222.1	111.0	0.0	0.0	317.2	317.2	158.7		0.0	0.0	1,590.1
Government Administration Cost	0.0	4.7	34.8	32.1	31.4	0.0	3.5	23.5	23.5	23.4	291.1
Engineering Services	0.0	15.6	116.1	106.9	104.6	0.0	11.7	78.3	78.3	78.2	970.4
Physical Contingency	22.2	30.3	142.7	131.5	160.4	31.7	30.3	96.3	96.3	96.2	1,352.6
Total	244.3	333.4	1,569.9	1,446.7	1,764.5	348.9	333.3	1,059.1	1,058.9	1,058.3	14,878.4

Source : The Study Team

Table H.1.30 Disbursement Schedule for Economic Analysis (Master Plan Project, Economic Price)

Unit: Php Million

Work Item	Project Cost					Phase 1					
	Phase 1	Phase 2	Phase 3	2021-	Total	2005	2006	2007	2008	2009	2010
Civil Works	3,699.5	3,335.2	2,395.4	0.0	9,430.2	0.0	0.0	0.0	2,250.0	734.8	714.8
VAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resettlement and Compensation Cost	207.9	477.5	682.1	0.0	1,367.5	81.8	81.8	44.4	0.0	0.0	191.0
Government Administration Cost	98.2	88.6	63.6	0.0	250.3	0.0	0.0	0.0	59.7	19.5	19.0
Engineering Services	369.9	333.5	239.5	0.0	942.9	0.0	0.0	0.0	225.0	73.5	71.4
Physical Contingency	470.3	453.0	359.3	0.0	1,282.6	8.2	8.2	4.5	273.3	89.3	106.0
Operation Cost	1,244	1,036	1,036	0	3,316.2	207.3	207.3	207.3	207.3	207.3	207.3
Maintenance Cost	26.2	111.2	189.0	943.0	1,269.4	0.0	0.0	0.0	0.0	11.3	14.9
Total	6,115.6	5,835.4	4,965.1	943.0	17,859.1	297.2	297.2	256.1	3,015.2	1,135.6	1,324.4

Work Item	Phase 2					Phase 3					2021	Total
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	-2040	
Civil Works	0.0	151.8	1,127.5	1,039.1	1,016.8	0.0	114.1	760.6	760.4	760.2	0.0	9,430.2
VAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Resettlement and Compensation Cost	191.0	95.5	0.0	0.0	272.8	272.8	136.4	0.0	0.0	0.0	0.0	1,367.5
Government Administration Cost	0.0	4.0	29.9	27.6	27.0	0.0	3.0	20.2	20.2	20.1	0.0	250.3
Engineering Services	0.0	15.3	112.7	103.9	101.7	0.0	11.4	76.1	76.1	76.0	0.0	942.9
Physical Contingency	19.1	28.0	137.1	126.3	150.8	27.3	27.5	92.5	92.5	92.3	0.0	1,282.6
Operation Cost	207.3	207.3	207.3	207.3	207.3	207.3	207.3	207.3	207.3	207.3	0.0	3,316.2
Maintenance Cost	18.5	18.5	19.3	24.9	30.1	35.2	35.2	35.7	39.5	43.3	943.0	1,269.4
Total	435.9	520.3	1,633.7	1,529.1	1,806.4	542.5	534.9	1,192.4	1,196.0	1,199.3	0.0	17,859.1

Source : The Study Team

H.1.4 ECONOMIC EVALUATION

(1) Economic Viability

The master plan was evaluated from the economic viewpoint by figuring out the economic viability, comparing the economic benefit and the economic cost in terms of economic internal rate of return (EIRR), benefit and cost ratio (B/C), and net present value (NPV = B – C, or Benefit minus Cost).

All the monetary calculations were based on the following parameters either predetermined or using assumptions.

Project Duration

- Project Start-up : 2005
- Project Life Span (Economic Life) :
  30 years[12] after completion of the work in Short-Term
- Project Phase : The first phase starts in 2005 and continues to 2010.
  The second phase works are facilitated from 2011 to 2015.
  The third phase works are facilitated from 2016 to 2020.
  Then, beyond 2020, operation and maintenance works continue to 2040

Timing of Accruing Benefits

- 25% of annual average benefit will appear after the first phase,
- 50% of annual average benefit will appear after the second phase,
- The matured annual average benefit will appear after the third phase, i.e., completion of all phases of civil works.

Price Level

- The valuation of project costs and benefit should be in constant price at the current year's level. Though, cost of civil works was identified as the price at July 2004 (see *Chapter G of Supporting Report*), the basic price level in the economic analysis is set at the beginning of 2004 in order to keep consistency among all cost items.

Social Discount Rate (SDR)

- Based on the guideline of NEDA[13] for basic infrastructure projects, SDR is applied at 15% in this analysis.[14]

Prevailing Exchange Rate

- Php 55 per US$ and JPY 110 per US$ at the official rate in market

Depreciation, Financial Charges, Interest and Amortization

- In general, financing of the project is not relevant to the economic evaluation. These financial items are independent of the economic value of the project. To ensure that only feasible projects are financed, investments should be subjected to cost-benefit analysis removed from financing considerations. Only after a project is determined feasible should terms of financing be incorporated to evaluate possible benefits derived from relative, favorable (e.g., concessional) loan terms.[15] From these points of view, depreciation (residual value) of waterways and pumping stations, and financial cost or charges are not estimated in this analysis.

The calculations of NPV, B/C(Benefit and Cost Ratio), and EIRR were based on the annual cash flow that was prepared from the above-mentioned economic cost and the annual average benefit

discussed in accordance with the implementation schedule or annual disbursement schedule. The economic viability of the optimum plan was thus figured out as follows.

Table H.1.31 Results of Economic Analysis (Future Condition, M/P Projects)

NPV	Php 27,595 milion
B/C	5.2
EIRR	42.8%

Source: The Study Team

Table H.1.32 Annual Cash Flow of Master Plan 1 (Future Condition)

(Php. million, at Current Price in Economic Value under Future Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total Cost		
1	2005	Short-term Phase		81.8	215.4	297.2		▲ 297.2
2	2006			81.8	215.4	297.2		▲ 297.2
3	2007			44.4	211.7	256.1		▲ 256.1
4	2008		2,250.0		765.2	3,015.2		▲ 3,015.2
5	2009		734.8		400.8	1,135.6		▲ 1,135.6
6	2010		714.8	191.0	418.6	1,324.4		▲ 1,324.4
7	2011	Medium-term Phase		191.0	244.8	435.9	4,934.2	4,498.3
8	2012		151.8	95.5	273.0	520.3	5,050.2	4,529.9
9	2013		1,127.5		506.3	1,633.7	5,168.8	3,535.1
10	2014		1,039.1		490.0	1,529.1	5,290.3	3,761.2
11	2015		1,016.8	272.8	516.8	1,806.4	5,414.6	3,608.2
12	2016	Long-term Phase		272.8	269.7	542.5	10,829.2	10,286.7
13	2017		114.1	136.4	284.3	534.9	10,829.2	10,294.4
14	2018		760.6		431.8	1,192.4	10,829.2	9,636.9
15	2019		760.4		435.6	1,196.0	10,829.2	9,633.3
16	2020		760.2		439.1	1,199.3	10,829.2	9,629.9
17	2021				47.2	47.2	21,658.5	21,611.3
18	2022				47.2	47.2	21,658.5	21,611.3
19	2023				47.2	47.2	21,658.5	21,611.3
20	2024				47.2	47.2	21,658.5	21,611.3
21	2025				47.2	47.2	21,658.5	21,611.3
22	2026				47.2	47.2	21,658.5	21,611.3
23	2027				47.2	47.2	21,658.5	21,611.3
24	2028				47.2	47.2	21,658.5	21,611.3
25	2029				47.2	47.2	21,658.5	21,611.3
26	2030				47.2	47.2	21,658.5	21,611.3
27	2031				47.2	47.2	21,658.5	21,611.3
28	2032				47.2	47.2	21,658.5	21,611.3
29	2033				47.2	47.2	21,658.5	21,611.3
30	2034				47.2	47.2	21,658.5	21,611.3
31	2035				47.2	47.2	21,658.5	21,611.3
32	2036				47.2	47.2	21,658.5	21,611.3
33	2037				47.2	47.2	21,658.5	21,611.3
34	2038				47.2	47.2	21,658.5	21,611.3
35	2039				47.2	47.2	21,658.5	21,611.3
36	2040				47.2	47.2	21,658.5	21,611.3
					(Total at Current)	17,859.2	513,174.3	495,315.1
					(Total at PV)	6,601.9	34,197.3	27,595.4

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**27,595.4**
Social Discount Rate :	15%	**B/C :**	**5.2**
		EIRR :	**42.8%**

Source : The Study Team

(2) Sensitivity Analysis

The cost and benefits were estimated at conservative side with discretion in this analysis. In spite of that, some uncertainty still exists in the estimation. In particular, the cases with long implementation period and/or expectation of future growth in Metropolitan Manila have high risks in terms of judgment on project viability. In this context, the sensitivity analysis was tested in the following relevant parameters guided by NEDA[16] in consideration of sensitive factors for project feasibility.

Assumption I : Increase in projected costs by 10% and 20%

Assumption II : Decrease in benefits by 10% and 20%

Assumption III: Combination of Cases I and II

In addition to the above NEDA guideline, another case that the benefit decreased to 50% of original estimate was also tested for reference.

Assumption IV: Decrease in benefit by 50%

Table H.1.33 Results of the Sensitivity Analysis 1 (NPV, Future Condition, M/P Projects)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	27,595	24,176	20,756	10,497
	+10%	26,935	23,515	20,096	9,837
	+20%	26,275	22,855	19,436	9,176

Source: The Study Team

Table H.1.34 Results of the Sensitivity Analysis 2 (B/C, Future Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	5.2	4.7	4.1	2.6
	+10%	4.7	4.2	3.8	2.4
	+20%	4.3	3.9	3.5	2.2

Source: The Study Team

Table H.1.35 Results of the Sensitivity Analysis 3 (EIRR, Future Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	42.8%	40.3%	37.8%	28.6%
	+10%	40.6%	38.2%	35.8%	27.0%
	+20%	38.6%	36.4%	34.0%	25.5%

Source: The Study Team

(2) Sensitivity Analysis

The cost and benefits were estimated at conservative side with discretion in this analysis. In spite of that, some uncertainty still exists in the estimation. In particular, the cases with long implementation period and/or expectation of future growth in Metropolitan Manila have high risks in terms of judgment on project viability. In this context, the sensitivity analysis was tested in the following relevant parameters guided by NEDA[16] in consideration of sensitive factors for project feasibility.

Assumption I : Increase in projected costs by 10% and 20%

Assumption II : Decrease in benefits by 10% and 20%

Assumption III: Combination of Cases I and II

In addition to the above NEDA guideline, another case that the benefit decreased to 50% of original estimate was also tested for reference.

Assumption IV: Decrease in benefit by 50%

Table H.1.33 Results of the Sensitivity Analysis 1 (NPV, Future Condition, M/P Projects)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	27,595	24,176	20,756	10,497
	+10%	26,935	23,515	20,096	9,837
	+20%	26,275	22,855	19,436	9,176

Source: The Study Team

Table H.1.34 Results of the Sensitivity Analysis 2 (B/C, Future Condition, M/P Projects)

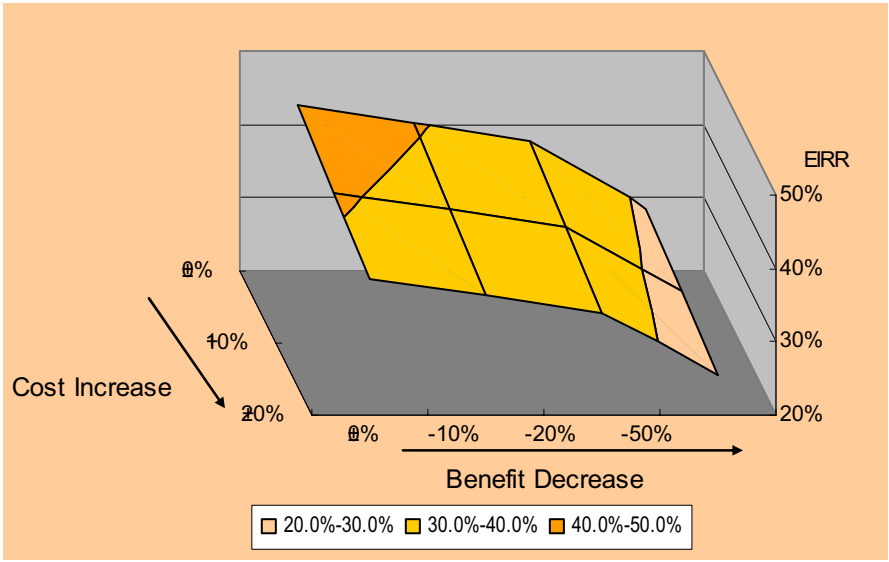
		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	5.2	4.7	4.1	2.6
	+10%	4.7	4.2	3.8	2.4
	+20%	4.3	3.9	3.5	2.2

Source: The Study Team

Table H.1.35 Results of the Sensitivity Analysis 3 (EIRR, Future Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	42.8%	40.3%	37.8%	28.6%
	+10%	40.6%	38.2%	35.8%	27.0%
	+20%	38.6%	36.4%	34.0%	25.5%

Source: The Study Team



Source: The Study Team

Figure H.1.14 Results of Sensitivity Analysis (EIRR, Future Condition, M/P Projects)

In principle, it is said that the project is feasible when NPV is positive (over 0), B/C is over 1.0, and EIRR is over social discount rate (15% in Philippines). As shown in the tables above, NPV of the all cases were positive, B/C exceeded 1.0, and the lowest EIRR exceeded social discount rate. Thus, the proposed projects are sufficiently feasible from the economic point of view.

Incidentally, in case of excluding socio-economic growth in future, EIRR would still keep the economically feasible level (20.0%, under the assumption of +20% increased cost and -50 % decreased benefit, see *Table H.1.38*).

Table H.1. 36 Results of the Sensitivity Analysis 4 (NPV, Present Condition, M/P Projects)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	16,823	14,481	12,138	5,111
	+10%	16,163	13,820	11,478	4,450
	+20%	15,503	13,160	10,818	3,790

Source: The Study Team

Table H.1. 37 Results of the Sensitivity Analysis 5 (B/C, Present Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	3.5	3.2	2.8	1.8
	+10%	3.2	2.9	2.6	1.6
	+20%	3.0	2.7	2.4	1.5

Source: The Study Team

Table H.1.38 Results of the Sensitivity Analysis 6 (EIRR, Present Condition, M/P Projects)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	35.0%	32.8%	30.6%	22.6%
	+10%	33.0%	31.0%	28.8%	21.2%
	+20%	31.3%	29.4%	27.3%	20.0%

Source: The Study Team

Table H.1.39 Annual Cash Flow of Master Plan 2 (Present Condition)

(Php million, at Current Price in Economic Value under Present Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total		
1	2005	Short-term Phase		81.8	215.4	297.2		▲ 297.2
2	2006			81.8	215.4	297.2		▲ 297.2
3	2007			44.4	211.7	256.1		▲ 256.1
4	2008		2,250.0		765.2	3,015.2		▲ 3,015.2
5	2009		734.8		400.8	1,135.6		▲ 1,135.6
6	2010		714.8	191.0	418.6	1,324.4		▲ 1,324.4
7	2011	Medium-term Phase		191.0	244.8	435.9	3,659.7	3,223.9
8	2012		151.8	95.5	273.0	520.3	3,659.7	3,139.4
9	2013		1,127.5		506.3	1,633.7	3,659.7	2,026.0
10	2014		1,039.1		490.0	1,529.1	3,659.7	2,130.6
11	2015		1,016.8	272.8	516.8	1,806.4	3,659.7	1,853.3
12	2016	Long-term Phase		272.8	269.7	542.5	7,319.5	6,777.0
13	2017		114.1	136.4	284.3	534.9	7,319.5	6,784.6
14	2018		760.6		431.8	1,192.4	7,319.5	6,127.1
15	2019		760.4		435.6	1,196.0	7,319.5	6,123.5
16	2020		760.2		439.1	1,199.3	7,319.5	6,120.1
17	2021				47.2	47.2	14,638.9	14,591.8
18	2022				47.2	47.2	14,638.9	14,591.8
19	2023				47.2	47.2	14,638.9	14,591.8
20	2024				47.2	47.2	14,638.9	14,591.8
21	2025				47.2	47.2	14,638.9	14,591.8
22	2026				47.2	47.2	14,638.9	14,591.8
23	2027				47.2	47.2	14,638.9	14,591.8
24	2028				47.2	47.2	14,638.9	14,591.8
25	2029				47.2	47.2	14,638.9	14,591.8
26	2030				47.2	47.2	14,638.9	14,591.8
27	2031				47.2	47.2	14,638.9	14,591.8
28	2032				47.2	47.2	14,638.9	14,591.8
29	2033				47.2	47.2	14,638.9	14,591.8
30	2034				47.2	47.2	14,638.9	14,591.8
31	2035				47.2	47.2	14,638.9	14,591.8
32	2036				47.2	47.2	14,638.9	14,591.8
33	2037				47.2	47.2	14,638.9	14,591.8
34	2038				47.2	47.2	14,638.9	14,591.8
35	2039				47.2	47.2	14,638.9	14,591.8
36	2040				47.2	47.2	14,638.9	14,591.8
				(Total at Current)	7,061.5	17,859.2	347,674.3	329,815.1
				(Total at PV)	2,477.4	6,601.9	23,425.1	16,823.1

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**16,823**
Social Discount Rate :	15%	**B/C :**	**3.55**
		EIRR :	**35.0%**

Source : The Study Team

(3) Project Justification

Though social infrastructure projects such as flood control and drainage improvement works are in general put into implementation even at the lower EIRR, compared with other productive projects, the master plan shows a very high viability of 42.8% in EIRR (Future Condition), likewise resulting in high values of B/C and NPV for the conceivable reason that socio-economic needs for flood prevention in the study area where the central function of the political and economic activity locates will augment to a maximum degree.

The reason of high viability is easy to see. As mentioned already in the beginning of this report, there are totally 74 km esteros/creeks in length, 35 km drainage mains, and other small drainage network in Metropolitan Manila. In addition, there are high quality pumping stations started in service in 1970s and have been maintained functionally. However, the construction cost of these tremendous investments are not considered in this economic analysis, because these costs shall be excluded as "sunk cost" in conventional economic analysis on public infrastructure project. In other words, taking advantage of these infrastructure heritages, it is possible to output the most effective result with minimum additional investment for these kinds of infrastructure.

In this context, the Master Plan can be justified from the economic viewpoint to take a next step in accordance with the proposed schedule.

H.1.5 CONSIDERATION FOR INVESTMENT PLAN FOR M/P PROJECT

The purpose of this section is to analyze financial affordability for the master plan. Three resources can be considered to be available.

The first is the source under fiscal disbursement of the national government which is to be allocated to DPWH and MMDA in charge of flood control and drainage works.

The second is the local fund from respective LGUs.

The last source is special funds or schemes such as new allocation to the sector and/or introduction of new ear-marked taxation system in order to enhance financial capability of government.

As for the local fund from LGUs, very scarce budget has been allocated to flood control and drainage works in the past years. Even if fiscal revenue of LGUs through IRA would be expected to grow in near future, investment for this sector would not be expected unless the priority of this sector would become high dramatically.

While, the third option takes time to put in practice without strong political decision, because the introduction of new system is all-time subject of controversy. Therefore, the analysis on the third option must be based on conceptual approach.

(1) Future Framework of National Government Revenue

Growth of the Philippines Economy and GDP

In the last decade (1994-2003), the average of the growth rate of GDP (Gross Domestic Product) was about 4 %, though this includes the recession period of Asian Crisis in and after 1997. If these periods are excluded as singular situation, the performance of Philippines' economy is regarded better than the figure. After the crisis, as is witnessed by the fact that the country's economy recovered and record the following figures ;

Table H.1.40 MTPDP (2001-2004) Targets vs. Actual Performance

Unit : %

GDP Growth Rate	2001	2002	2003	2004
MTPDP 2001-2004	3.3	4.0-4.5	5.4-5.9	5.7-6.3
Actual Growth	3.0	4.3	4.7 (1st semester 4.5)	 (1st semester 6.3)

Source : MTPDP 2004-2010, NEDA

Note : At constant price basis, *As of first semester 2004

The GDP steadily grew and its growth rate has showed upward tendency. The rates of divergence between the actual performance and planned growth rates in the previous MTPDP (Medium Term Philippine Development Plan) were not big.

While, in the new MTPDP 2004-2010, the government set the target of the growth rate as follows ;

Table H.1.41 GDP Targets of MTPDP (2004-2010)

Unit : %

	2004	2005	2006	2007	2008	2009	2010
GDP Growth Rate	4.9-5.8	5.3-6.3	6.3-7.3	6.5-7.5	6.9-7.8	7.0-8.0	7.0-8.0

Source : MTPDP 2004-2010, NEDA

Under the conditions where the country's economy was up-trend in recent years and the forecast of the authority was relatively accurate in the previous MTPDP, these new targets of 4.9% to 8.0% might not be impossible, though it seems rather high rates compared to the past performance.

Growth or the National Government's Revenue and Expenditure

Fiscal Revenue is broadly classified into tax and non-tax portion. In Philippines, the major tax portion consists of

- taxes on income and profits,
- taxes on property,
- taxes on domestic goods and services,
- taxes on international trade and transactions, and
- other taxes.

Non-tax revenues refer to all other impositions or collections of the government in exchange for services rendered, assets conveyed, penalties imposed, foreign grants, etc.

In addition, the national budget is financed not only from these fiscal revenues but

- borrowing from both domestic and foreign sources, and
- withdrawals from available cash balances.

Fiscal expenditure is broadly classified into current expenditure and development expenditure. The former, current expenditure is also called as Current Operating Expenditure (COE)[17]. The COE covers ;

- personal services (PS) such as salaries, wages, social security contributions, etc., and
- maintenance and other operating expenditures (MOOE) for day-to-day regular operation,

The latter, development expenditure consists of

- Capital Outlays (CO),
- Net Lending referring to net advances to government owned and/or controlled corporations (GOCCs) for servicing of government-guaranteed corporate debt and loan outlays, and
- Debt Service (Debt Amortization) such as the repayment of interest and related costs.

To make an accurate estimate, the forecast of future revenues and expenditures should be analyzed by each item individually based on the elasticity with respective economic growth, then, it should be multiplied. But the financial balance is affected not only by the socio-economic conditions but also by tax policies and other relevant political strategies for structural reform.

In the MTPDP 2004-2010, the government manifested the following targets;

- to balance the budget by 2010,
- to reduce the ratio of Consolidated Public Sector Deficit (CSPD) to GDP from 6.7% in 2004 to 1.0% in 2010, and
- to reduce the ratio of Public Sector Debt[18] to GDP from 136% in 2004 to 90% by 2010 through institutional reforms for a more financial viability.

MTPDP 2004-2010 emphasized the importance of investment for infrastructures such as ;

"It will also boost growth by providing the fiscal resources to raise public infrastructure spending from 2.6 percent of GDP in 2003 to 4.2 percent on GDP by 2010.",

"The government is aiming to achieve its growth targets on account of strong investment spending and exports. Investment spending is targeted to increase to 28 percent by 2010 from around 20 percent in 2003, ….."

In line with these policies, it is considered that the framework of allocations to DPWH and MMDA shall be increased or at least maintained as same as the growth rate of total government investment for public infrastructure in future.

Regional & Sector allocation of DPWH to Metropolitan Manila on Flood Control and Drainage works.

In MTPDP, except the emphasis on the effort for decongestion of intensive traffic in Metropolitan Manila, there is no specific regional strategy for the area. The national government, preferably, put the stress of regional development from the viewpoint of poverty alleviation and uplifting the connectivity throughout the country.

(2) Development Expenditure of Relevant Stakeholders

The current expenditures on flood control and drainage improvement projects of relevant agencies are shown in the following table. When the annualized cost of proposed cost of the Master Plan are compared to the average amount of total expenditure of MMDA and the 6 LGUs for the past 6 years, it is fairly huge and requires almost 1.5 times of annual budget in order to implement the Master Plan.

While, on the assumption that the ODA loan would be appropriated as financial source of the Master Plan, the required share of the Philippine Government is equivalent to around 45% to the present expenditures, and that burden is not a prohibitive level of expenditure from the aspect of the financial status of the relevant authorities.

Table H.1.42 Comparison of Expenditure on Flood Control

Unit: Php Million

	1999	2000	2001	2002	2003	2004	Average	Proposed Master Plan
National								15 billion for 15 years
(MMDA)	120	955	200	199	200	956*1	438	
LGUs								Annualized
(Manila)	-	10	29	21	48	-	27	1,000 million / year
(Makati)	118	127	73	30	5	212	94	
(Pasay)								
(Caloocan)	5	51	73	22	31	206*1	65	
(Taguig)	-	-	-	36	31	116	61	
(Quezon)*2	1	1	1	1	1	1	1	
Total						6,667	686	
Ratio of Present Average Expenditure to Total of Master Plan							146% (= 1,000/686)	
Ratio of Present Average Expenditure to GOP portion							45% (=311/686)	
							GOP 30% 311	Loan 70% 727

Source: The Study Team

Note : *1 Propsed, *2 Only for Maintenance

Based on the Study Team's survey to the MMDA and relevant agencies, present allocation is badly short on even recurrent cost for operation and maintenance activities against the required level. Although this Master Plan is proposing the same level of the future budgetary allocation comparing to the present conditions, this amount is regarded as bare minimum but essential level.

Table H.1.43 Comparison of Budget on Operation & Maintenance of Flood Control

Unit : Php Million

	2003	2004	Proposed Master Plan
Amount for OM	218	242	241
note	Approved	Proposal	

Source: MMDA

(3) External Resources

External Borrowing and Loan

The total project cost of the Master Plan is estimated at about Php 15 billion. Assuming the project would be implemented with financial support by multilateral lending institutions, the example of general principle guideline of loan conditions are like as follows:

- There are upper limit of loan amount. For example, a limit of one of multilateral institutions shall be 85% of the total project cost or the total foreign exchange cost.
- There are also conditions of non-eligible cost for the loan by type of expenditures.

In accordance with one of institutions' loan conditions, non-eligible costs are considered for the following categories, but they could be included in the total project cost:

- Land acquisition cost
- Compensation for PAP (Project Affected People)
- Taxes and duties as well as government administration cost
- Interest during borrowing period

The total cost of Master Plan is shown in table below. Following the loan conditions, for example, the eligible costs for JBIC loan are civil works and engineering service which amount to Php 10,689 million corresponding to 70% of the total project cost.

Table H.1.44 Project Costs (Financial Term)

Item	Amount (Php million)	Ratio	Eligible Item for Loan *
1. Civil Works	9,703	63 %	O
2. VAT for (1)	970	6 %	
3. Resetlement & Social Cost	1,590	10 %	
4. Government Administration	291	2 %	
5. Engineering Service	970	6 %	O
6. Physical Contingency	1,353	9 %	
7. Supporting Measure	489	0 %	
Total	15,367	100 %	

Source: The Study Team

Note : Amount excludes present on-going cost for operation / maintenance

Total does not represent the sum of items because of rounding.

* This is an example of loan scheme of JBIC(Japan Bank for International Cooperation).

(4) Other Fund Source (Non-Loan Scheme, Technical Assistance, and Coordination with Other Agencies)

In accordance with the eligibility of loan conditions among multilateral lending institutions, social costs are often not covered by the loan scheme. Meanwhile, bilateral donors and multilateral lending institutions start to put into effect their guidelines on Confirmation of Environmental and Social Considerations which placed a premium on participation by such stakeholders as local community inhabitants who will be affected by the project. They require the project executor to solicit stakeholders' participation from the project planning stage. Therefore, non-eligible costs which must be prepared by the Philippine Government side is required to fulfill the standard of the guideline in terms of technical, social and financial aspects.

As mentioned earlier in the chapter on social issue, however, the Philippine Government side has domestic laws and guidelines which define their own standard on involuntary resettlements affected by infrastructure projects.

In other words, there are some discrepancies between foreign donors/multinational lending agencies and Philippines side, and it can be possible that neither ODA nor national budget does finance some parts of social cost. In order to fill the gap, as the next best policy, technical assistance can be utilized for smooth implementation on relocation and establishment of stable livelihood of PAP.

As referred in *Main Report, Chapter 2.2 "Economic Conditions"* and *4.12 "Implementation*

Organization", the stakeholders such as NHA and relevant agencies are closely related to this project from a view point of providing socialized housing, upgrading health/sanitary conditions and social welfare standard in vulnerable communities like the area along the waterways. In order to maximize the effectiveness of the priority projects, especially non-structural measures and supporting measures, well coordination on budgeting from the planning stage or preferably differentiate the roles and budgetary allocations clearly among agencies are indispensable for optimizing the limited government resources.

(5) Financial Feasibility

Comparing to the project cost and the current expenditures and its assumed future available resource on flood control and drainage improvement projects of relevant agencies, i.e. MMDA and the 6 LGUs, the burden of the proposed project is not a prohibitive level of expenditure from the financial aspect.

However, based on the Study Team's survey, present budgetary allocation of relevant agencies is badly short. The current budget levels of these agencies are bare minimum. Assuming to be maintained at proper level of services, future budgetary allocation for flood control and drainage improvement projects are strongly recommended to be raised politically to higher level than the above mentioned forecast which is basically based on the past trend. In the event of these proper budgetary arrangements are considered, the proposed cost of Master Plan are fairly achievable. Regardless of whether the projects would be financed by domestic resources or external resources, in view of the extensive damage of flood and its effect on socio-economic activities, metropolitan function of the country, and view of economically sound result of analysis, it is surely worthwhile for the national government to consider the increase of budgetary allocation to the urban flood control.

H.2 ECONOMIC EVALUATION FOR FEASIBILITY STUDY

H.2.1 BACKGROUND OF ECONOMIC EVALUATION

The economic evaluation in this section focuses on the projects dealt by Feasibility Study, i.e. the Priority Projects which would be implemented during 1st phase of Master Plan.

The basic concept to estimate the benefit derived from the proposed programs/projects is worked out by the same equation referred in the on Master Plan.

Explanations of "benefit" and "cost" are found in *Chapter H.2.2 and H.2.3,* respectively, and then, economic viability derived from "net benefit" is analyzed in *H.2.4*. In *Chapter H.2.5*, financial viability is considered.

H.2.2 BENEFIT OF THE PRIORITY PROJECTS

(1) Basic Conditions for Analyzing Benefits of Priority Projects

The components of benefit considered in Feasibility Study were selected as same as analysis of Master Plan except traffic disruption*. Correspondingly, same unit values of assets, parameters of damage rate, future socio-economic framework and so on are applied in the Feasibility Study. For details, see previous *Chapter H.1.*

> ** As a result of analysis of Master Plan, the damages caused by traffic disruption were relatively small compared with other direct damages. Therefore, the additional computer modeling on traffic simulation for Priority Projects was not analyzed.*

(2) Flood Damage by Return Period

Flood damage under the "Without" situation, the same estimate as Master Plan (see previous *Chapter H.1)* are employed. The results of the estimates under the "With Feasibility Study Project" are summarized in the following tables:

Table H.2.1 Flood Damage by Return Period (With Priority Projects : North Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	5,011.0	5,869.9	7,274.5	8,938.9	11,595.2	13,033.3
1. Residence - House	757.8	901.0	1,054.6	1,253.1	1,833.0	2,113.2
2. Residence - Household Effects	352.9	456.9	589.1	724.7	993.0	1,156.3
3. Business Establishments	2,712.0	3,120.1	3,905.8	4,841.4	6,019.7	6,673.2
3-1 Manufacturing	775.8	898.4	1,129.0	1,403.4	1,740.2	1,925.9
3-2 Commerce (Wholesale & Retail Trade)	772.6	900.1	1,142.7	1,430.1	1,809.2	2,028.1
3-3 Hotel and Restaurants	409.0	467.7	581.7	716.6	876.3	962.8
3-4 Financial / Insurance / Real Estate Business	351.3	400.5	497.6	613.0	757.0	836.0
3-5 Educational Facilities	98.4	110.3	134.3	164.0	202.1	221.7
3-6 Medical Facilities	305.0	343.2	420.4	514.3	635.0	698.7
4. Infrastructure	1,188.3	1,391.9	1,725.0	2,119.7	2,749.5	3,090.6
B. Indirect Damage	2,373.6	2,828.1	3,510.4	4,303.9	5,630.6	6,331.9
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	1,521.4	1,768.6	2,201.9	2,716.5	3,458.2	3,863.7
6. Cost for Alternative Activities	852.2	1,059.6	1,308.5	1,587.4	2,172.4	2,468.2
C. Total	7,384.7	8,698.0	10,784.9	13,242.8	17,225.7	19,365.2

Source: The Study Team

Table H.2.2 Flood Damage by Return Period (With Priority Projects : South Manila)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	1,990.2	3,534.4	5,568.0	8,869.7	11,308.4	12,582.9
1. Residence - House	303.6	690.6	1,173.9	2,039.1	2,625.1	2,882.9
2. Residence - Household Effects	142.4	327.9	552.8	1,044.3	1,434.2	1,606.9
3. Business Establishments	1,072.2	1,677.8	2,521.0	3,683.0	4,567.6	5,109.3
3-1 Manufacturing	257.5	395.9	599.6	873.3	1,065.0	1,197.2
3-2 Commerce (Wholesale & Retail Trade)	297.5	464.0	700.0	1,036.8	1,306.9	1,480.6
3-3 Hotel and Restaurants	183.7	294.7	440.7	634.3	780.8	867.2
3-4 Financial / Insurance / Real Estate Business	177.7	280.8	417.9	616.7	780.0	862.0
3-5 Educational Facilities	36.4	56.4	84.6	121.2	146.2	161.5
3-6 Medical Facilities	119.3	185.9	278.2	400.8	488.7	540.8
4. Infrastructure	471.9	838.1	1,320.3	2,103.3	2,681.6	2,983.8
B. Indirect Damage	908.5	1,637.6	2,584.5	4,268.6	5,458.0	6,052.5
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	602.3	1,013.2	1,566.0	2,412.5	3,044.2	3,393.8
6. Cost for Alternative Activities	306.2	624.4	1,018.5	1,856.1	2,413.8	2,658.6
C. Total	2,898.6	5,172.1	8,152.5	13,138.3	16,766.4	18,635.3

Source: The Study Team

Table H.2.3 Flood Damage by Return Period (With Priority Projects : All Study Area)

Unit : Php Million

Item	Return Period (Year)					
	2	3	5	10	20	30
A. Direct Damage	7,001.2	9,404.4	12,842.5	17,808.6	22,903.6	25,616.2
1. Residence - House	1,061.4	1,591.6	2,228.6	3,292.2	4,458.1	4,996.1
2. Residence - Household Effects	495.3	784.8	1,141.9	1,769.0	2,427.1	2,763.2
3. Business Establishments	3,784.3	4,797.9	6,426.7	8,524.5	10,587.3	11,782.5
3-1 Manufacturing	1,033.3	1,294.2	1,728.7	2,276.7	2,805.2	3,123.1
3-2 Commerce (Wholesale & Retail Trade)	1,070.1	1,364.2	1,842.7	2,466.9	3,116.1	3,508.7
3-3 Hotel and Restaurants	592.7	762.5	1,022.4	1,350.9	1,657.1	1,830.0
3-4 Financial / Insurance / Real Estate Business	529.0	681.3	915.4	1,229.7	1,537.0	1,698.0
3-5 Educational Facilities	134.8	166.7	218.9	285.2	348.2	383.2
3-6 Medical Facilities	424.3	529.1	698.6	915.1	1,123.7	1,239.5
4. Infrastructure	1,660.2	2,230.0	3,045.3	4,222.9	5,431.1	6,074.3
B. Indirect Damage	3,282.1	4,465.7	6,094.9	8,572.4	11,088.6	12,384.4
5. Loss of Business Opportunity, Cost for Cleaning Activities, Public Service / Utility Serivce Disruption	2,123.7	2,781.8	3,767.9	5,129.0	6,502.4	7,257.5
6. Cost for Alternative Activities	1,158.3	1,684.0	2,327.0	3,443.4	4,586.2	5,126.8
C. Total	10,283.3	13,870.1	18,937.4	26,381.1	33,992.2	38,000.6

Source: The Study Team

(3) Estimation of Annual Average Benefit

The annual average benefit, defined as the reduction of probable damage under the “with” and “without” Priority Projects situations was estimated for the proposed plan, as presented in the tables below.

Table H.2.4 Breakdown of Annual Average Benefit (Present Condition, Priority Projects, North Manila)

Unit : Php million

Flood Return Preod	Flood Damage		Reduction	Average	Expectation Rate	Benefit by Return Period
	Without Project	With Project				
				917	0.5000	459
2 year	9,219	7,385	1,834	2,201	0.1667	367
3 year	11,266	8,698	2,568	3,012	0.1333	402
5 year	14,241	10,785	3,456	4,574	0.1000	457
10 year	18,935	13,243	5,693	5,510	0.0500	275
20 year	22,553	17,226	5,327	4,936	0.0167	82
30 year	23,910	19,365	4,545	Total (Annual Average Benefit)		2,042

Source: The Study Team

Table H.2.5 Breakdown of Annual Average Benefit (Present Condition, Priority Projects, South Manila)

Unit : Php million

Flood Return Preod	Flood Damage		Reduction	Average	Expectation Rate	Benefit by Return Period
	Without Project	With Project				
				1,876	0.5000	938
2 year	6,651	2,899	3,752	3,718	0.1667	620
3 year	8,856	5,172	3,684	4,026	0.1333	537
5 year	12,520	8,153	4,367	4,667	0.1000	467
10 year	18,106	13,138	4,968	4,854	0.0500	243
20 year	21,506	16,766	4,740	4,770	0.0167	79
30 year	23,436	18,635	4,800	Total (Annual Average Benefit)		2,883

Source: The Study Team

Table H.2.6 Breakdown of Annual Average Benefit
(Present Condition, Priority Projects, All Study Area)

Unit : Php million

Flood Return Preod	Flood Damage		Reduction	Average	Expectation Rate	Benefit by Return Period
	Without Project	With Project				
				2,793	0.5000	1,397
2 year	15,870	10,283	5,586	5,919	0.1667	987
3 year	20,122	13,870	6,252	7,037	0.1333	938
5 year	26,760	18,937	7,823	9,242	0.1000	924
10 year	37,041	26,381	10,660	10,364	0.0500	518
20 year	44,059	33,992	10,067	9,706	0.0167	162
30 year	47,346	38,001	9,345	Total (Annual Average Benefit)		4,926

Source: The Study Team

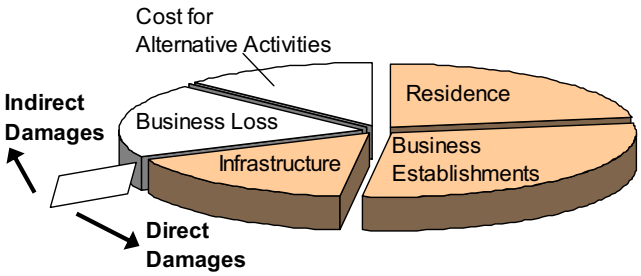
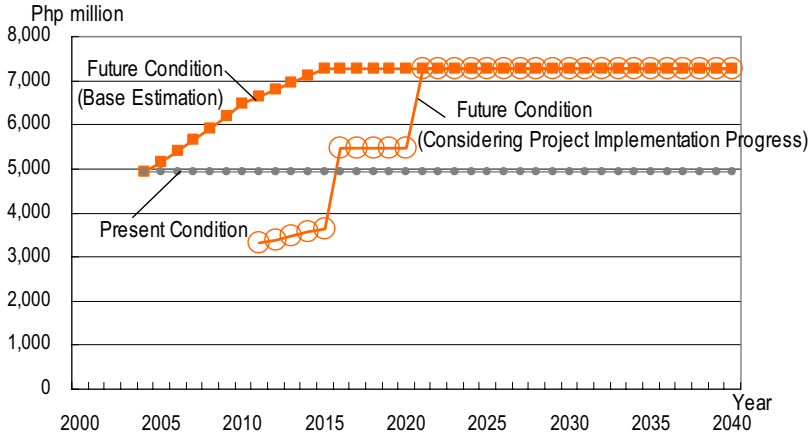


Figure H.2.1 Elements of Annual Average Benefit (Priority Projects, All Study Area)

(4) Adjusted Annual Average Benefit

In accordance with the future framework, flood damages under the future conditions are estimated. The annual average benefits in respective years are shown in the following figure (Base Estimation). When the progress of the project implementation is considered, the timing of accruing benefit appears to be delayed. It is shown in the following figure as well.



Note: At current prices
Source: The Study Team

Figure H.2.2 Annual Average Benefit & Timing of Accruing Benefits
(Future Condition, Priority Projects, All Study Area)

H.2.3 COST OF THE PRIORITY PROJECTS

(1) Basic Conditions for Analyzing Cost of Priority Projects

All financial costs are converted into economic cost by categorizing foreign currency portion and local currency portion. In the analysis of Master Plan, only general two types of share rates of foreign currency portion and local currency portion are used, but in this feasibility study analysis, every project items were identified each distribution of foreign and local currency individually.

Regarding to the conversion factor from financial cost to economic cost, in the analysis of Master Plan, two conversion factors (Transfer payments and Foreign exchange shadow price rate) were applied, but in this feasibility study analysis, Shadow Wage Rate (SWR) is also considered in addition to Transfer payments and Foreign exchange shadow price rate because of the high precision of cost estimates of Priority Projects compared to M/P.

Since most of the labors engaged in a project are from the unskilled urban labor pool, labor cost is adjusted to reflect the estimated opportunity cost of labor. In this analysis, the adjustment is applied based on the NEDA guideline as follows.

SWR of Unskilled Labor : 0.6 times of market wage rate

This adjustment is to be applied only to the unskilled labor component. It is regarded that there is a competitive market of skilled labor, and their wage rate is decided reflecting the balance of demand and supply. Therefore, the SWR of skilled labor is negligible or defined as follows.

SWR of Skilled Labor : 1.0 times of market wage rate.

(2) Operations and Maintenance (O/M) Costs

Cost for operation and maintenance are assumed as same condition as Master Plan Analysis (see *Chapter H.1)*. Operation Cost is included for 2005 – 2010. After project implementation period (2011-) are excluded from economic analysis except for the additional maintenance cost to maintain the engineering capacity of the drainage system increased by the additional works proposed in Priority Projects. Maintenance Cost is considered for 2005 – 2040.

And also, the project costs for supporting measures were excluded from this economic analysis because of same reason of M/P analysis.

Table H.2.7 Project Cost (Priority Projects, North Manila)

Work Item	Financial Cost	Economic Cost for Economic Analysis
Civil Works	1,685.7	1,627.9
VAT	168.5	0.0
Resettlement and Compensation Cost	17.8	15.3
Government Administration Cost	50.6	48.8
Engineering Services	168.5	162.8
Physical Contingency	209.1	185.5
Operation Cost (2005-2010)	0.0	649.8
Maintenance Cost (2005-2040)	0.0	256.7
Total	2,300.0	2,946.8

Source: The Study Team

Note : Cost for Supporting Measures are excluded. Details may not add up to totals due to rounding.

Table H.2.8 Project Cost (Priority Projects, South Manila)

Work Item	Financial Cost	Economic Cost for Economic Analysis
Civil Works	1,729.0	1,685.1
VAT	172.9	0.0
Resettlement and Compensation Cost	204.0	175.4
Government Administration Cost	51.9	50.6
Engineering Services	172.9	168.5
Physical Contingency	233.1	208.0
Operation Cost (2005-2010)	0.0	593.8
Maintenance Cost (till 2040)	0.0	266.1
Total	2,564.1	3,147.5

Source: The Study Team

Note : Cost for Supporting Measures are excluded. Details may not add up to totals due to rounding.

Table H.2.9 Project Cost (Priority Projects, All Study Area)

Work Item	Financial Cost	Economic Cost for Economic Analysis
Civil Works	3,415.1	3,313.0
VAT	341.5	0.0
Resettlement and Compensation Cost	221.9	190.8
Government Administration Cost	102.5	99.4
Engineering Services	341.5	331.3
Physical Contingency	442.3	393.4
Operation Cost (2005-2010)	0.0	1,243.6
Maintenance Cost (till 2040)	0.0	522.8
Total	4,864.8	6,094.3

Source: The Study Team

Note : Cost for Supporting Measures are excluded. Details may not add up to totals due to rounding.

Table H.2.10 Disbursement Schedule for Economic Analysis (Priority Projects, Financial Price)

Unit: Php

Description		Amount				
		Foreign	Local			Total
				LC except Unskild Lbr	LC Unskild Lbr	
1. Civil Works						
	North Manila	1,091,973,822	593,501,151	564,715,178	28,747,741	1,685,702,428
	South Manila	1,186,889,028	542,374,693	525,786,196	16,626,728	1,729,036,266
	Total of North & South (All Study Area)	2,278,862,850	1,135,875,843	1,090,501,374	45,374,469	3,414,738,693
2. VAT						
	North Manila	109,197,382	59,350,115	56,471,518	2,874,774	168,547,497
	South Manila	118,688,903	54,237,469	52,578,620	1,662,673	172,926,372
	Total of North & South (All Study Area)	227,886,285	113,587,584	109,050,137	4,537,447	341,473,869
3. Resettlement & Compensation Cost						
	North Manila	0	17,810,142	17,810,142	0	17,810,142
	South Manila	0	204,010,296	204,010,296	0	204,010,296
	Total of North & South (All Study Area)	0	221,820,438	221,820,438	0	221,820,438
4. Government Administration Cost						
	North Manila	32,759,215	17,805,035	16,941,455	862,432	50,564,249
	South Manila	35,606,671	16,271,241	15,773,586	498,802	51,877,912
	Total of North & South (All Study Area)	68,365,885	34,076,275	32,715,041	1,361,234	102,442,161
5. Engineering Services						
	North Manila	109,197,382	59,350,115	56,471,518	2,874,774	168,547,497
	South Manila	118,688,903	54,237,469	52,578,620	1,662,673	172,926,372
	Total of North & South (All Study Area)	227,886,285	113,587,584	109,050,137	4,537,447	341,473,869
6. Phisical Contingency						
	North Manila	134,312,780	74,781,656	71,240,981	3,535,972	209,094,436
	South Manila	145,987,350	87,113,117	85,072,732	2,045,088	233,100,467
	Total of North & South (All Study Area)	280,300,131	161,894,773	156,313,713	5,581,060	442,194,903
7. Operation Cost						
	North Manila	0	755,542,667	755,542,667	0	0
	South Manila	0	690,457,333	690,457,333	0	0
	Total of North & South (All Study Area)	0	241,000,000	1,446,000,000	0	0
8. Maintenance Cost						
	North Manila	0	0	0	0	0
	South Manila	0	0	0	0	0
	Total of North & South (All Study Area)	0	0	0	0	0
Total						
	North Manila	1,477,440,582	822,598,213	783,650,792	38,895,694	2,300,038,795
	South Manila	1,605,860,854	958,244,285	935,800,049	22,495,963	2,564,105,139
	Total of North & South (All Study Area)	3,083,301,436	1,780,842,498	1,719,450,841	61,391,657	4,864,143,934

Source : The Study Team

Table H.2.11 Disbursement Schedule for Economic Analysis (Priority Projects, Economic Price)

Unit: Php

Description		2005			2006			2007		
		F/C	LC except Unskild	LC Unskild	F/C	LC except Unskild	LC Unskild	F/C	LC except Unskild	LC Unskild
1. Civil Works										
	North Manila	16,563,043	4,408,683	139,480	0	0	0	27,030,886	7,194,970	227,631
	South Manila	0	0	0	0	0	0	13,964,654	3,981,746	412,830
	Total of North & South (All Study Area)	16,563,043	4,408,683	139,480	0	0	0	40,995,540	11,176,716	640,461
2. VAT										
	North Manila	0	0	0	0	0	0	0	0	0
	South Manila	0	0	0	0	0	0	0	0	0
	Total of North & South (All Study Area)	0	0	0	0	0	0	0	0	0
3. Resettlement & Compensation Cost										
	North Manila	0	0	0	0	0	0	0	15,316,722	0
	South Manila	0	0	0	0	115,704,400	0	0	59,744,455	0
	Total of North & South (All Study Area)	0	0	0	0	115,704,400	0	0	75,061,177	0
4. Government Administration Cost										
	North Manila	496,891	132,260	4,184	0	0	0	810,927	215,849	6,829
	South Manila	0	0	0	0	0	0	418,940	119,452	12,385
	Total of North & South (All Study Area)	496,891	132,260	4,184	0	0	0	1,229,866	335,301	19,214
5. Engineering Services										
	North Manila	1,656,304	440,868	13,948	0	0	0	2,703,089	719,497	22,763
	South Manila	0	0	0	0	0	0	1,396,465	398,175	41,283
	Total of North & South (All Study Area)	1,656,304	440,868	13,948	0	0	0	4,099,554	1,117,672	64,046
6. Phisical Contingency										
	North Manila	1,871,624	498,181	15,761	0	0	0	3,054,490	2,344,704	25,722
	South Manila	0	0	0	0	11,570,440	0	1,578,006	6,424,383	46,650
	Total of North & South (All Study Area)	1,871,624	498,181	15,761	0	11,570,440	0	4,632,496	8,769,087	72,372
7. Operation Cost										
	North Manila	0	0	108,294,449	0	0	108,294,449	0	0	108,294,449
	South Manila	0	0	98,965,551	0	0	98,965,551	0	0	98,965,551
	Total of North & South (All Study Area)	0	0	207,260,000	0	0	207,260,000	0	0	207,260,000
8. Maintenance Cost										
	North Manila				82,815	22,043	697	82,815	22,043	697
	South Manila				0	0	0	0	0	0
	Total of North & South (All Study Area)				82,815	22,043	697	82,815	22,043	697
Total										
	North Manila	20,587,862	5,479,993	108,467,822	82,815	22,043	108,295,146	33,682,206	25,813,786	108,578,092
	South Manila	0	0	98,965,551	0	127,274,840	98,965,551	17,358,065	70,668,210	99,478,699
	Total of North & South (All Study Area)	20,587,862	5,479,993	207,433,373	82,815	127,296,883	207,260,697	51,040,271	96,481,996	208,056,790

Description		2008			2009			2010		
		F/C	LC except Unskild	LC Unskild	F/C	LC except Unskild	LC Unskild	F/C	LC except Unskild	LC Unskild
1. Civil Works										
	North Manila	698,663,190	276,556,100	4,973,995	223,938,626	106,993,605	4,973,995	161,121,946	90,586,816	4,518,733
	South Manila	860,125,424	311,199,915	2,997,407	192,925,218	73,125,635	2,997,407	157,453,475	63,783,712	2,171,747
	Total of North & South (All Study Area)	1,558,788,614	587,756,015	7,971,402	416,863,844	180,119,240	7,971,402	318,575,421	154,370,528	6,690,480
2. VAT										
	North Manila	0	0	0	0	0	0	0	0	0
	South Manila	0	0	0	0	0	0	0	0	0
	Total of North & South (All Study Area)	0	0	0	0	0	0	0	0	0
3. Resettlement & Compensation Cost										
	North Manila	0	0	0	0	0	0	0	0	0
	South Manila	0	0	0	0	0	0	0	0	0
	Total of North & South (All Study Area)	0	0	0	0	0	0	0	0	0
4. Government Administration Cost										
	North Manila	20,959,896	8,296,683	149,220	6,718,159	3,209,808	149,220	4,833,658	2,717,604	135,562
	South Manila	25,803,763	9,335,997	89,922	5,787,757	2,193,769	89,922	4,723,604	1,913,511	65,152
	Total of North & South (All Study Area)	46,763,658	17,632,680	239,142	12,505,915	5,403,577	239,142	9,557,263	4,631,116	200,714
5. Engineering Services										
	North Manila	69,866,319	27,655,610	497,400	22,393,863	10,699,361	497,400	16,112,195	9,058,682	451,873
	South Manila	86,012,542	31,119,992	299,741	19,292,522	7,312,563	299,741	15,745,347	6,378,371	217,175
	Total of North & South (All Study Area)	155,878,861	58,775,602	797,140	41,686,384	18,011,924	797,140	31,857,542	15,437,053	669,048
6. Phisical Contingency										
	North Manila	78,948,940	31,250,839	562,061	25,305,065	12,090,277	562,061	18,206,780	10,236,310	510,617
	South Manila	97,194,173	35,165,590	338,707	21,800,550	8,263,197	338,707	17,792,243	7,207,559	245,407
	Total of North & South (All Study Area)	176,143,113	66,416,430	900,768	47,105,614	20,353,474	900,768	35,999,023	17,443,870	756,024
7. Operation Cost										
	North Manila	0	0	108,294,449	0	0	108,294,449	0	0	108,294,449
	South Manila	0	0	98,965,551	0	0	98,965,551	0	0	98,965,551
	Total of North & South (All Study Area)	0	0	207,260,000	0	0	207,260,000	0	0	207,260,000
8. Maintenance Cost										
	North Manila	217,970	58,018	1,836	3,711,286	1,440,799	26,706	4,830,979	1,975,767	51,576
	South Manila	69,823	19,909	2,064	4,370,450	1,575,908	17,051	5,335,076	1,941,536	32,038
	Total of North & South (All Study Area)	287,793	77,927	3,900	8,081,736	3,016,707	43,757	10,166,055	3,917,303	83,614
Total										
	North Manila	868,656,314	343,817,250	114,478,961	282,066,997	134,433,850	114,503,831	205,105,557	114,575,179	113,962,810
	South Manila	1,069,205,726	386,841,404	102,693,392	244,176,497	92,471,072	102,708,379	201,049,746	81,224,691	101,697,071
	Total of North & South (All Study Area)	1,937,862,040	730,658,654	217,172,353	526,243,494	226,904,922	217,212,210	406,155,303	195,799,869	215,659,881

(Continued)

Table H.2.11 Disbursement Schedule for Economic Analysis (Priority Projects, Economic Price)

Unit: Php

Description		2011-2040	Total of 2005-2010			
		LC except Unskild Lbr	F/C	LC except Unskild	LC Unskild	Total
1. Civil Works						
	North Manila	0	1,127,317,689	485,740,174	14,833,835	1,627,891,698
	South Manila	0	1,224,468,772	452,091,008	8,579,392	1,685,139,171
	Total of North & South (All Study Area)	0	2,351,786,461	937,831,182	23,413,226	3,313,030,869
2. VAT						
	North Manila	0	0	0	0	0
	South Manila	0	0	0	0	0
	Total of North & South (All Study Area)	0	0	0	0	0
3. Resettlement & Compensation Cost						
	North Manila	0	0	15,316,722	0	15,316,722
	South Manila	0	0	175,448,855	0	175,448,855
	Total of North & South (All Study Area)	0	0	190,765,577	0	190,765,577
4. Government Administration Cost						
	North Manila	0	33,819,531	14,572,205	445,015	48,836,751
	South Manila	0	36,734,063	13,562,730	257,382	50,554,175
	Total of North & South (All Study Area)	0	70,553,594	28,134,935	702,397	99,390,926
5. Engineering Services						
	North Manila	0	112,731,769	48,574,017	1,483,383	162,789,170
	South Manila	0	122,446,877	45,209,101	857,939	168,513,917
	Total of North & South (All Study Area)	0	235,178,646	93,783,118	2,341,323	331,303,087
6. Phisical Contingency						
	North Manila	0	127,386,899	56,420,312	1,676,223	185,483,434
	South Manila	0	138,364,971	68,631,169	969,471	207,965,612
	Total of North & South (All Study Area)	0	265,751,870	125,051,481	2,645,695	393,449,046
7. Operation Cost						
	North Manila	0	0	0	649,766,694	649,766,694
	South Manila	0	0	0	593,793,306	593,793,306
	Total of North & South (All Study Area)	0	0	0	1,243,560,000	1,243,560,000
8. Maintenance Cost						
	North Manila	244,183,755	8,925,864	247,702,425	81,511	256,709,801
	South Manila	252,770,876	9,775,350	256,308,229	51,154	266,134,733
	Total of North & South (All Study Area)	496,954,630	18,701,215	504,010,655	132,665	522,844,534
Total						
	North Manila	244,183,755	1,410,181,752	868,325,856	668,286,661	2,946,794,269
	South Manila	252,770,876	1,531,790,033	1,011,251,092	604,508,644	3,147,549,769
	Total of North & South (All Study Area)	496,954,630	2,941,971,786	1,879,576,948	1,272,795,305	6,094,344,039

Source : The Study Team

H.2.4 ECONOMIC EVALUATION

(1) Economic Viability

Priority Projects are evaluated from the economic viewpoint by figuring out the economic viability, comparing the economic benefit and the economic cost in terms of economic internal rate of return (EIRR), benefit/cost ratio (B/C), and net present value (NPV or B – C, i.e. Benefit minus Cost).

All the monetary calculations are based on the following parameters either predetermined or using assumptions.

Project Duration(Economic Life)

- Civil works and collateral works & arrangements for Priority Projects start in FY2005 and complete in FY2010.
  Then, beyond 2010, operation and maintenance works continue for 30 years[19]
  i.e.
  FY2005 – FY2010 (6 years) : Civil works and collateral works & arrangements including structural and non-structural measures
  FY2011 – FY2040 (30 years) : Operation & maintenance as supporting measures

Timing of Accruing Benefits

Theoretically, the matured annual average benefit will appear after completion of F/S work, i.e., FY2011. However, considering consistency and make comparison easy to the analysis on Master Plan, the timing of accruing flood reduction benefit is set as follows:

- 50% of annual average benefit will appear after 2011,
- 75% of annual average benefit will appear after 2016,
- The matured annual average benefit will appear after 2021

Price Level

- The valuation of project costs and benefit should be in constant price at the current year's level. Though, cost of civil works was identified as the price at July 2004, the basic price level in the economic analysis is set at the beginning of 2004 in order to keep consistency among all cost items.

Social Discount Rate (SDR)

- SDR is applied at 15%[20] based on the guideline of NEDA[21] for basic infrastructure projects as same as the analysis of Master Plan

Prevailing Exchange Rate

- Php 55 per US$ and JPY 110 per US$ at the official rate in market as same as the analysis of Master Plan

Depreciation, Financial Charges, Interest and Amortization

- In general, financing of the project is not relevant to the economic evaluation. For further details, see *Chapter H.1.4*. From these points of view, depreciation (residual value) of waterways and pumping stations, and financial cost or charges are not estimated in the economic evaluation.

The calculations of NPV, B/C, and EIRR are based on the annual cash flow that is prepared from the above-mentioned economic cost and the annual average benefit discussed in accordance with the implementation schedule or annual disbursement schedule. The economic viability of the Priority Projects was thus figured out as follows.

Table H.2.12 Results of Economic Analysis (Future Condition, Priority Projects)

	North Manila	South Manila	All Study Area
NPV	Php 4,817 mil.	Php 7,374 mil.	Php 12,191 mil.
B/C	3.7	4.8	4.3
EIRR	34.0 %	38.8 %	36.6 %

Source: The Study Team

Table H.2.13 Annual Cash Flow of Priority Projects 1 (Future Condition, North Manila)

(Php. million, at Current Price in Economic Value under Future Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total Cost		
1	2005	Short-term Phase	21.1		113.4	134.5		▲ 134.5
2	2006				108.4	108.4		▲ 108.4
3	2007		34.5	15.3	118.3	168.1		▲ 168.1
4	2008		980.2		346.8	1,327.0		▲ 1,327.0
5	2009		335.9		195.1	531.0		▲ 531.0
6	2010		256.2		177.4	433.6		▲ 433.6
7	2011	Medium-term Phase			8.1	8.1	1,376.7	1,368.6
8	2012				8.1	8.1	1,409.1	1,400.9
9	2013				8.1	8.1	1,442.2	1,434.1
10	2014				8.1	8.1	1,476.1	1,467.9
11	2015				8.1	8.1	1,510.8	1,502.6
12	2016	Long-term Phase			8.1	8.1	2,266.2	2,258.0
13	2017				8.1	8.1	2,266.2	2,258.0
14	2018				8.1	8.1	2,266.2	2,258.0
15	2019				8.1	8.1	2,266.2	2,258.0
16	2020				8.1	8.1	2,266.2	2,258.0
17	2021				8.1	8.1	3,021.5	3,013.4
18	2022				8.1	8.1	3,021.5	3,013.4
19	2023				8.1	8.1	3,021.5	3,013.4
20	2024				8.1	8.1	3,021.5	3,013.4
21	2025				8.1	8.1	3,021.5	3,013.4
22	2026				8.1	8.1	3,021.5	3,013.4
23	2027				8.1	8.1	3,021.5	3,013.4
24	2028				8.1	8.1	3,021.5	3,013.4
25	2029				8.1	8.1	3,021.5	3,013.4
26	2030				8.1	8.1	3,021.5	3,013.4
27	2031				8.1	8.1	3,021.5	3,013.4
28	2032				8.1	8.1	3,021.5	3,013.4
29	2033				8.1	8.1	3,021.5	3,013.4
30	2034				8.1	8.1	3,021.5	3,013.4
31	2035				8.1	8.1	3,021.5	3,013.4
32	2036				8.1	8.1	3,021.5	3,013.4
33	2037				8.1	8.1	3,021.5	3,013.4
34	2038				8.1	8.1	3,021.5	3,013.4
35	2039				8.1	8.1	3,021.5	3,013.4
36	2040				8.1	8.1	3,021.5	3,013.4
					(Total at Current)	2,946.8	78,976.6	76,029.8
					(Total at PV)	1,774.1	6,591.4	4,817.3

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**4,817**
Social Discount Rate :	15%	**B/C :**	**3.7**
		EIRR :	**34.0%**

Source : The Study Team

Table H.2.14 Annual Cash Flow of Priority Projects 2 (Future Condition, South Manila)

(Php. million, at Current Price in Economic Value under Future Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total Cost		
1	2005	Short-term Phase			99.0	99.0		▲ 99.0
2	2006			115.7	110.5	226.2		▲ 226.2
3	2007		18.4	59.7	109.4	187.5		▲ 187.5
4	2008		1,174.3		384.4	1,558.7		▲ 1,558.7
5	2009		269.0		170.3	439.4		▲ 439.4
6	2010		223.4		160.6	384.0		▲ 384.0
7	2011	Medium-term Phase			8.4	8.4	1,943.7	1,935.3
8	2012				8.4	8.4	1,989.4	1,980.9
9	2013				8.4	8.4	2,036.1	2,027.7
10	2014				8.4	8.4	2,084.0	2,075.5
11	2015				8.4	8.4	2,132.9	2,124.5
12	2016	Long-term Phase			8.4	8.4	3,199.4	3,191.0
13	2017				8.4	8.4	3,199.4	3,191.0
14	2018				8.4	8.4	3,199.4	3,191.0
15	2019				8.4	8.4	3,199.4	3,191.0
16	2020				8.4	8.4	3,199.4	3,191.0
17	2021				8.4	8.4	4,265.9	4,257.4
18	2022				8.4	8.4	4,265.9	4,257.4
19	2023				8.4	8.4	4,265.9	4,257.4
20	2024				8.4	8.4	4,265.9	4,257.4
21	2025				8.4	8.4	4,265.9	4,257.4
22	2026				8.4	8.4	4,265.9	4,257.4
23	2027				8.4	8.4	4,265.9	4,257.4
24	2028				8.4	8.4	4,265.9	4,257.4
25	2029				8.4	8.4	4,265.9	4,257.4
26	2030				8.4	8.4	4,265.9	4,257.4
27	2031				8.4	8.4	4,265.9	4,257.4
28	2032				8.4	8.4	4,265.9	4,257.4
29	2033				8.4	8.4	4,265.9	4,257.4
30	2034				8.4	8.4	4,265.9	4,257.4
31	2035				8.4	8.4	4,265.9	4,257.4
32	2036				8.4	8.4	4,265.9	4,257.4
33	2037				8.4	8.4	4,265.9	4,257.4
34	2038				8.4	8.4	4,265.9	4,257.4
35	2039				8.4	8.4	4,265.9	4,257.4
36	2040				8.4	8.4	4,265.9	4,257.4
					(Total at Current)	3,147.5	111,500.2	108,352.6
					(Total at PV)	1,932.0	9,305.9	7,373.9

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**7,374**
Social Discount Rate :	15%	**B/C :**	**4.8**
		EIRR :	**38.8%**

Source : The Study Team

Table H.2.15 Annual Cash Flow of Priority Projects 3 (Future Condition, All Study Area)

(Php. million, at Current Price in Economic Value under Future Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total Cost		
1	2005	Short-term Phase	21.1		212.4	233.5		▲ 234
2	2006			115.7	218.9	334.6		▲ 335
3	2007		52.8	75.1	227.7	355.6		▲ 356
4	2008		2,154.5		731.2	2,885.7		▲ 2886
5	2009		605.0		365.4	970.4		▲ 970
6	2010		479.6		338.0	817.6		▲ 818
7	2011	Medium-term Phase			16.6	16.6	3,320.4	3,303.8
8	2012				16.6	16.6	3,398.4	3,381.9
9	2013				16.6	16.6	3,478.3	3,461.7
10	2014				16.6	16.6	3,560.0	3,543.5
11	2015				16.6	16.6	3,643.7	3,627.1
12	2016	Long-term Phase			16.6	16.6	5,465.6	5,449.0
13	2017				16.6	16.6	5,465.6	5,449.0
14	2018				16.6	16.6	5,465.6	5,449.0
15	2019				16.6	16.6	5,465.6	5,449.0
16	2020				16.6	16.6	5,465.6	5,449.0
17	2021				16.6	16.6	7,287.4	7,270.8
18	2022				16.6	16.6	7,287.4	7,270.8
19	2023				16.6	16.6	7,287.4	7,270.8
20	2024				16.6	16.6	7,287.4	7,270.8
21	2025				16.6	16.6	7,287.4	7,270.8
22	2026				16.6	16.6	7,287.4	7,270.8
23	2027				16.6	16.6	7,287.4	7,270.8
24	2028				16.6	16.6	7,287.4	7,270.8
25	2029				16.6	16.6	7,287.4	7,270.8
26	2030				16.6	16.6	7,287.4	7,270.8
27	2031				16.6	16.6	7,287.4	7,270.8
28	2032				16.6	16.6	7,287.4	7,270.8
29	2033				16.6	16.6	7,287.4	7,270.8
30	2034				16.6	16.6	7,287.4	7,270.8
31	2035				16.6	16.6	7,287.4	7,270.8
32	2036				16.6	16.6	7,287.4	7,270.8
33	2037				16.6	16.6	7,287.4	7,270.8
34	2038				16.6	16.6	7,287.4	7,270.8
35	2039				16.6	16.6	7,287.4	7,270.8
36	2040				16.6	16.6	7,287.4	7,270.8
					(Total at Current)	6,094.3	190,476.7	184,382.4
					(Total at PV)	3,706.1	15,897.3	12,191.2

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**12,191**
Social Discount Rate :	15%	**B/C :**	**4.3**
		EIRR :	**36.6%**

Source : The Study Team

(2) Sensitivity Analysis

The cost and benefits were estimated at conservative side with discretion in this analysis. In spite of that, some uncertainty still exists in the estimation. In particular, the cases with long implementation period and/or expectation of future growth in Metropolitan Manila have high risks in terms of judgment on project viability. In this context, the sensitivity analysis was tested in the following relevant parameters guided by NEDA[22] in consideration of sensitive factors for project feasibility.

Assumption I : Increase in projected costs by 10% and 20%

Assumption II : Decrease in benefits by 10% and 20%

Assumption III : Combination of Cases I and II

In addition to the above NEDA assumptions, another case that benefit decreased to 50% of original estimate was also tested for reference. i.e.,

Assumption IV : Decrease in benefits by 50%

The commencement of project delayed 5 years and 10 years were tested to check the elasticity against time utility. i.e.,

Assumption V : Delay of commencement of project for 5 years and 10 years

While the all of above mentioned analysis are considered the socioeconomic development, another sensitivity without change of socioeconomic development was tested. i.e.,

Assumption VI : Project without socioeconomic development
(= Present Condition)

Result of Assumption I, II, III and IV

As mentioned in *chapter H.1*, it is said that the project is feasible when NPV is positive (over 0), B/C is over 1.0, and EIRR is over social discount rate (15% in Philippines). As shown in the tables below, NPV of the all cases were positive, B/C exceeded 1.0, and the lowest EIRR exceeded social discount rate. Thus, the proposed projects are sufficiently feasible from the economic point of view.

The results are as follows:

Table H.2.16 Results of the Sensitivity Analysis 1
(NPV, Future Condition, Priority Projects, North Manila)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	4,817	4,158	3,499	1,522
	+10%	4,640	3,981	3,322	1,344
	+20%	4,462	3,803	3,144	1,167

Source: The Study Team

Table H.2.17 Results of the Sensitivity Analysis 2 (B/C, Future Condition, Priority Projects, North Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	3.7	3.3	3.0	1.9
	+10%	3.4	3.0	2.7	1.7
	+20%	3.1	2.8	2.5	1.5

Source: The Study Team

Table H.2.18 Results of the Sensitivity Analysis 3 (EIRR, Future Condition, Priority Projects, North Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	34.0%	32.0%	29.9%	22.6%
	+10%	32.2%	30.3%	28.3%	21.3%
	+20%	30.6%	28.8%	26.9%	20.1%

Source: The Study Team

Table H.2.19 Results of the Sensitivity Analysis 4 (NPV, Future Condition, Priority Projects, South Manila)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	7,374	6,443	5,513	2,721
	+10%	7,181	6,250	5,320	2,528
	+20%	6,988	6,057	5,126	2,335

Source: The Study Team

Table H.2.20 Results of the Sensitivity Analysis 5 (B/C, Future Condition, Priority Projects, South Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	4.8	4.3	3.9	2.4
	+10%	4.4	3.9	3.5	2.2
	+20%	4.0	3.6	3.2	2.0

Source: The Study Team

Table H.2.21 Results of the Sensitivity Analysis 6 (EIRR, Future Condition, Priority Projects, South Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	38.8%	36.7%	34.4%	22.6%
	+10%	36.9%	34.8%	32.6%	21.3%
	+20%	35.2%	33.2%	31.0%	20.1%

Source: The Study Team

Table H.2.22 Results of the Sensitivity Analysis 7
(NPV, Future Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	12,191	10,601	9,012	4,243
	+10%	11,821	10,231	8,641	3,872
	+20%	11,450	9,860	8,271	3,501

Source: The Study Team

Table H.2.23 Results of the Sensitivity Analysis 8
(B/C, Future Condition, Priority Projects, All Study Area)

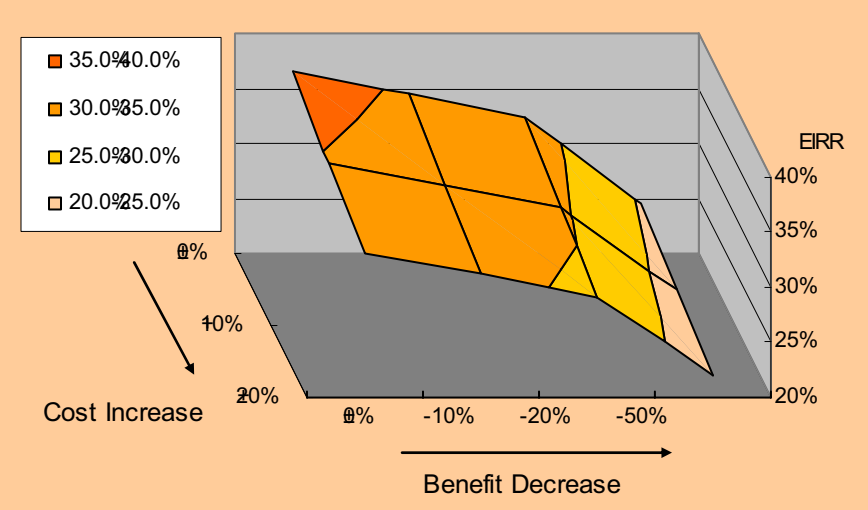
		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	4.3	3.9	3.4	2.1
	+10%	3.9	3.5	3.1	1.9
	+20%	3.6	3.2	2.9	1.8

Source: The Study Team

Table H.2.24 Results of the Sensitivity Analysis 9
(EIRR, Future Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	36.6%	34.5%	32.3%	24.6%
	+10%	34.7%	32.8%	30.6%	23.2%
	+20%	33.1%	31.2%	29.1%	22.0%

Source: The Study Team



Source: The Study Team

Figure H.2.3 Results of Sensitivity Analysis
(EIRR, Future Condition, Priority Projects, All Study Area)

Result of Assumption V

If the commencement of the project would delay for 5 years or 10 years, each index changes as following table. Because of the socioeconomic development of Metropolitan Manila, B/C and EIRR would slightly improve, but each NPV would drop sharply at 50 % and 75% respectively. In addition, this assumption doesn't consider financial price escalation. If the inflation would be considered, the result would worsen. In view of this time conditions, it is recommended to commence the project as soon as possible.

Table H.2.25 Results of the Sensitivity Analysis 10 (Delay of Project Commencement, Future Condition, Priority Projects, All Study Area)

	Base Case	Delay of 5 Years	Delay of 10 Years
NPV	Php 12,191 mil.	Php 6,215 mil.	Php 3,090 mil.
B/C	4.3	4.4	4.4
EIRR	36.6 %	37.5 %	37.5 %

Source: The Study Team

Result of Assumption VI

Incidentally, in case of excluding socioeconomic growth in future (= Present Condition), EIRR would decrease, but still keep economically feasible level (17.3%, under the assumption of +20% increased cost and -50 % decreased benefit, see *Table H.2.34*).

(3) Project Justification

In line with the same manner as described in *Chapter H.1.4, "(3) Project Justification for the Master Plan*", the Priority Projects also can be justified from the economic viewpoint to take a next step in accordance with the proposed schedule. Comparing to the economic viability of the Priority Projects between in North Manila area and South Manila area, to be precise, South Manila portion shows slightly better viability, but roughly speaking, the rates are almost same. It is recommended that all portions of Priority Projects in both North Manila and South Manila be to be implemented simultaneously.

Table H.2.26 Annual Cash Flow of Priority Projects 4 (Present Condition, North Manila)

(Php million, at Current Price in Economic Value under Present Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total		
1	2005	Short-term Phase	21.1		113.4	134.5		▲ 134.5
2	2006		0.0		108.4	108.4		▲ 108.4
3	2007		34.5	15.3	118.3	168.1		▲ 168.1
4	2008		980.2		346.8	1,327.0		▲ 1,327.0
5	2009		335.9		195.1	531.0		▲ 531.0
6	2010		256.2		177.4	433.6		▲ 433.6
7	2011	Medium-term Phase			8.1	8.1	1,021.1	1,013.0
8	2012				8.1	8.1	1,021.1	1,013.0
9	2013				8.1	8.1	1,021.1	1,013.0
10	2014				8.1	8.1	1,021.1	1,013.0
11	2015				8.1	8.1	1,021.1	1,013.0
12	2016	Long-term Phase			8.1	8.1	1,531.7	1,523.6
13	2017				8.1	8.1	1,531.7	1,523.6
14	2018				8.1	8.1	1,531.7	1,523.6
15	2019				8.1	8.1	1,531.7	1,523.6
16	2020				8.1	8.1	1,531.7	1,523.6
17	2021				8.1	8.1	2,042.3	2,034.1
18	2022				8.1	8.1	2,042.3	2,034.1
19	2023				8.1	8.1	2,042.3	2,034.1
20	2024				8.1	8.1	2,042.3	2,034.1
21	2025				8.1	8.1	2,042.3	2,034.1
22	2026				8.1	8.1	2,042.3	2,034.1
23	2027				8.1	8.1	2,042.3	2,034.1
24	2028				8.1	8.1	2,042.3	2,034.1
25	2029				8.1	8.1	2,042.3	2,034.1
26	2030				8.1	8.1	2,042.3	2,034.1
27	2031				8.1	8.1	2,042.3	2,034.1
28	2032				8.1	8.1	2,042.3	2,034.1
29	2033				8.1	8.1	2,042.3	2,034.1
30	2034				8.1	8.1	2,042.3	2,034.1
31	2035				8.1	8.1	2,042.3	2,034.1
32	2036				8.1	8.1	2,042.3	2,034.1
33	2037				8.1	8.1	2,042.3	2,034.1
34	2038				8.1	8.1	2,042.3	2,034.1
35	2039				8.1	8.1	2,042.3	2,034.1
36	2040				8.1	8.1	2,042.3	2,034.1
					(Total at Current)	2,946.8	53,609.2	50,662.4
					(Total at PV)	1,774.1	4,542.0	2,767.8

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**2,768**
Social Discount Rate :	15%	**B/C :**	**2.56**
		EIRR :	**27.6%**

Source : The Study Team

Table H.2.27 Annual Cash Flow of Priority Projects 5 (Present Condition, South Manila)

(Php million, at Current Price in Economic Value under Present Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total		
1	2005	Short-term Phase	0.0		99.0	99.0		▲ 99.0
2	2006		0.0	115.7	110.5	226.2		▲ 226.2
3	2007		18.4	59.7	109.4	187.5		▲ 187.5
4	2008		1,174.3		384.4	1,558.7		▲ 1,558.7
5	2009		269.0		170.3	439.4		▲ 439.4
6	2010		223.4		160.6	384.0		▲ 384.0
7	2011	Medium-term Phase			8.4	8.4	1,441.6	1,433.2
8	2012				8.4	8.4	1,441.6	1,433.2
9	2013				8.4	8.4	1,441.6	1,433.2
10	2014				8.4	8.4	1,441.6	1,433.2
11	2015				8.4	8.4	1,441.6	1,433.2
12	2016	Long-term Phase			8.4	8.4	2,162.5	2,154.0
13	2017				8.4	8.4	2,162.5	2,154.0
14	2018				8.4	8.4	2,162.5	2,154.0
15	2019				8.4	8.4	2,162.5	2,154.0
16	2020				8.4	8.4	2,162.5	2,154.0
17	2021				8.4	8.4	2,883.3	2,874.9
18	2022				8.4	8.4	2,883.3	2,874.9
19	2023				8.4	8.4	2,883.3	2,874.9
20	2024				8.4	8.4	2,883.3	2,874.9
21	2025				8.4	8.4	2,883.3	2,874.9
22	2026				8.4	8.4	2,883.3	2,874.9
23	2027				8.4	8.4	2,883.3	2,874.9
24	2028				8.4	8.4	2,883.3	2,874.9
25	2029				8.4	8.4	2,883.3	2,874.9
26	2030				8.4	8.4	2,883.3	2,874.9
27	2031				8.4	8.4	2,883.3	2,874.9
28	2032				8.4	8.4	2,883.3	2,874.9
29	2033				8.4	8.4	2,883.3	2,874.9
30	2034				8.4	8.4	2,883.3	2,874.9
31	2035				8.4	8.4	2,883.3	2,874.9
32	2036				8.4	8.4	2,883.3	2,874.9
33	2037				8.4	8.4	2,883.3	2,874.9
34	2038				8.4	8.4	2,883.3	2,874.9
35	2039				8.4	8.4	2,883.3	2,874.9
36	2040				8.4	8.4	2,883.3	2,874.9
					(Total at Current)	3,147.5	75,686.1	72,538.6
					(Total at PV)	1,932.0	6,412.4	4,480.4

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**4,480**
Social Discount Rate :	15%	**B/C :**	**3.32**
		EIRR :	**31.9%**

Source : The Study Team

Table H.2.28 Annual Cash Flow of Priority Projects 6 (Present Condition, All Study Area)

(Php million, at Current Price in Economic Value under Present Condition)

Project Year	Year		Economic Cost				Benefit	Balance
			Civil Works	Resettlement & Compensation	Other Costs	Total		
1	2005	Short-term Phase	21.1		212.4	233.5		▲ 234
2	2006			115.7	218.9	334.6		▲ 335
3	2007		52.8	75.1	227.7	355.6		▲ 356
4	2008		2,154.5		731.2	2,885.7		▲ 2886
5	2009		605.0		365.4	970.4		▲ 970
6	2010		479.6		338.0	817.6		▲ 818
7	2011	Medium-term Phase			16.6	16.6	2,462.8	2,446.2
8	2012				16.6	16.6	2,462.8	2,446.2
9	2013				16.6	16.6	2,462.8	2,446.2
10	2014				16.6	16.6	2,462.8	2,446.2
11	2015				16.6	16.6	2,462.8	2,446.2
12	2016	Long-term Phase			16.6	16.6	3,694.2	3,677.6
13	2017				16.6	16.6	3,694.2	3,677.6
14	2018				16.6	16.6	3,694.2	3,677.6
15	2019				16.6	16.6	3,694.2	3,677.6
16	2020				16.6	16.6	3,694.2	3,677.6
17	2021				16.6	16.6	4,925.5	4,909.0
18	2022				16.6	16.6	4,925.5	4,909.0
19	2023				16.6	16.6	4,925.5	4,909.0
20	2024				16.6	16.6	4,925.5	4,909.0
21	2025				16.6	16.6	4,925.5	4,909.0
22	2026				16.6	16.6	4,925.5	4,909.0
23	2027				16.6	16.6	4,925.5	4,909.0
24	2028				16.6	16.6	4,925.5	4,909.0
25	2029				16.6	16.6	4,925.5	4,909.0
26	2030				16.6	16.6	4,925.5	4,909.0
27	2031				16.6	16.6	4,925.5	4,909.0
28	2032				16.6	16.6	4,925.5	4,909.0
29	2033				16.6	16.6	4,925.5	4,909.0
30	2034				16.6	16.6	4,925.5	4,909.0
31	2035				16.6	16.6	4,925.5	4,909.0
32	2036				16.6	16.6	4,925.5	4,909.0
33	2037				16.6	16.6	4,925.5	4,909.0
34	2038				16.6	16.6	4,925.5	4,909.0
35	2039				16.6	16.6	4,925.5	4,909.0
36	2040				16.6	16.6	4,925.5	4,909.0
					(Total at Current)	6,094.3	129,295.3	123,201.0
					(Total at PV)	3,706.1	10,954.4	7,248.2

Residual Value of Capital at Current Price :	Php 0	**NPV :**	**7,248**
Social Discount Rate :	15%	**B/C :**	**2.96**
		EIRR :	**30.0%**

Source : The Study Team

Table H.2.29 Results of the Sensitivity Analysis 11 (NPV, Present Condition, Priority Projects, North Manila)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	2,768	2,314	1,859	497
	+10%	2,590	2,136	1,682	319
	+20%	2,413	1,959	1,505	142

Source: The Study Team

Table H.2.30 Results of the Sensitivity Analysis 12 (B/C, Present Condition, Priority Projects, North Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	2.6	2.3	2.0	1.3
	+10%	2.3	2.1	1.9	1.2
	+20%	2.1	1.9	1.7	1.1

Source: The Study Team

Table H.2.31 Results of the Sensitivity Analysis 13 (EIRR, Present Condition, Priority Projects, North Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	27.6%	25.9%	24.1%	17.8%
	+10%	26.1%	24.5%	22.7%	16.7%
	+20%	24.7%	23.2%	21.5%	15.7%

Source: The Study Team

Table H.2.32 Results of the Sensitivity Analysis 14 (NPV, Present Condition, Priority Projects, South Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	4,480	3,839	3,198	1,274
	+10%	4,287	3,646	3,005	1,081
	+20%	4,094	3,453	2,812	888

Source: The Study Team

Table H.2.33 Results of the Sensitivity Analysis 15 (B/C, Present Condition, Priority Projects, South Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	3.3	3.0	2.7	1.7
	+10%	3.0	2.7	2.4	1.5
	+20%	2.8	2.5	2.2	1.4

Source: The Study Team

Table H.2.34 Results of the Sensitivity Analysis 16 (EIRR, Present Condition, Priority Projects, South Manila)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	31.9%	30.1%	28.1%	21.0%
	+10%	30.2%	28.4%	26.5%	19.8%
	+20%	28.7%	27.0%	25.2%	18.7%

Source: The Study Team

Table H.2.35 Results of the Sensitivity Analysis 17 (NPV, Present Condition, Priority Projects, All Study Area)

Unit : Php Million

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	7,248	6,153	5,057	1,771
	+10%	6,878	5,782	4,687	1,400
	+20%	6,507	5,412	4,316	1,030

Source: The Study Team

Table H.2.36 Results of the Sensitivity Analysis 18 (B/C, Present Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	3.0	2.7	2.4	1.5
	+10%	2.7	2.4	2.1	1.3
	+20%	2.5	2.2	2.0	1.2

Source: The Study Team

Table H.2.37 Results of the Sensitivity Analysis 19 (EIRR, Present Condition, Priority Projects, All Study Area)

		Benefit			
		±0%	-10%	-20%	-50%
Cost	±0%	30.0%	28.2%	26.3%	19.6%
	+10%	28.3%	26.6%	24.8%	18.4%
	+20%	26.9%	25.3%	23.5%	17.3%

Source: The Study Team

H.2.5 CONSIDERATION FOR INVESTMENT PLAN FOR PRIORITY PROJECTS

The purpose of this section is to analyze financial affordability for the Priority Projects.

The current expenditures on flood control and drainage improvement projects of relevant agencies are shown in the following table. When the annualized costs of proposed Priority Projects are compared to the average amount of current expenditures of MMDA and the 6 LGUs for the past 6 years, the cost for Priority Projects is fairly huge and equivalent to more than total of annual budget of relevant agencies.

While, on the assumption when some portion of Priority Projects would be financed by ODA loan or other assistance scheme, the burden of the agencies would be eased. If the costs for civil works which is equivalent to around 70% of total propose costs of Priority Projects are financed by assistance scheme, the share of the agencies would become 35% of total expenditure of relevant agencies and it is not a prohibitive level from the aspect of the financial status of the authorities.

Table H.2.38 Comparison of Expenditure on Flood Control

Unit: Php Million

	1999	2000	2001	2002	2003	2004	Average	Proposed Master Plan
National								4,865 milion for Priority Projects for 6 years Annualized 810 million / year
(MMDA)	120	955	200	199	200	956*1	438	
LGUs								
(Manila)	-	10	29	21	48	-	27	
(Makati)	118	127	73	30	5	212	94	
(Pasay)								
(Caloocan)	5	51	73	22	31	206*1	65	
(Taguig)	-	-	-	36	31	116	61	
(Quezon)*2	1	1	1	1	1	1	1	
Total						6,667	686	
Ratio of Current Expenditures to Priority Projects costs							118% (= 810/686)	
Ratio of Present Average Expenditure to GOP portion							35% (=243/686)	GOP 30% 243 mil / Loan 70% 567 mil

Source: The Study Team

Note : *1 Proposed, *2 Only for Maintenance

Reference

[1] Detailed Engineering Design of Pasig-Marikina River Channel Improvement Project, Main Report Volume II, March 2002, DPWH

[2] The above schedule was obtained from the assessors' office of the City of Manila. Since this schedule was prepared under the coordination with surrounding LGUs based on Presidential Decree No.921 and Republic Act 7160 known as the Local Government Code of 1991, these unit costs are subject to same conditions as other LGUs in the study area.

[3] Population and Housing Census, NSO, and Detailed Engineering Design of Pasig-Marikina River Channel Improvement Project, Main Report Volume II, March 2002, DPWH

[4] For example, these factors are applied in the following studies.
Final Alternative Master Plan Strategy Report for the Metro-Manila Integrated Urban Drainage and Flood Control Master Plan, March 1984, DPWH, or
Flood Control Manual, 1993, Canadian International Development Agency (CIDA), or
Economic model for urban watersheds, J. Hyd. Div. Am. Soc. Civ. Engrs., 106, (HY4), April, 475, 1980, T. N. Debo and G. N. Day

[5] The factor of agriculture (10%) was not used because there is no agricultural land use in the study area. The Factor of Highway (25%) was not used because Railroads (23 %) was applied as a representing factor of Infrastructure from the aspect of conservative evaluation.

[6] Contrarily, there is an adverse opinion on including the land enhancement benefit into flood control benefit. Market price of land does not represent its economic value provided that has been set in terms of demand and supply in the market, as such no consumption of scarce resources accrued to the specific project in sight. Further, land prices in urban area tend to be distorted by speculation in future escalation expected and by social prestige psychologically attached to the specific land lot; therefore, the land value does not increase in proportion to the project benefit. The determination of the impact of the project among the land value requires a detailed survey on the location and structure of the economic environment surrounding the project.

[7] Metro Manila Drainage System Rehabilitation Project, Final Report, Drainage Improvement Plans of Estero de Vitas and other Catchment Areas, March 1986, Ministry of Public Works and Highways

[8] Based on the schedule of market value of land and the city ordinances of each city

[9] ICC Project Evaluation procedures and Guidelines, NEDA

[10] Technical Standards and Guidelines for Planning and Design, Draft, Volume I : Flood Control, March 2002, DPWH - JICA

[11] ICC Project Evaluation procedures and Guidelines, NEDA

[12] Regarding project life span, 30 years is recommended in the guideline "Economic Analysis for Social Development Study, 13 Flood Control & Sabo", 2002, JICA

[13] ICC Project Evaluation procedures and Guidelines, NEDA

[14] In Japan's guideline and several study reports, it is suggested to add a risk premium onto the discount rate as another way to reflect uncertainty in long-term and wide-sector analysis of the project like flood control which reduces the risk by itself. A variation of this is to add a premium to the discount rate for the benefits, and subtract a premium for the costs.
Introducing these premiums into the calculations of economic evaluation has the effect of giving less weight to increasingly uncertain costs and benefits in the future. This method, however, must determine an arbitrary risk premium to add to the discount rate.

[15] ICC Project Evaluation procedures and Guidelines, NEDA

[16] ditto

[17] The acronyms with parentheses hereinafter referred are definition by Department of Budget and Management. For details, the following publication is convenient for understanding of the words and basic concept of budgetary system of Philippines, "Frequently Asked Questions – National Government Budget", A joint undertaking of the Budget Advocacy Project, Philippine Governance Forum and the Department of Budget and Management, PH FF 3496 2002 NWB

[18] Among outstanding liabilities of the national government of Philippines in the present

situations, the most big issue is adjustment of NPC (National Power Corporation)'s financial loss and its absorption by the government. The burden depends on the appraisal value of the debt and affects the amortization plan of the government in no small way.

[19] Regarding project life span, 30 years is recommended in the guideline "Economic Analysis for Social Development Study, 13 Flood Control & Sabo", 2002, JICA

[20] In Japan's guideline and several study reports, it is suggested to add a risk premium onto the discount rate as another way to reflect uncertainty in long-term and wide-sector analysis of the project like flood control which reduces the risk by itself. A variation of this is to add a premium to the discount rate for the benefits, and subtract a premium for the costs. Introducing these premiums into the calculations of economic evaluation has the effect of giving less weight to increasingly uncertain costs and benefits in the future. This method, however, must determine an arbitrary risk premium to add to the discount rate.

[21] ICC Project Evaluation procedures and Guidelines, NEDA

[22] Ditto