APPENDIX

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Appendix 1

Appendix 1-1 Joint Meeting Member

A joint meeting with the Philippine related organizations was planned on March 13, 2020, but the meeting was canceled due to the influence of COVID-19. Therefore, the meeting materials were distributed to related organizations, and the materials and comments on this survey were collected.

The table below shows the list of participating organizations of the Joint Meeting and the meeting request form scheduled to be held on March 13, 2020.

No.	Organization	Representative Person
1	DPWH	EMIL K. SADAIN, CESO II (Undersecretary for UPMO Operations)
2	DPWH-UPMO	RAMON A. ARRIOLA, CESO III (Project Director, UPMO-FCMC)
3	DPWH-UPMO	LEONILA R. MERCADO (Project Manager I, UPMO-FCMC)
4	LLDA	General Manager JAIME JOEY C. MEDINA
5	MMDA	Director BALTAZAR N. MELGAR
6	DENR	Secretary ROY A. CIMATU
7	NEDA	Assistant Secretary RODERICK M. PLANTA
8	DOST-PAGASA	Dr. VICENTE B. MALANO
9	DOST-PHIVOLCS	Undersecretary RENATO U. SOLIDUM, JR.
10	UP-National Hydraulic Research Center	Director ROBERTO S. SORIANO, Ph.D.
11	DILG	Secretary EDUARDO M. ANO
12	Province of Rizal	Hon. REBECCA ALCANTARA YNARES
13	Province of Cavite	Hon. JUANITO VICTOR C. REMULLA, JR.
14	Province of Laguna	Hon. RAMIL L. HERNANDEZ
15	City of Bacoor	Hon. LANI MERCADO REVILLA
16	City of Taguig	Hon. LINO EDGARDO CAYETANO
17	City of Muntinlupa	Hon. JAIME DELA ROSA FRESNEDI
18	City of Las Pinas	Hon. IMELDA T. AGUILAR
19	City of Paranaque	Hon. EDWIN L. OLIVAREZ
20	JICA Philippines Office	Ms. Ayumu OHSHIMA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Secretary ROY A. CIMATU
Department of Environment and Natural Resources
Visayas Avenue, Diliman
1100 Quezon City, Philippines

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Secretary Cimatu:

We would like to inform the Secretary that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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The result of the conference is vital in the finalization of the aforementioned study prior to the conduct of a full blown Feasibility Study of the Parañaque Spillway.

We are looking forward to your agency's participation and continuous support to the Department.

Very truly yours,

EMIL K. SADAIN, CESO I
Undersecretary for UPMO Operations
and Technical Services

21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. REBECCA ALCANTARA YNARES
Governor, Province of Rizal
Circumferencial Road cor. P. Oliveros St.
Ynares Center Complex
Antipolo City, 1870

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Governor Ynares:

We would like to inform the Honorable Governor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
and Technical Services

21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. JUANITO VICTOR C. REMULLA, JR.
Governor, Province of Cavite
Provincial Capitol Building
Provincial Capitol Compound
Bgry. San Agustin, Trece Martires City
4109

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Governor Remulla:

We would like to inform the Honorable Governor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
and Technical Services

21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. RAMIL L. HERNANDEZ
Governor, Province of Laguna
New Capitol Building
Provincial Capitol Compound
P. Guevara St.
Santa Cruz, Laguna
Philippines
4009

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Governor Hernandez:

We would like to inform the Honorable Governor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
and Technical Services

21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. LANI MERCADO-REVILLA
Mayor
City of Bacoor
Bacoor Government Center
Bacoor Boulevard
Barangay Bayanan, Bacoor City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Mayor Mercado-Revilla:

We would like to inform the Honorable Mayor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
and Technical Services

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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

0 2 MAR 2020

Hon. LINO EDGARDO CAYETANO
Mayor
City of Taguig
Taguig City Hall, Gen. Luna St.
Tuktukan, Taguig City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Mayor Cayetano:

We would like to inform the Honorable Mayor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
and Technical Services

21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. JAIME DELA ROSA FRESNEDI
Mayor
City of Muntinlupa
National Road, Putatan
Muntinlupa City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Mayor Fresnedi:

We would like to inform the Honorable Mayor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
and Technical Services

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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. IMELDA T. AGUILAR
Mayor
City of Las Piñas
Alabang-Zapote Rd.,
Las Piñas, National Capital
Region (NCR)

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Mayor Aguilar:

We would like to inform the Honorable Mayor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Hon. EDWIN L. OLIVAREZ
Mayor
City of Parañaque
Hernandez Avenue,
San Antonio Valley I,
Parañaque City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Mayor Olivarez:

We would like to inform the Honorable Mayor that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Undersecretary RENATO U. SOLIDUM, JR.
Disaster Risk Reduction and Climate Change
Department of Science and Technology (DOST)
Officer-in-Charge, Philippine Institute of
Volcanology and Seismology (PHIVOLCS)
DOST Main Building, DOST Complex
General Santos Avenue, Bicutan
Taguig City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Undersecretary Solidum:

We would like to inform the Undersecretary that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
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21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

0 2 MAR 2020

Ms. AYUMU OHSHIMA
Senior Representative
JICA Philippines Office
40th Floor, Yuchengco Tower,
RCBC Plaza 6819 Ayala Avenue,
Makati City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Ms. Ohshima:

We would like to inform the Senior Representative that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Dr. VICENTE B. MALANO
Administrator
Philippine Atmospheric, Geophysical
and Astronomical Services Administration
Science Garden, Agham Road
Diliman, Quezon City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Dr. Malano:

We would like to inform the Administrator that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Undersecretary for UPMO Operations
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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Director ROBERTO S. SORIANO, Ph.D.
National Hydraulic Research Center
2/F Melchor Hall
University of the Philippines
Diliman, Quezon City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Director Soriano:

We would like to inform the Director that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

General Manager JAIME 'JOEY' C. MEDINA
Laguna Lake Development Authority
National Ecology Center, Diliman, Quezon City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear General Manager Medina:

We would like to inform the General Manager that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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21.1 LRM/RAA

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

0 2 MAR 2020

Director BALTAZAR N. MELGAR
Director IV
Flood Control and Sewerage Management Office
Metropolitan Manila Development Authority
EDSA cor. Orense Street
Guadalupe, Makati

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Director Melgar:

We would like to inform the Director that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Assistant Secretary RODERICK M. PLANTA
Investment Programming Group
National Economic and Development Authority
12 St. J. Escriva Drive, Ortigas Center
Pasig City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Assistant Secretary Planta:

We would like to inform the Assistant Secretary that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
CENTRAL OFFICE
Manila

02 MAR 2020

Secretary EDUARDO M. AÑO
Department of Interior and Local Government
DILG NAPOLCOM Center
EDSA corner Quezon Avenue, Quezon City

SUBJECT : Joint Meeting for the JICA-Assisted Follow-Up Study on Parañaque Spillway Project

Dear Secretary Año:

We would like to inform the Secretary that the Department of Public Works and Highways will hold a Joint Meeting for the Follow-up Study on Parañaque Spillway Project under the grant aid assistance of JICA on March 13, 2020 at the Operations Room, Office of the Secretary, from 08:00 AM – 12:00 NN. The agenda of the conference are the following:

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EMIL K. SADAIN, CESO I
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and Technical Services

21.1 LRM/RAA

Appendix 1

Appendix 1-2 Joint Meeting Part-1

Follow-up Study on Parañaque Spillway Project

JOINT MEETING

Part-1 Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

May 8, 2020

Japan International Cooperation Agency

CTI Engineering International Co., Ltd. (CTII)
Nippon Koei Co., Ltd. (NK)

■Topics

Part-1

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

Part-2

2. Detailed Explanation of Comprehensive Flood Management Plan
   - 2.1 Setting Design Flood Level (DFL)
   - 2.2 Economic Evaluation of Parañaque Spillway
     - 2.2.1 Revised Operation Level and Routes of Parañaque Spillway
     - 2.2.2 Additional Economic Benefit which Include the Characteristic of Laguna de Bay Inundation Phenomena (long-term inundation)
     - 2.2.3 Consideration of the Contribution of Parañaque Spillway to Mitigate Flood Damage in Pasig-Marikina River
     - 2.2.4 Result of Economic Evaluation of Parañaque Spillway
   - 2.3 Improvement Effects Other Than Economic Evaluation
   - 2.4 Inundation Allowable Area / Level
   - 2.5 Comprehensive Flood Management Plan in Conservation and Sustainable Development of Laguna de Bay

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

＜1 Goals and Safety Level of Flood Control＞

- Considering the development status of Laguna lakeshore area, the historical flooding damage, the impact of climate change, etc., prevent and reduce inundation damage to 1/100 probability floods after climate change by gradually constructing Parañaque spillway and lakeshore diking system over 30 years

＜2 Design Flood Level (DFL)＞

- The Design Flood Level (DFL) of Laguna de Bay is set at 13.8m

＜3 Comprehensive Flood Management Plan＞

Structural Measures (water level rise suppression and flood damage reduction)

- Construction of Parañaque Spillway (underground tunnel, Diameter13m
  *the inner diameter should be closely inspected in about 0.1 m in next F/S stage.
- Lakeshore Diking System (Total length 82.75km, including drainage channels, drainage stations, back levee, bridges, etc.)

Non-Structural Measures

- Stricter development regulations within lake management boundaries (EL.12.5m or less)
- Promotion of land use regulations and ensuring the safety of residents in flood-prone areas (including resettlement)
- Hazard map creation, evacuation plan, disaster prevention awareness-raising activities for residents, local disaster prevention plan
- Construction of flood forecasting and warning system

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

＜4 Outline of Parañaque Spillway＞

Scale of Structures

- Commercial facilities and houses are dense on the assumed route of the Parañaque Spillway, and if the open channel type is adopted, many residents will be relocated, making commercialization difficult. In order to minimize social impact, the drainage channel will be Underground Pressure Tunnel type.
- In the case of climate change, Parañaque Spillway requires a tunnel inner diameter of 13m and a maximum discharge rate of 240m^3 / s to reduce the highest water level of Laguna Lake at 14.5m during a **1/100 probability flood to 13.8m (DFL).**

Operation Level of Parañaque Spillway

・January～May（Non-flooding Period）
：non-operation
・June～July(water level raising Period）
：11.5m
・August～December（water level lowering Period）
：12.0m

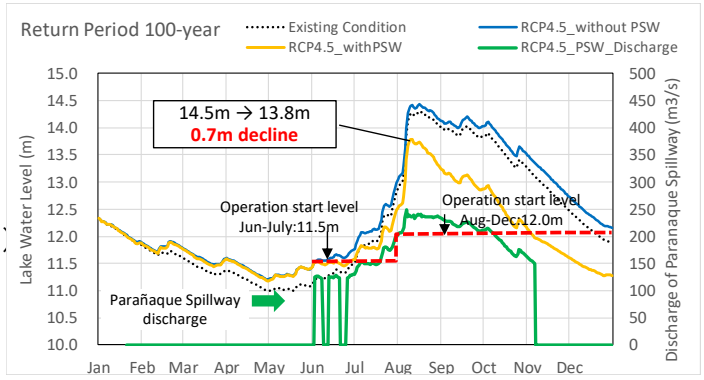
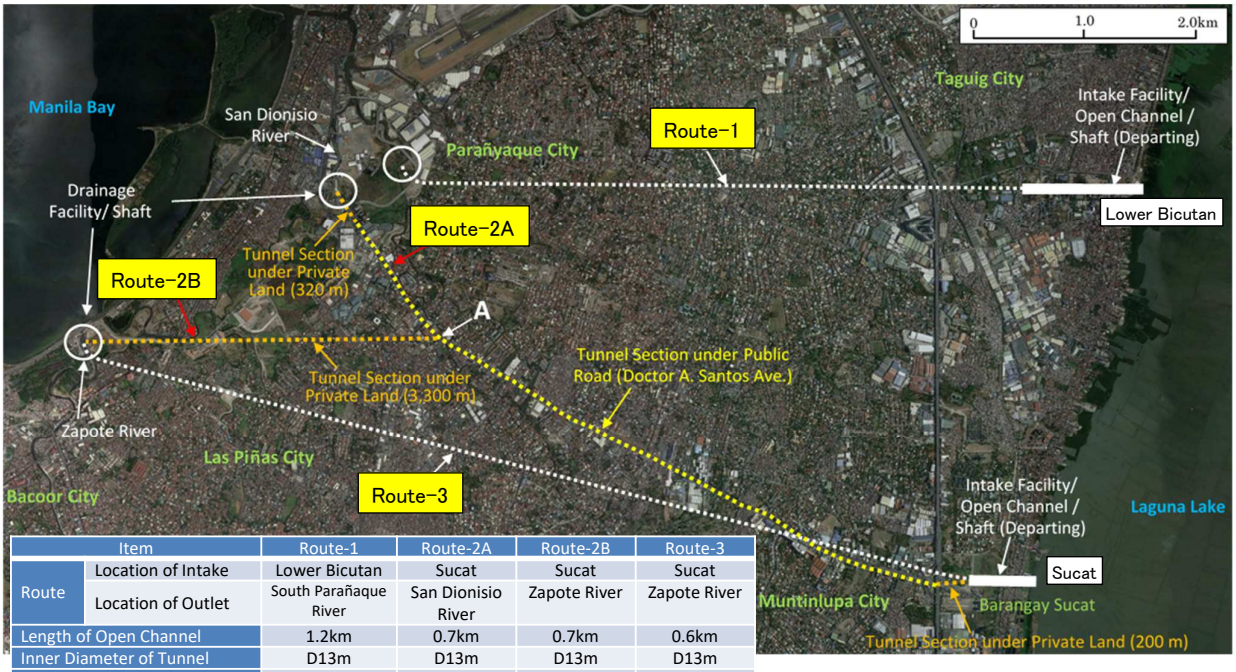


Figure 1-2 Effect of Parañaque Spillway of 100-year Return Period
（with Climate Change, D=13m, Max. Discharge=240m^3/s）

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

＜Alignment Plan＞

・The Parañaque spillway route (underground tunnel) will be studied based on the following four plans.



Item		Route-1	Route-2A	Route-2B	Route-3
Route	Location of Intake	Lower Bicutan	Sucat	Sucat	Sucat
	Location of Outlet	South Parañaque River	San Dionisio River	Zapote River	Zapote River
Length of Open Channel		1.2km	0.7km	0.7km	0.6km
Inner Diameter of Tunnel		D13m	D13m	D13m	D13m
Length of Tunnel		6.0km	7.2km	8.7km	8.8km
Depth of Tunnel from Surface		> 50m	< 30m	< 30m	> 50m
Height of Intake Vertical Shaft		75m	-	-	75m
Height of Outlet Vertical Shaft		75m	32m	32m	75m
Length of River Improvement		4.0km	8.0km	1.0km	1.0km

Figure 1-3 Routes of Parañaque Spillway

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

＜Outline of Lakeshore Diking System＞

- To construct a lakeshore diking system in the priority area along the lakeshore area to prevent inundation. Lakeshore diking system consists of lakeshore dike, drainage canals, pumping stations, community roads, bridges, etc., and resolves flood damage caused by rising water levels in Laguna de Bay.
- Lakeshore dike elevation will be 15.0m, considering 1.2m free board add to 13.8m (DFL).

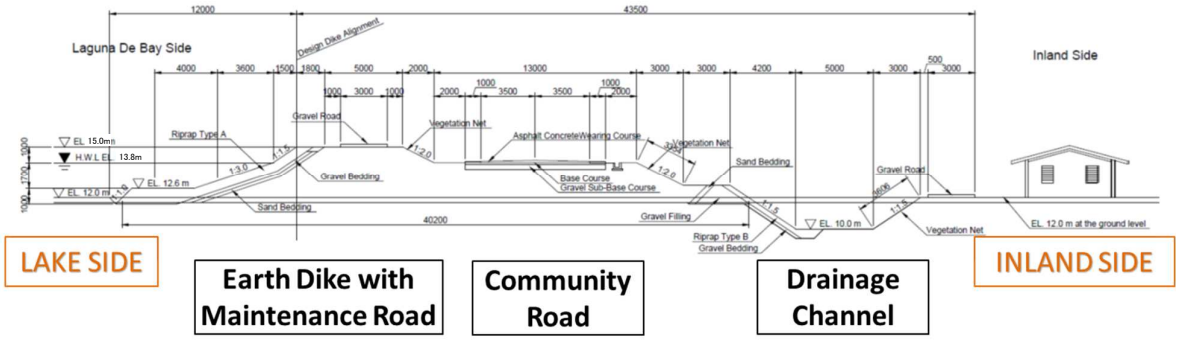


Figure 1-3 Lakeshore Dike Typical Cross Section

- Lakeshore dike will be constructed on lakeshores of Laguna Lake elevation of 12 m to 12.5 m.
- Prioritize the location of lakeshore diking systems based on land use, beneficiary population, beneficiary area, etc. in the shore area, and arrange lakeshore diking from areas with higher priority.
- The length of the planned lakeshore dike will be about 83 km compared to about 220 km around the lake shore, and non-structural measures (warning systems, etc.) will be used for areas where there are few assets and the economic effect is low for arranging lakeshore diking system.

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

＜7 Plan of Lakeshore Diking System　～Approx. 83km divided into three phases～＞

- Lakeshore Diking System is implemented in 82.75 km from Angono to Santa Cruz in three phases.
  - ・Phase I　：Angono to Muntinlupa、17.02km in Length
  - ・Phase II　：San Pedro to Calamba、32.83km in Length
  - ・Phase III：Los Banos to Santa Cruz、32.90km in Length

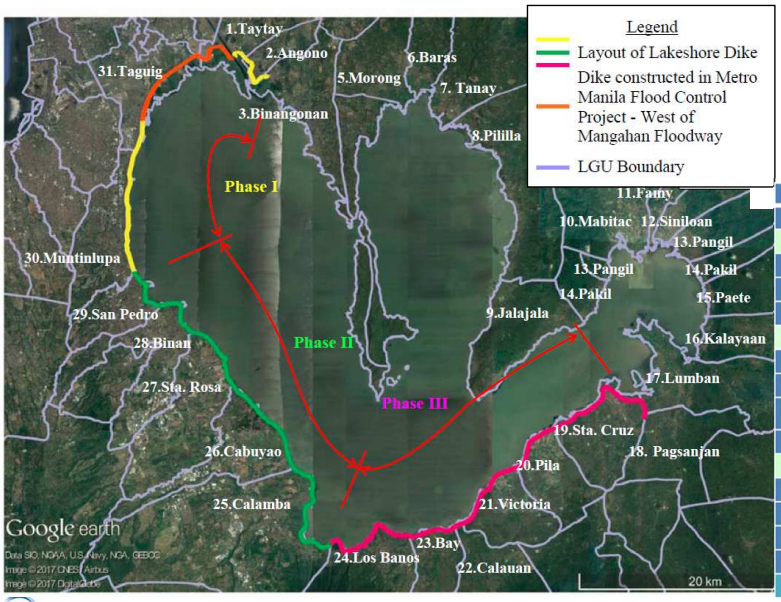


Table 1-1 Length of Lakeshore Diking System（Phase I, II, III）

Place		Dike Length (m)	Place		Dike Length (m)
Province	LGU		Province	LGU	
Phase I					
Rizal	Angono	3,310	NCR	Taguig	2,490
Rizal	Taytay	1,350	NCR	Muntinlupa	9,870
Sub-total of Phase I					17,020
Phase II					
Laguna	San Pedro	4,080	Laguna	Cabuyao	8,390
Laguna	Biñan	4,660	Laguna	Calamba	9,920
Laguna	Santa Rosa	5,780			
Sub-total of Phase II					32,830
Phase III					
Laguna	Los Baños	8,240	Laguna	Victoria	6,470
Laguna	Bay	3,780	Laguna	Pila	4,750
Laguna	Calauan	840	Laguna	Santa Cruz	8,820
Sub-total of Phase III					32,900
Sub-total of Priority Area					82,750

Figure 1-4 Layout of Lakeshore Diking System（Phase I, II, III）

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

＜8 Plan of Drainage Stations　～Approx. 30 Stations divided into three phases～＞

- Drainage pumping stations for draining inland water are implemented in three phases as part of the 82.75km Lakeshore Diking System planned from Angono to Santa Cruz.

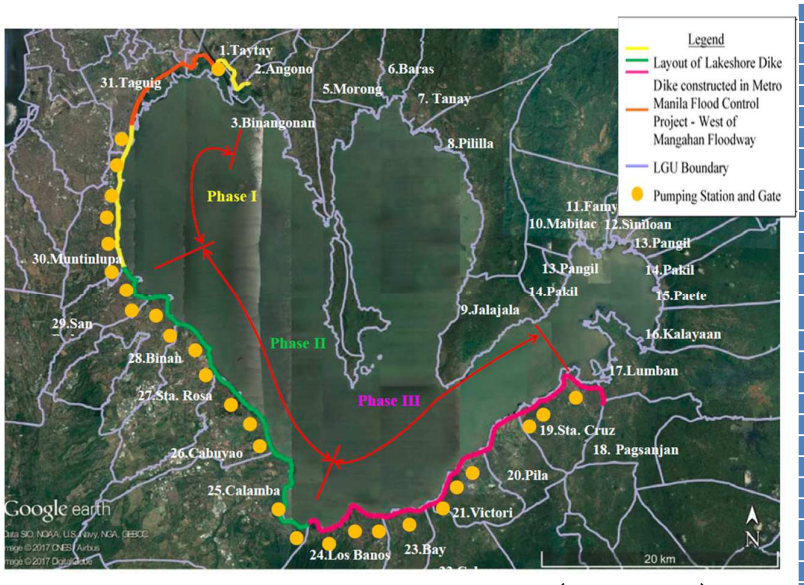


Figure1-5 Location of Drainage Stations（Phase I, II, III）

Table 1-2 Drainage Stations（Phase I, II, III）

No	River Basin			Retarding Pond			Capacity of Pomp (m³/s)
				Area (ha)	Depth (m)	Capacity (m³)	
1	SB-23	Muntinlupa	SB23-RB1	0.9	2.0	17,000	5.0
2			SB23-RB2	1.2	2.0	23,000	7.0
3			SB23-RB3	1.4	2.0	27,000	9.0
4			SB23-RB4	0.5	2.0	10,000	3.0
5			SB23-RB5	0.2	2.0	4,900	2.0
6	SB-22	San Pedoro	SB22-RB1	0.5	2.0	9,000	2.0
7			SB22-RB2	1.7	2.0	34,000	7.0
8			SB22-RB3	1.2	2.0	23,500	5.0
9	SB-21	Binan	SB21-RB1	6.4	2.0	128,200	27.0
10			SB21-RB2	1.3	2.0	25,000	5.0
11	SB-20	Sta. Rosa	SB20-RB1	0.8	2.0	16,000	4.0
12			SB20-RB2	2.9	2.0	58,000	14.0
13			SB20-RB3	0.9	2.0	18,000	4.0
14			SB20-RB4	7.5	2.0	149,000	36.0
15	SB-19	San Cristobal	SB19-RB1	5.7	2.0	113,000	27.0
16	SB-18	San Juan	SB18-RB1	2.9	2.0	57,000	15.0
17	SB-17	Los Banos	SB17-RB1	1.6	2.0	32,800	13.0
18			SB17-RB2	1.0	2.0	20,200	8.0
19			SB17-RB3	2.9	2.0	58,100	23.0
20			SB17-RB4	0.3	2.0	5,800	2.0
21	SB-16	Calauan	SB16-RB1	0.4	2.0	7,000	2.0
22			SB16-RB2	0.3	2.0	5,800	2.0
23	SB-15	Pila	SB15-RB1	0.8	2.0	16,900	4.0
24			SB15-RB2	4.4	2.0	87,900	23.0
25			SB15-RB3	7.1	2.0	141,300	37.0
26	SB-14	Sta. Cruz	SB14-RB1	5.9	2.0	118,000	26.0
27			SB14-RB2	0.7	2.0	14,000	3.0
28	SB-02	Taytay	SB02-RB1	1.0	2.0	20,000	6.0
Total				62.0		1,240,400	321.0

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

<9 Non-Structural Measures>

- As a countermeasure until Parañaque spillway and Lakeshore Diking System are completed, non-structural measures (warning system, etc.) are promoted in areas where there are few assets and the economic effect is low for arranging Lakeshore Diking System.

Table 1-3 Proposed Non-Structural Measures for Flood Mitigation of Lowland Area of Laguna de Bay

Proposed Non-Structural Measure	Description
Strict Implementation of Land Use Management Regulation in Lake Public Area below El. 12.5m	Existing reclamation activity, houses, factories, stockyards should strictly be regulated and controlled. Lake boundary at El. 12.5m should be clearly determined.
Evacuation/Resettlement from Flood Dangerous Area	Promotion of resettlement from flood dangerous areas below El. 12.5m to safety areas.
Improvement of the Disaster Risk Management System, Preparation of Hazard Maps and Education and Information Campaign for Inhabitants	Some LGUs along the lakeshore area have prepared the DRRMP. However, DRRMP for the entire Laguna Lake is not prepared yet. It is needed. Assistance in preparation of Hazard maps along the lakeshore and inflow rivers. Using Hazard maps, education for inhabitants through LGUs.
Proposed Flood Forecasting and Warning System for the Laguna de Bay Basin	Flood forecasting and warning for flash floods of inflow rivers and lake floods should be established. Warning system for inhabitants along the Parañaque Spillway should be established for proper operation.

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

<10 Project Implementation Plan ～Long-term plan for 30 years and priority implementation of Parañaque Spillway～>

- Parañaque Spillway can be expected to be completed in about 5 to 9 years (depend on routes), and flood mitigation effect is expected over the entire Laguna Lakeshore area as soon as possible. On the other hand, Lakeshore Diking System requires a lot of resettlement and land acquisition, and is expected to have an impact on fisheries historically. It takes a long time (20-30 years) to complete. Therefore, it is appropriate as a flood management plan to implement Parañaque spillway as a priority early (about 5 to 9 years for construction), and steadily implement Lakeshore Diking System over a long period of time (about 30 years) considering reduction of water level effect of Parañaque Spillway.

Table 1-4 Project Implementation Plan

No	Component	30-year Project Implementation (2021-2050)		
		10 years (2021-2030)	Next 10 years (2031-2040)	Final 10 years (2041-2050)
I	Structural Measures			
	1) Parañaque Spillway	━━		
	2) Lakeshore Diking System*			
	Phase I (17.02km)	━━		
	Phase II (32.83km)		━━	
	Phase III (32.90km)			━━
II	Non-Structural Measures			
	1) Strict Implementation of Land Use Management Regulation	▪▪▪▪▪		
	2) Evacuation/Resettlement from Flood Dangerous Area	▪▪▪▪▪		
	3) Improvement of the Disaster Risk Management System	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪
	4) Proposed Flood Forecasting and Warning System	▪▪▪▪▪	▪▪▪▪▪	▪▪▪▪▪

* Implementation of Lakeshore Diking System was assumed based on construction quantity and did not include the period for house evacuation and land acquisition.

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

<11 Project Cost and Project Evaluation>

- Cost and Compensation of **Comprehensive Flood Management Plan for Laguna de Bay**

Table 1-5 Cost of Comprehensive Flood Management Plan（with Climate Change、PSW D=13m、Shield）

Parañaque Spillway（PSW）+ Lakeshore Dike System (LDS)	Cost (million PHP)								
	Construction		Design and Supervision	Price Escalation	Physical Contingency	Compensation	Administration	Vat	Total
	PSW	LDS							
PSW (Route-1) + LDS	46,203	44,945	9,115	34,286	13,455	15,293	3,266	19,596	186,158
PSW (Route-2A) + LDS	41,888	44,945	8,683	32,318	12,783	16,028	3,133	18,797	178,576
PSW (Route-2B) + LDS	41,263	44,945	8,621	32,159	12,699	16,428	3,122	18,734	177,971
PSW (Route-3) + LDS	50,736	44,945	9,568	35,486	14,074	15,941	3,415	20,490	194,654

Table 1-6 Compensation of Comprehensive Flood Management Plan（with Climate Change、PSW D=13m、Shield）

Parañaque Spillway (PSW) + Lakeshore Dike System (LDS)	Parañaque Spillway				Lakeshore Diking System			
	Compensation Cost (million PHP)	Land Acquisition (ha)	House Evacuation (house)	Affected People (person)	Compensation Cost (million PHP)	Land Acquisition (ha)	House Evacuation (house)	Affected People (person)
PSW (Route-1) + LDS	2,147	12.8	340	1,390	13,146	1,284.9	2,913	11,524
PSW (Route-2A) + LDS	2,882	7.7	360	1,470				
PSW (Route-2B) + LDS	3,283	12.9	360	1,470				
PSW (Route-3) + LDS	2,795	6.8	360	1,470				

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

<11 Project Cost and Project Evaluation>

- Project Evaluation of **Comprehensive Flood Management Plan for Laguna de Bay**

Table 1-7 Evaluation of Comprehensive Flood Management Plan（with Climate Change、PSW D=13m、Shield）

Parañaque Spillway（PSW）+ Lakeshore Dike System (LDS)	Annual Benefit (million PHP)	NPV of B (million PHP)	NPV of C (million PHP)	EIRR	NPV (million PHP)	B/C
PSW (Route-1) + LDS	22,475	80,132	41,043	16.3%	39,088	1.95
PSW (Route-2A) + LDS	21,279	95,871	42,474	19.6%	53,397	2.26
PSW (Route-2B) + LDS	21,181	95,459	42,427	19.7%	53,032	2.25
PSW (Route-3) + LDS	23,751	84,165	44,060	16.2%	40,105	1.91

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

<12 Parañaque Spillway Project Cost and Project Evaluation>

Table 1-8 Compensation of Parañaque Spillway（with Climate Change、PSW D=13m、Shield）

Parañaque Spillway（PSW）	Parañaque Spillway				
	Compensation Cost (million PHP)	Land Acquisition (ha)	House Evacuation (house)	Affected People (person)	Construction Period (month)
PSW (Route-1)	2,147	12.8	340	1,390	98
PSW (Route-2A)	2,882	7.7	360	1,470	60
PSW (Route-2B)	3,283	12.9	360	1,470	64
PSW (Route-3)	2,795	6.8	360	1,470	105

Table 1-9 Cost of Parañaque Spillway（with Climate Change、PSW D=13m、Shield）

Parañaque Spillway (PSW)	Cost (million PHP)							
	Construction	Design and Supervision	Price Escalation	Physical Contingency	Compensation	Administration	Vat	Total
PSW (Route-1)	46,203	4,620	7,797	5,862	2,147	1,333	7,996	75,959
PSW (Route-2A)	41,888	4,189	5,830	5,191	2,882	1,200	7,197	68,376
PSW (Route-2B)	41,263	4,126	5,671	5,106	3,283	1,189	7,134	67,771
PSW (Route-3)	50,736	5,074	8,997	6,481	2,795	1,482	8,890	84,454

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

<12 Parañaque Spillway Project Cost and Project Evaluation>

Table 1-10 Evaluation of Parañaque Spillway Project（with Climate Change、PSW D=13m、Shield）

Parañaque Spillway (PSW)	Annual Benefit (million PHP)	NPV of B (million PHP)	NPV of C (million PHP)	EIRR	B/C
PSW (Route-1)	19,676	69,586	26,013	18.9%	2.68
PSW (Route-2A)	18,480	86,201	27,444	23.1%	3.14
PSW (Route-2B)	18,382	85,790	27,397	23.1%	3.13
PSW (Route-3)	20,952	73,619	29,030	18.6%	2.54

Appendix 1

Appendix 1-3 Joint Meeting Part-2

Follow-up Study on Parañaque Spillway Project

JOINT MEETING

Part-2 Detailed Explanation of Comprehensive Flood Management Plan

May 8, 2020

Japan International Cooperation Agency

CTI Engineering International Co., Ltd. (CTII)
Nippon Koei Co., Ltd. (NK)

■Topics

Part-1

1. Update of Draft Comprehensive Flood Management Plan for Laguna de Bay

Part-2

2. Detailed Explanation of Comprehensive Flood Management Plan

- 2.1 Setting Design Flood Level (DFL)
- 2.2 Economic Evaluation of Parañaque Spillway
  - 2.2.1 Revised Operation Level and Routes of Parañaque Spillway
  - 2.2.2 Additional Economic Benefit which Include the Characteristic of Laguna de Bay Inundation Phenomena (long-term inundation)
  - 2.2.3 Consideration of the Contribution of Parañaque Spillway to Mitigate Flood Damage in Pasig-Marikina River
  - 2.2.4 Result of Economic Evaluation of Parañaque Spillway
- 2.3 Improvement Effects Other Than Economic Evaluation
- 2.4 Inundation Allowable Area / Level
- 2.5 Comprehensive Flood Management Plan in Conservation and Sustainable Development of Laguna de Bay

2. Detailed Explanation of Comprehensive Flood Management Plan
2.1 Setting Design Flood Level (DFL)

1) Setting the Planning Scale in Laguna de Bay

According to the 2018 survey, the design scale at Laguna de Bay was set at 100-year return period in accordance with the DPWH guidelines (DGCS,2015).

Table 2-1-1 Design Scale of Laguna de Bay in 2018 Study

Classification	Evaluation Index	Design Scale	Setting Rationale
Flood caused by the water level rise of Laguna de Bay	**Water Level**	**100-year**	・ Since Laguna de Bay is considered as one of the important basins in the Philippines, the design scale is set to a 100-year which is equivalent to the value of the Pasig - Marikina River Basin. ・ The water level observed data of Laguna de Bay has been accumulated over a long period of time as compared to the rainfall data. Therefore, the water level probability scale is adopted.

☐ General Criteria for Flood Control, DGCS2015 volume 3

i. Design Flood

River Type	Design Flood
Principal and Major Rivers(40 km^2 drainage area and above)	100 year
For Small Rivers (below 40 km^2 drainage area)	50 year

Source; Design Guidelines, Criteria & Standards volume 3 Water Engineering project, 2015 DPWH

ii. Climate Change

Climate change should be considered as a part of the design and scoping for the project.

2. Detailed Explanation of Comprehensive Flood Management Plan
2.1 Setting Design Flood Level (DFL)

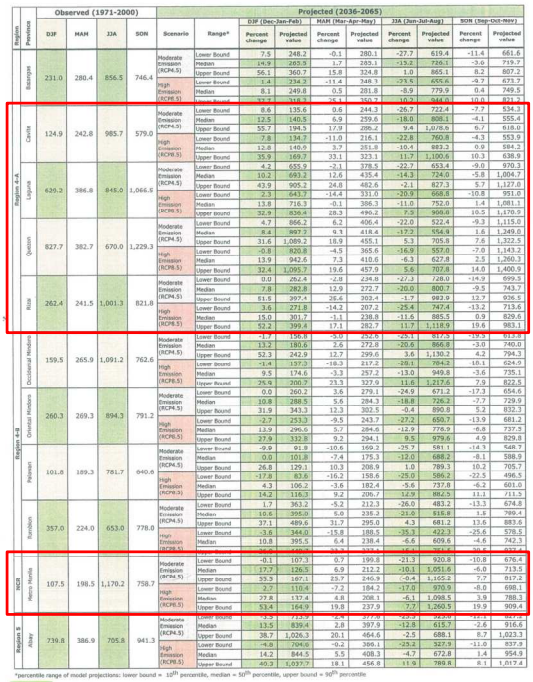
2) Climate Change

Predicting rainfall increase and decrease due to climate change (PAGASA)

- In the 2018 survey, future changes in rainfall in the study area were organized using the results of the Regional Climate Model (RCM) implemented by PAGASA, and the impact on the Laguna de Bay lake level was examined.
- In this follow-up study, study team discussed with PAGASA (January 27, 2020) and confirmed the latest climate change model (2018 version). Currently, PAGASA forecasts future weather based on RCP scenarios (Representative Concentration Pathways, IPCC Fifth Report).
- PAGASA makes predictions based on RCP4.5 and RCP8.5 scenarios. Using the prediction results for each Province described in the report "Observed Climate Trends and Projected Climate Change in the Philippines, 2018" obtained from PAGASA, the impact on the Laguna Lake water level taking into account climate change was examined.

Table 2-1-2 Result of Climate Change Evaluation（PAGASA) 2018

: Related Provinces of the Laguna de Bay Lakeshore area



Source: PAGASA (Observed Climate Trends and Projected Climate Change in the Philippines,2018)

2. Detailed Explanation of Comprehensive Flood Management Plan
2.1 Setting Design Flood Level (DFL)

- Predicted rainfall based on the RCP scenario will increase by about 50% from December to February and increase by about 25% from March to May, while it will decrease by 0.9% from June to August in the rainy season and from September to November is forecast to increase by about 8%

Table 2-1-3 The Result of 3-month Rain Change Rate by RCP4.5

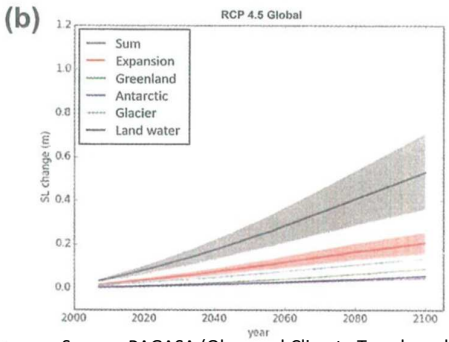
Month	Present Condition 1971-2000					Future 2036-2065 (RCP4.5)									
	Rainfall (mm)					Rate of Rainfall change (%)						Rainfall (mm)			
	Cavite	Laguna	Quezon	Rizal	NCR	Cavite	Laguna	Quezon	Rizal	NCR	Average	Cavite	Laguna	Quezon	Rizal
12~2	124.9	629.2	827.7	262.4	107.5	55.7	43.9	31.6	51.5	55.5	47.64	194.5	905.2	397.4	397.4
3~5	242.8	386.8	382.7	241.5	198.5	17.9	24.8	18.9	25.6	25.7	22.58	286.2	482.6	303.4	303.4
6~8	985.7	845	670	1001.3	1170.2	9.4	-2.1	5.3	-1.7	-0.4	2.1	1,078.6	827.3	983.9	983.9
9~11	579	1065.5	1229.3	821.8	758.7	6.7	5.7	7.6	12.7	7.7	8.08	618.0	1,127.0	926.5	926.5

Table 2-1-4 Area Weight Average of Relevant Province

Month	Future 2036-2065 (RCP4.5)					
	Rate of Rainfall change (%)_Weighted average					
	Cavite	Laguna	Quezon	Rizal	NCR	Total
12~2	3.7	21.7	0.8	17.1	4.5	47.8
3~5	1.2	12.3	0.5	8.5	2.1	24.5
6~8	0.6	-1.0	0.1	-0.6	-0.0	-0.9
9~11	0.5	2.8	0.2	4.2	0.6	8.3
Average	1.5	8.9	0.4	7.3	1.8	19.9

☐ Sea Level Raise

Based on RCP 4.5 scenarios (Representativ
Concentration Pathways, IPCC Fifth Report
of PAGASA, sea level raise is set 20 cm rais



Source: PAGASA (Observed Climate Trends and Projected Climate Change in the Philippines,2018)

2. Detailed Explanation of Comprehensive Flood Management Plan
2.1 Setting Design Flood Level (DFL)

In order to determine the Design Flood Level (DFL) of Laguna de Bay, It is necessary to comprehensively evaluate the following 3 issues;

- Consistency with existing flood control facilities,
- Flood control safety level, and
- Cost and B/C.

1) Consistency with Existing Flood Control Facilities

West of Manggahan Lakeshore Dike was completed in 2007 with DFL of 13.8m under the Metro Manila Flood Control Project - West of Manggahan Floodway.

2) Flood Control Safety Level

The DFL shall not increase inundation risk compared to the recent maximum water level of 13.85m during Typhoon Ondoy in 2009. The planned DFL will be set to 13.8 m or less in consideration of the past flood levels.

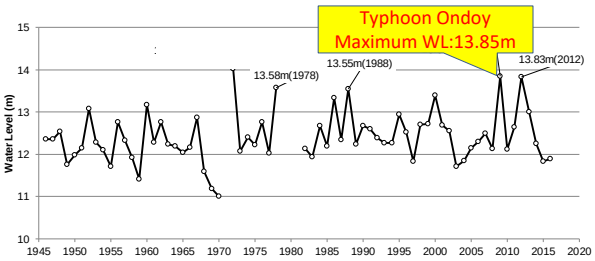


Figure Historical Maximum Lake Water Level

3) Cost and B/C

A higher safety level (Lower DFL) is desirable, but if the safety level is further increased, the project cost will be increased, and the B/C will be decreased.

From the above comprehensive evaluation, 13.8m is determined as the Design Flood Level of Laguna de Bay.

2.2 Economic Evaluation of Parañaque Spillway
2.2.1 Revised Operation Level and Routes of Parañaque Spillway

1) Revised Operation Level of Parañaque Spillway

- In this study, the initial operation level of Parañaque Spillway was revised as follows; to lower the lake level of Laguna de Bay before the flood season and to increase the storage capacity during the flood.
- In addition, the starting operation level of the four (4) drainage stations installed at West Manggahan Lakeshore dike is 11.5m.

＜Operation Level of Parañaque Spillway＞

- January～May（Non-flooding Period） : non operation
- June～July(water level raising Period） : 11.5m
- August～December（water level lowering Period） : 12.0m

→Due to a severe water shortage in Metro Manila (March 2019), to avoid the impact on water intake during the dry season of water treatment facilities that utilize Laguna de Bay as a water resources, Parañaque Spillway will not operate during non-flooding season (January to May) .

There are two (2) existing water purification facilities of Maynilad and Manila Water, Laguna de Bay as a water resources.
In consultation with Maynilad and Manila Water, we confirmed the water level at Laguna de Bay, which will affect water intake. However, there has been no event that water cannot be collected due to the low water level at Laguna de Bay. It is said that the water quality (salinity) of Laguna de Bay affects the water intake

2.2 Economic Evaluation of Parañaque Spillway
2.2.1 Revised Operation Level and Routes of Parañaque Spillway

- Laguna de Bay Lake level, taking into account climate change, is 14.5m with a 100-year return period without Parañaque Spillway.
- Water level will be increased due to increase precipitation during non-flooding period and then water level before flood period of June will be more than 11.5m and Parañaque Spillway can operate from early June. Therefore water level before flooding period will be same level as 100-year return period without climate change and Parañaque Spillway.
- 100-year probability with the Parañaque Spillway (Diameter D=13.0m) can reduce the water level to 13.8m (DFL) .
- **Parañaque Spillway is a facility that responds to climate change.**

No.	Climate Change		Parañaque Spillway			WL (m) 100-yr
	Yes	No	Yes	No	Diameter	
1		✔		✔	-	14.3m
2	✔			✔	-	14.5m
3	✔		✔		12.0m	13.9m
4	✔		✔		13.0m	13.8m

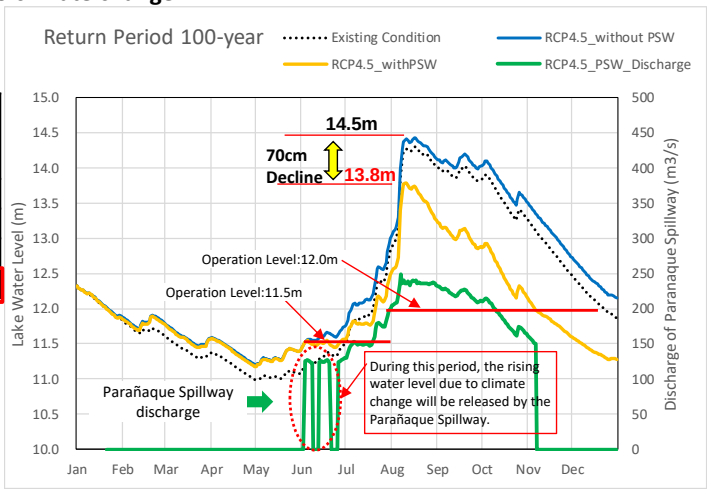


Figure 2-2-1 Analysis Results of Water Level Fluctuation (100-year,D=13m)

2.2 Economic Evaluation of Parañaque Spillway
2.2.1 Revised Operation Level and Routes of Parañaque Spillway

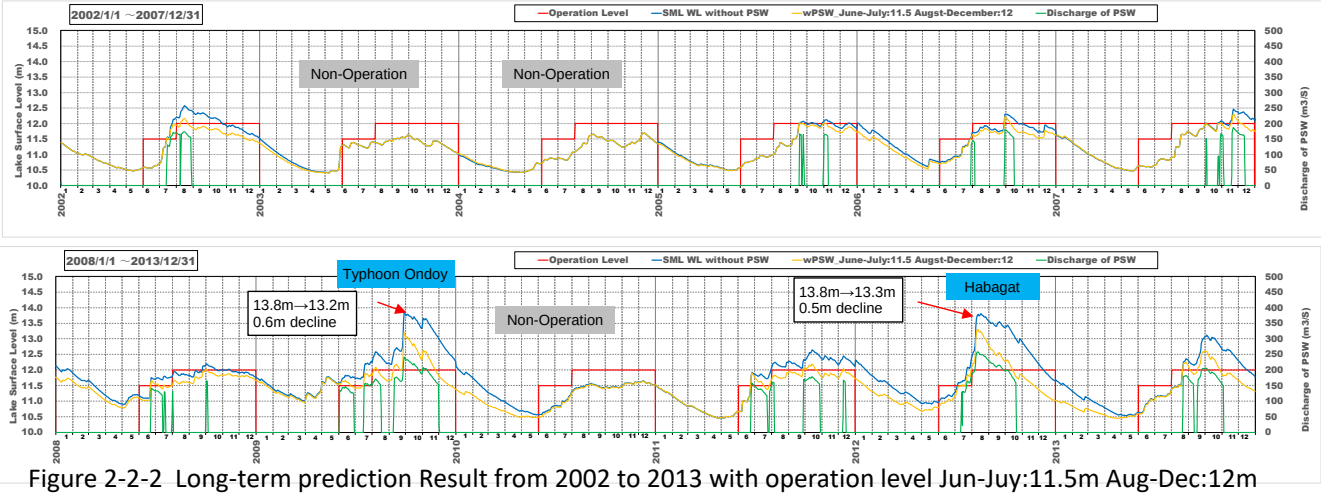
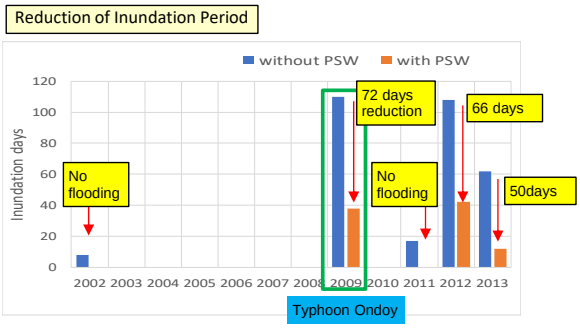


Figure 2-2-2 Long-term prediction Result from 2002 to 2013 with operation level Jun-Juy:11.5m Aug-Dec:12m (Diameter of Tunnel is 13.0m)

	Maximum Water level				days of more than 12.5m		
	Observed	SML					
		WL without PSW ①	With PSW ②	①−②	WL without PSW ③	With PSW ④	days (③-④)
2002	12.6	12.6	12.2	0.4	8	0	8
2003	11.7	11.6	11.6	0.0	0	0	0
2004	11.9	11.7	11.7	0.0	0	0	0
2005	12.2	12.1	12.0	0.1	0	0	0
2006	12.3	12.3	12.2	0.1	0	0	0
2007	12.5	12.5	12.3	0.1	0	0	0
2008	12.1	12.2	12.0	0.2	0	0	0
2009	13.9	13.8	13.2	0.6	110	38	72
2010	12.1	12.1	11.6	0.5	0	0	0
2011	12.7	12.7	12.2	0.5	17	0	17
2012	13.8	13.8	13.3	0.5	108	42	66
2013	13.0	13.1	12.6	0.5	62	12	50
Min	**11.7**	**11.6**	**11.6**	**0.0**	**0**	**0**	**0**
Ave	**12.6**	**12.5**	**12.3**	**0.3**	**25**	**8**	**18**
Max	**13.9**	**13.8**	**13.3**	**0.6**	**110**	**42**	**72**



2.2 Economic Evaluation of Parañaque Spillway
2.2.1 Revised Operation Level and Routes of Parañaque Spillway

2) Setting a Route Plan* to Reduce Costs

I. In the past, the Parañaque Spillway has been considered several times but has not been realized. The main reason for this was that, besides the size of the project funds, social impacts such as relocation and land acquisition were very large.

II. In the 2018 survey, from the viewpoint of minimizing its social impact, it was examined in the “draft of underground waterway “ applying the recently enacted Philippine law `` Private land rights do not occur below 50 m underground ”.

III. In this follow-up study, from the viewpoint of reducing its project cost, 2018 study was reviewed and revised the routes of Parañaque Spillway to shorten the shorten of vertical shaft considering that construction of shafts (entrance and exit) was a large part of construction cost and construction period.

IV. This proposed route can omit the construction of the shaft at the entrance of the spillway, reduce the cost and the construction period, can construct most of the tunnels on national land, and also reduce the social impact.

* Detail study of routes shall be executed in Feasibility Study

2.2 Economic Evaluation of Parañaque Spillway
2.2.1 Revised Operation Level and Routes of Parañaque Spillway

Alignment of Parañaque Spillway in 2020 Follow-up Study

- **Route-1 : Lower Bicutan – South Parañaque (same route as 2018)**
- **Revised Route-2-A :Sucat – San Dionisio**
- **Revised Route-2-B :Sucat – Zapote**
- **Route-3 : Sucat – Zapote(same route as 2018)**

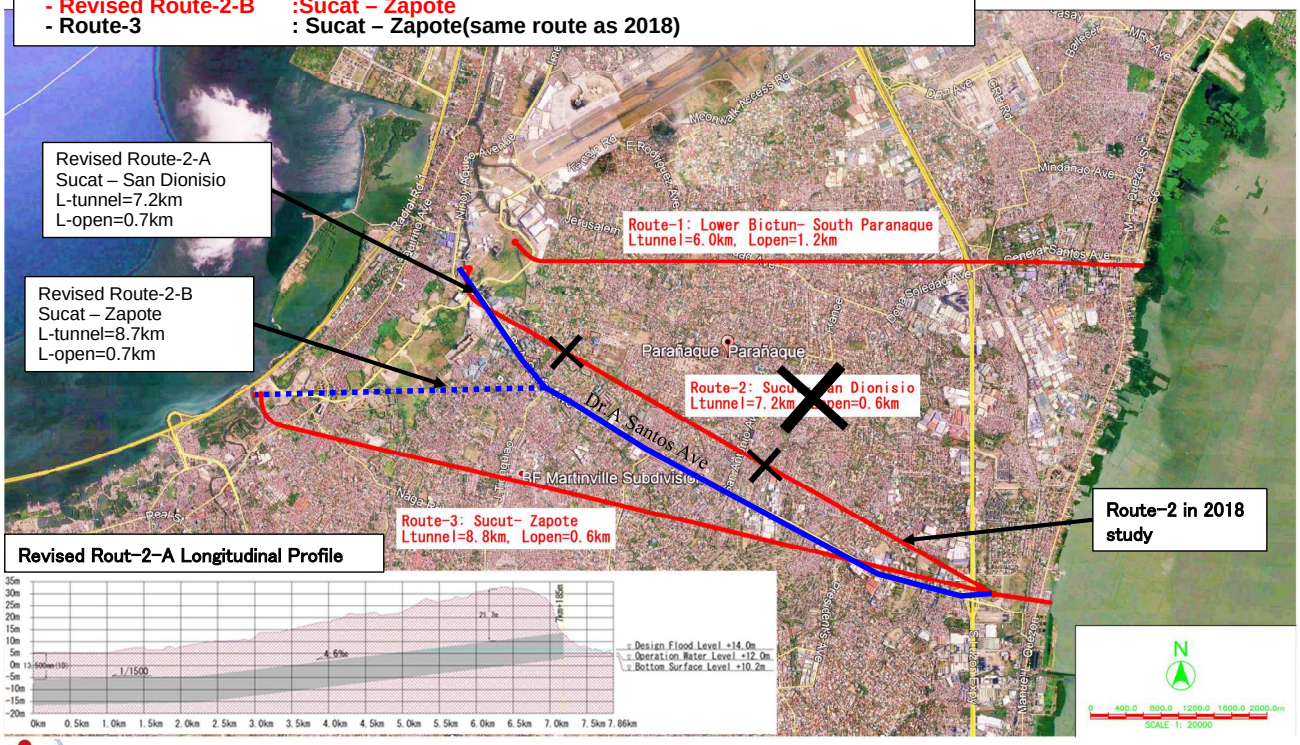


Figure 2-2-3 Alignment Plan Drawing of Parañaque Spillway, 2020

2.2 Economic Evaluation of Parañaque Spillway
2.2.1 Revised Operation Level and Routes of Parañaque Spillway

Table 2-2-1 Cost Breakdown of Parañaque Spillway (Shield method, D=13m)

Route	Cost (million PHP)						
	Project Cost	Construction Cost					
		Total	Tunnel	Vertical Shaft	Open Channel	River Improvement	Soil Disposal
Route 1	75,959	46,203	22,091	13,636	5,392	2,827	2,257
Route 2-A	68,376	41,888	25,665	4,629	4,062	5,671	1,861
Route 2-B	67,771	41,263	29,682	4,618	4,062	709	2,192
Route 3	84,454	50,736	29,926	13,620	4,044	706	2,440

Table 2-2-2 Compensation Cost, Land Acquisition, House Evacuation, Affected people, Construction period (Shield method, D=13m)

Route	Compensation Cost (million PHP)	Land Acquisition (ha)	House Evacuation (house)	People affected (person)	Construction Period (month)
Route 1	2,147	12.8	340	1,390	98
Route 2-A	2,882	7.7	360	1,470	60
Route 2-B	3,283	12.9	360	1,470	64
Route 3	2,795	6.8	360	1,470	105

2.2.2 Additional Economic Benefit which Include the Characteristic of Laguna de Bay Inundation Phenomena (long-term inundation)

In this follow-up study, considering the flood characteristics of Laguna de Bay (long-term inundation), attempted to calculate the following benefits that were not quantified in the 2018 study.

1）Reduction of damage to household business suspension

Flooded house count (every 0.5m) x shortened days x minimum labor (356PHP / day)

＝150 million PHP/year

2）Reduction of fishery damage due to flooding

Estimated to be nine (9) million pesos / day based on the amount of damage and days of flooding during the typhoon in 2009.

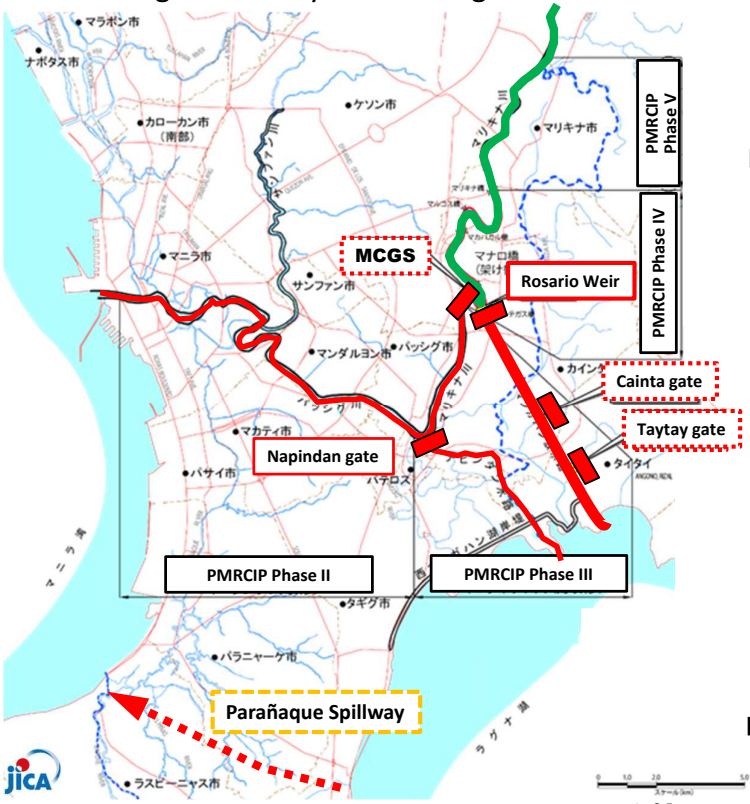
Inundation reduction days in each probability year x Day damage amount x Probability of occurrence

＝160 million PHP/year

2.2.3 Consideration of the Contribution of Parañaque Spillway to Mitigate Flood Damage in Pasig-Marikina River

1) Hydraulic Systems in Pasig-Marikina River basin and Laguna de Bay

An integrated study of the Pasig-Marikina River basin and Laguna de Bay is required.



: Existing

: Scheduled Installation（Phase IV）

: Not installed

※**Bold characters already exist**

■River Channel Network

【Downstream channel Network from Rosario point】

- **Phase II river channel**
- **Phase III river channel**
- Diversion/ Discharge System
  - MCGS
  - **Rosario weir**
  - **Manggahan Floodway**
  - Cainta gate
  - Taytay gate
  - **Napindan control gate**
  - Parañaque Spillway

【Upstream Channel Network from Rosario point】

- Phase IV river channel
- Phase V river channel

■Flood Storage Facility

- Marikina dam and Retarding Basin

2.2.3 Consideration of the Contribution of Parañaque Spillway to Mitigate Flood Damage in Pasig-Marikina River

2) Three (3) Types of Lake Water Discharged from Parañaque Spillway

■Rainfall Runoff to Lakeshore basin

Water A): Precipitation directly on the surface of Laguna de Bay

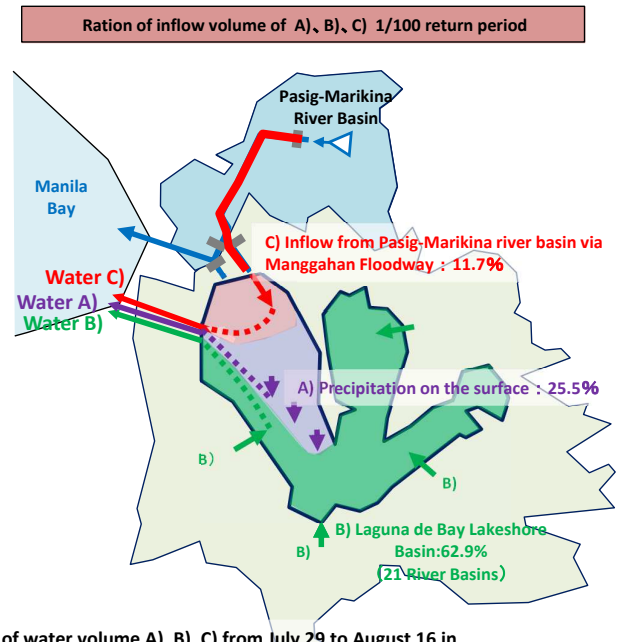
Water B): Inflow from lakeshore area of Laguna de Bay (21 river basins)

■Flowing from Other Basins

Water C): Water released from Pasig-Marikina river basin to Laguna de Bay via Manggahan floodway

Water C) through Manggahan Floodway can contribute to mitigate flood damage in Pasig-Marikina River Basin

The benefits created by the release of the Parañaque spillway are the sum of the benefits created by each of the above A), B) and C).



Ratio of water volume A), B), C) from July 29 to August 16 in 100-year Laguna Lake water level forecast results

Item	Water A)	Water B)	Water C)
Inflow Volume （MCM）	565	1,392	258
Ratio	25.5%	62.9%	11.7%

2.2.3 Result of Economic Evaluation of Parañaque Spillway

1） Economic Evaluation Results

In this 2020 follow-up study, EIRR was 18.6% to 23.1% as a result of reviewing the “Climate change adaptation”, “operation level and route”, “benefit generation area” and “additional economic benefit” of the Parañaque Spillway.

Table 2-2-3 Economic Evaluation Results
(Diameter of Parañaque Spillway is 13m and Tunneling Method is Shield)

Parañaque Spillway Route※1	Project Cost (million PHP)	NPV of B※2 (million PHP)			NPV of C (million PHP)	EIRR	B/C
		Pasig-Marikina Basin	Laguna Lake Shore	Total			
Route-1	75,959	47,953	21,651	69,586	26,013	18.9%	2.68
Revised Route-2-A	68,376	58,774	27,427	86,201	27,444	23.1%	3.14
Revised Route-2-B	67,771	58,363	27,427	85,790	27,397	23.1%	3.13
Route-3	84,454	51,968	21,651	73,619	29,030	18.6%	2.54

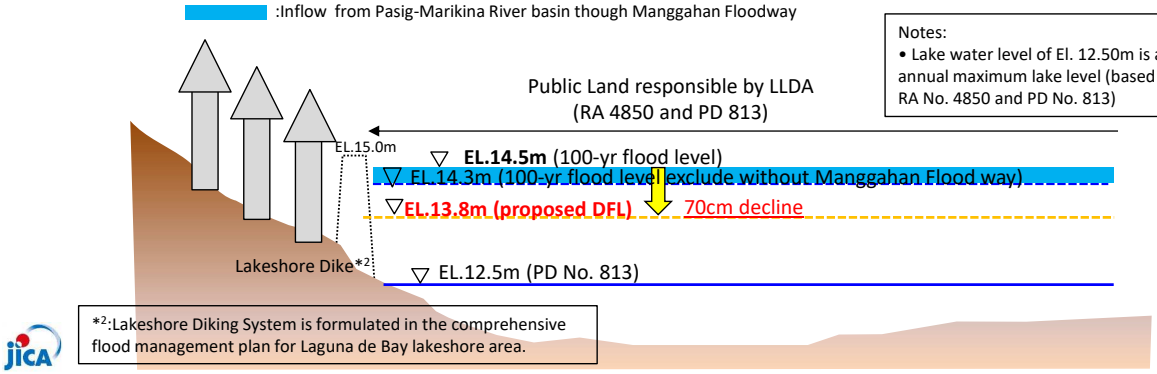
※1: Detail study of routes shall be executed in Feasibility Study
※2: Additional economic benefit items (household business suspension, fishery damage) were included
.

2.3 Improvement Effects other than Economic Evaluation

- At the time of the 1/100 probable flood, Laguna lakeshore area had a 20cm water level rise due to inflow from Manggahan Floodway (planned maximum discharge 2,400m³/s), but Parañaque Spillway (Diameter=13.0m,maximum discharge 240m³/s) eliminates this impact and has the effect of lowering the water level by 50cm (total 70cm decline).

Case	Parañaque Spillway	Manggahan Floodway	WL(m) 100yr flood
Initial	— without PSW	— without MFW	14.3
Current	— without PSW	✔ With MFW	14.5 (50cm decline)
With the Project	✔ with PSW	✔ With MFW	**13.8** (70cm*1 decline)

*1:Storage space of Laguna de Bay will be secured by pre-discharge through the Paranaque spillway prior to the water level raising period and the water level can be lowered by 90cm.

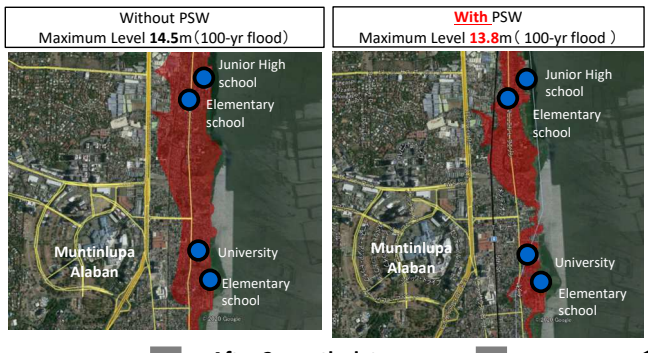


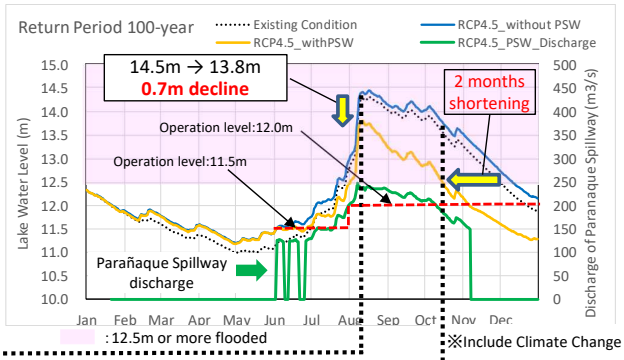
Notes:
• Lake water level of El. 12.50m is average annual maximum lake level (based on the RA No. 4850 and PD No. 813)

*2:Lakeshore Diking System is formulated in the comprehensive flood management plan for Laguna de Bay lakeshore area.

2.3 Improvement Effects other than Economic Evaluation

○Parañaque Spillway shortens the inundation period of 12.5 m or more by about 2 months and reduces economic and social damage. ※Reduced from 142 days to 75 days





After 2 months later

Without PSW Maximum Level:**13.8**m
(Flood Area:66.1km²
Affected people513,000)

With PSW Maximum Level **12.5**m
(Flood Area:0km²
Affected people zero)

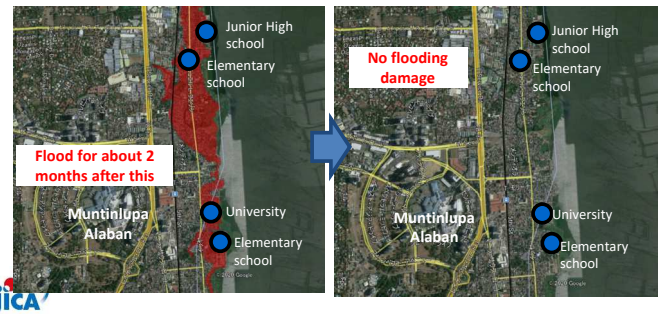
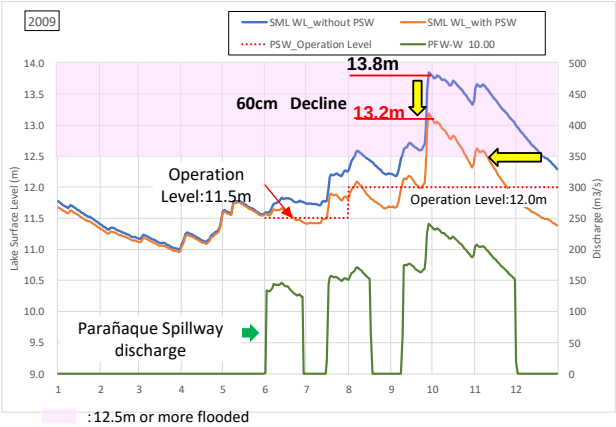


Table 2-3-1 Probable Lake Water Level (D=13m)

Return period	Existing Condition	Without project Climate Change RCP4.5	With PSW Climate Change RCP4.5
200	14.7	14.9	14.1
100	**14.3**	**14.5**	**13.8**
50	14.0	14.2	13.6
30	13.7	13.9	13.3
20	13.6	13.8	13.2
10	13.2	13.4	12.9
5	12.9	13.1	12.8
3	12.6	12.8	12.6
2	12.3	12.5	12.3

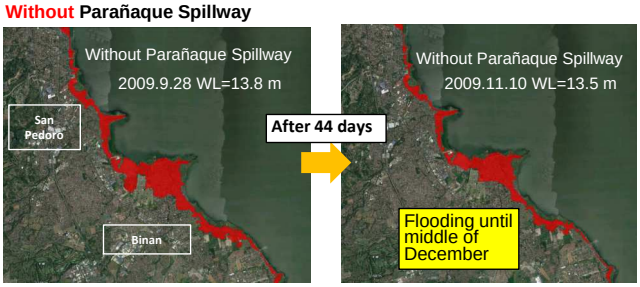
2.3 Improvement Effects Exclusive of Economic Evaluation

○Parañaque Spillway can shorten the inundation period of 12.5 m or more by about 2 months and reduces economic and social damage in 2009 Typhoon Ondoy.

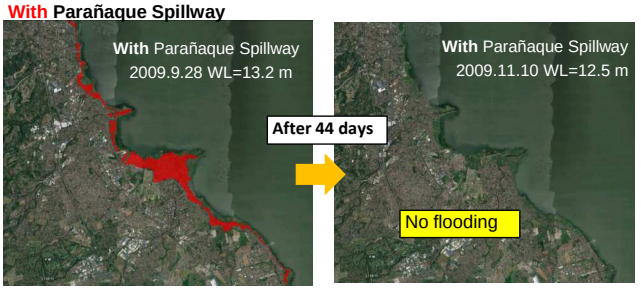


- The maximum lake water level will be decline from 13.8m to 13.2 (0.6m decline) with Parañaque Spillway.
- Inundation period (days) will be shorten 78 days (without PSW:110 days, with PSW:38 days)

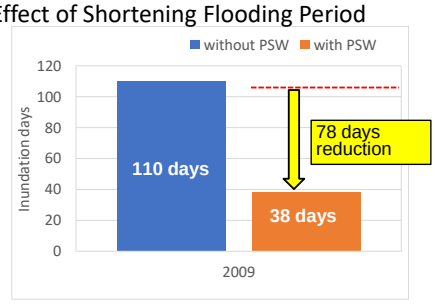
Without Parañaque Spillway



With Parañaque Spillway

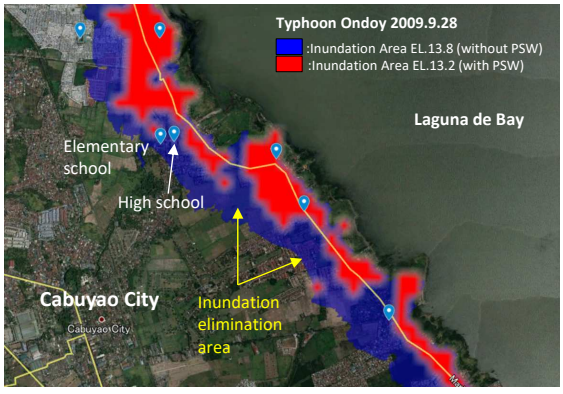


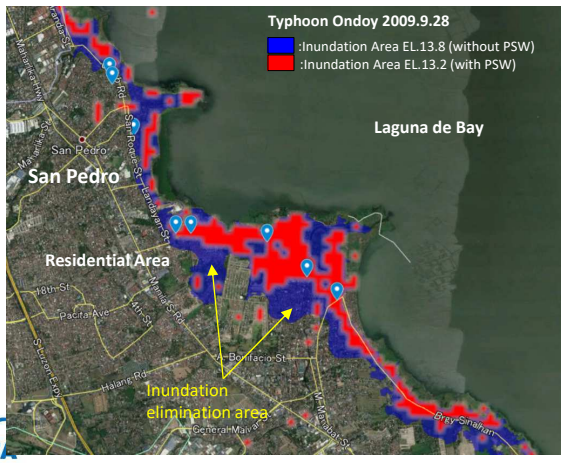
■ Effect of Shortening Flooding Period

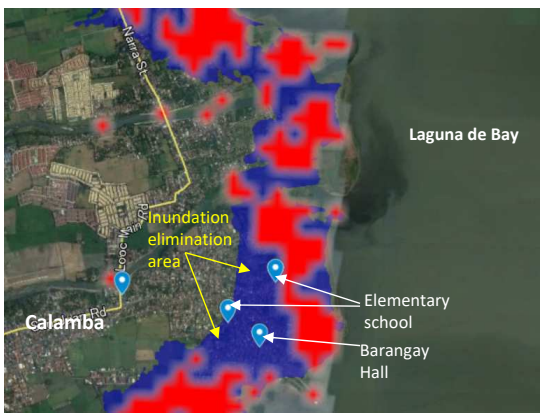


2.3 Improvement Effects Exclusive of Economic Evaluation

○In the case of Typhoon Ondoy, there are some areas where the Parañaque spillway can eliminate flood damage.







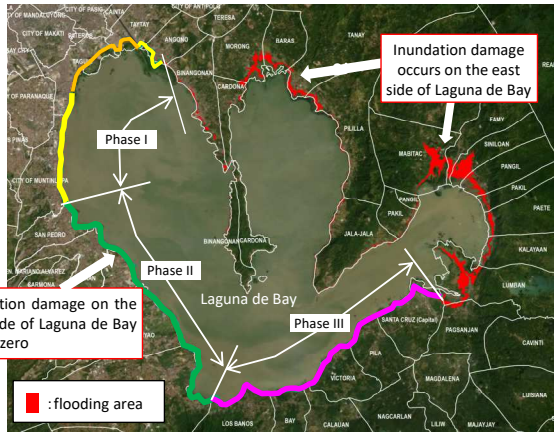
2.4 Inundation Allowable Area / Level

- Parañaque Spillway will contribute to reduce the inundation depth and shorten the inundation period on the lakeshore area, but it will not eliminate inundation damage.
- Also, if the Lakeshore Diking System is constructed (Phase I to Phase III), flooding in the constructed section will be zero, but inundation damage will occur on the east side of Laguna de Bay.
- Therefore, it is necessary to take measures not only for structural measures (hard measures) but also for non-structural measures (soft measures) in order to protect human lives and minimize inundation damage.

After Construction of Parañaque Spillway
100-yr flood WL：13.8m

Parañaque spillway will contribute to reduce the depth of inundation on the lakeshore area, shorten the period of inundation, and prevent inundation in some areas, but will not eliminate inundation damage in the entire area.

After Construction of Parañaque Spillway and Lakeshore Diking System
100-yr flood WL： 13.8m



2.4 Inundation Allowable Area / Level

Category	Stractural Measures	Non-stractural Measures	Allowable Area	Allowable Level
Priority Project	Paranaque Spillway	Strengthen early warning system, create / share flooded area map, etc.	・All areas are covered except the West Mangahan lakeshore dike Area	・Since lake water level with 100-year return period will be 13.8 m, housing, offices, schools, etc. less than 13.8 m will be inundated by up to 1.3 m. ・The maximum flooding period for a 100-year flood is 1.2 months (1.2 months of flooding at an altitude of 12.5 m).
Comprehensive Flood Control Plan (Draft)	Paranaque Spillway Lakeshore Dikng System	Strengthen early warning system, create / share flooded area map, etc.	・Areas where the lake bank system is not implemented ・Target LGUs are shown in Chapter 4 (4.6.3), 6th prioritize area and 7th prioritize area.	・In West Mangahan area and lakeshore diking system implemented area (Phase1 to Phase3), inundation damage will be zero until 100-year flood due to the effect of Paranaque spillway and lakeshore diking system. ・As shown in the priority project category, the east side of Laguna de Bay, where lakeshore diking system is not implemanted, has a maximum flooding period of approximately 1.2 months and a maximum flooding depth of 1.3 m during a 100-year flood.

2.4 Inundation Allowable Area / Level

- After construction of Parañaque Spillway, people affected by inundation can be mitigated from 930,000 to 513,000 (about 55%) and continuously after construction of Lakeshore Diking System (Phase I, II, III) people affected by inundation can be mitigated from 513,000 to 107,000 (about 12%).

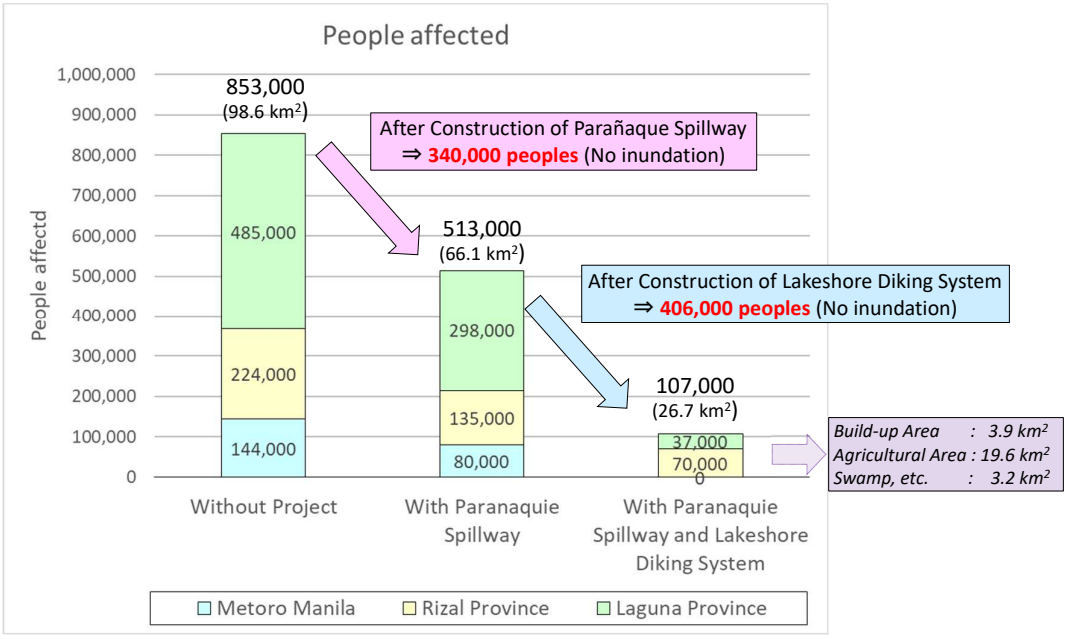


Figure 2-3-1 Analysis Results of Effect of Parañaque Spillway (D=13m) and Lakeshore Diking System (100-year, Including Climate Change)

2.4 Inundation Allowable Area / Level

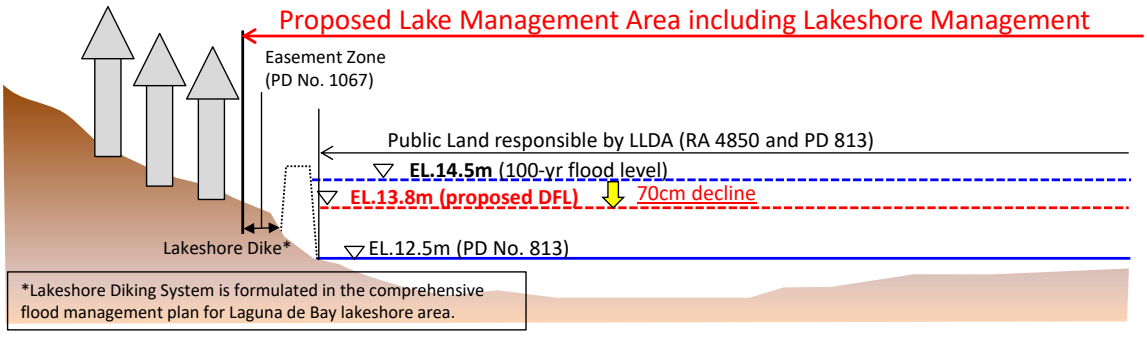
☐ Non-structural Measures

I. Lakeshore Management

- RA No. 4850 (1966) and PD No. 813 state that Laguna Lake below El. 12.50m is public land for management by LLDA.

II. Proposal of Establishing Lakeshore Management System

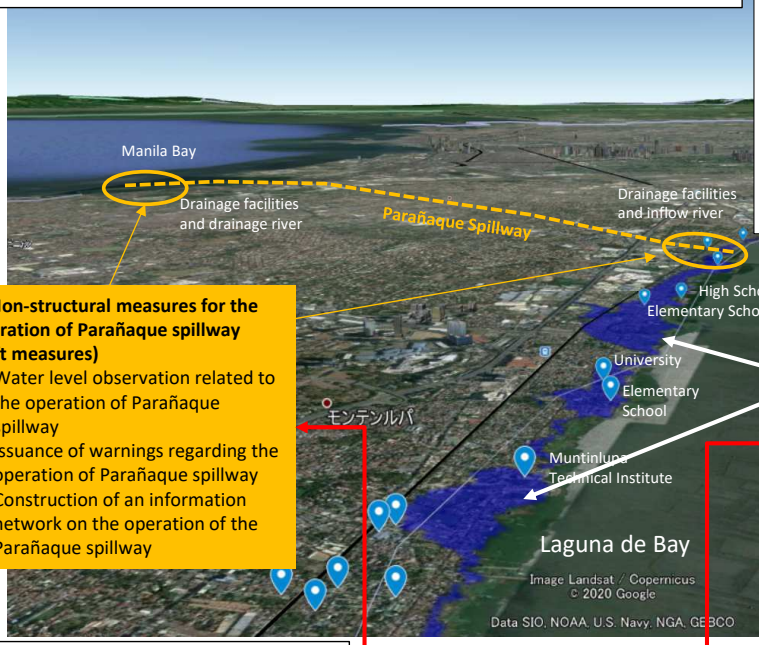
- Set the lakeshore dike elevation : El. 13.8m + free board (1.2m)
- Set easement zones from the Lakeshore bank (3m for urban area, 20m for agricultural area etc.)
- Manage between the easement zone to the other side of the Lake
- Lakeshore management is to be conducted by LLDA under cooperation by LGUs and the related agencies (DPWH, DENR, DA etc.).



Notes:
- Lake water level of El. 12.50m is average annual maximum lake level (based on the RA No. 4850 and PD No. 813)
- Easement zone: 3 m for urban area and 20 m for agricultural area (based on the PD No. 1067: Water Code)

2.4 Inundation Allowable Area / Level

Even after the Parañaque Spillway, the early warning system will be strengthened as a non-structural measure, and inundation area maps will be created and shared.



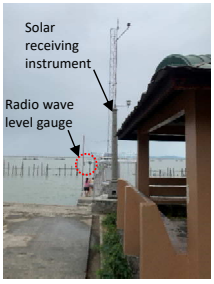
①Non-structural measures for the operation of Parañaque spillway (soft measures)

- Water level observation related to the operation of Parañaque spillway
- Issuance of warnings regarding the operation of Parañaque spillway
- Construction of an information network on the operation of the Parañaque spillway

After Construction Parañaque Spillway
100-yr Flood WL:13.8m

Information Sharing

Warning System for Lake Level Rise (existing)



- Warning system installed in 'Sucat People's Park' in Sucat, Muntinlupa.
- According to an on-site interview survey, it is managed by the city and installed last year (2019), and a warning is issued when Laguna Lake water level rises.

Source：Study Team（2020/02/13）

② Non-structural measures for raising Laguna lake water level

- Lake level observation
- Issuing a warning about the rising Laguna Lake water level
- Construction of information network
- Create and hazard map and share

Flood-related sign installation image

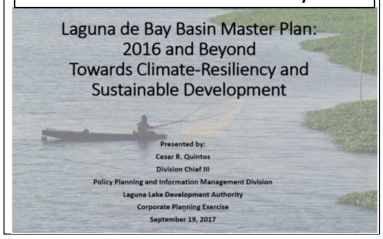
2.5 Comprehensive Flood Management Plan in Conservation and Sustainable Development of Laguna de Bay

- Laguna de Bay is variously utilized for irrigation water, hydropower generation, industrial water, resource of domestic water supply. Moreover, the lake is used for inland fishery, water transport etc.
- Due to expansion of Metro Manila, rapid increase in population and development in the lakeshore area causes the issues such as the decrease in lake water quality and increase in flood damage, etc.
- LLDA has updated a Master Plan in 1995; Master Plan: 2016 and beyond. In the updated Master Plan, the vulnerability of flood hazards and related health and economic risks is prioritized as the most critical for Laguna basin administrative authorities.
- Comprehensive Flood Management Plan including Parañaque Spillway meets the above and is positioned as the most important innovation to support safety and stability in people's life and economic activities along the lakeshore area. Moreover, the Master Plan can mitigate flood inundation in center of Metro Manila in combined operation with existing Mangahan Floodway.
- Increase in damages by natural disasters caused by climate change is a serious issue in order to aim the sustainable development. Parañaque Spillway is also very effective on the mitigation of increase in lake water level caused by climate change, resulting in reduction of flood damage.

Rapid Population Growth

Inland Fishery

Master Plan: 2016 and beyond



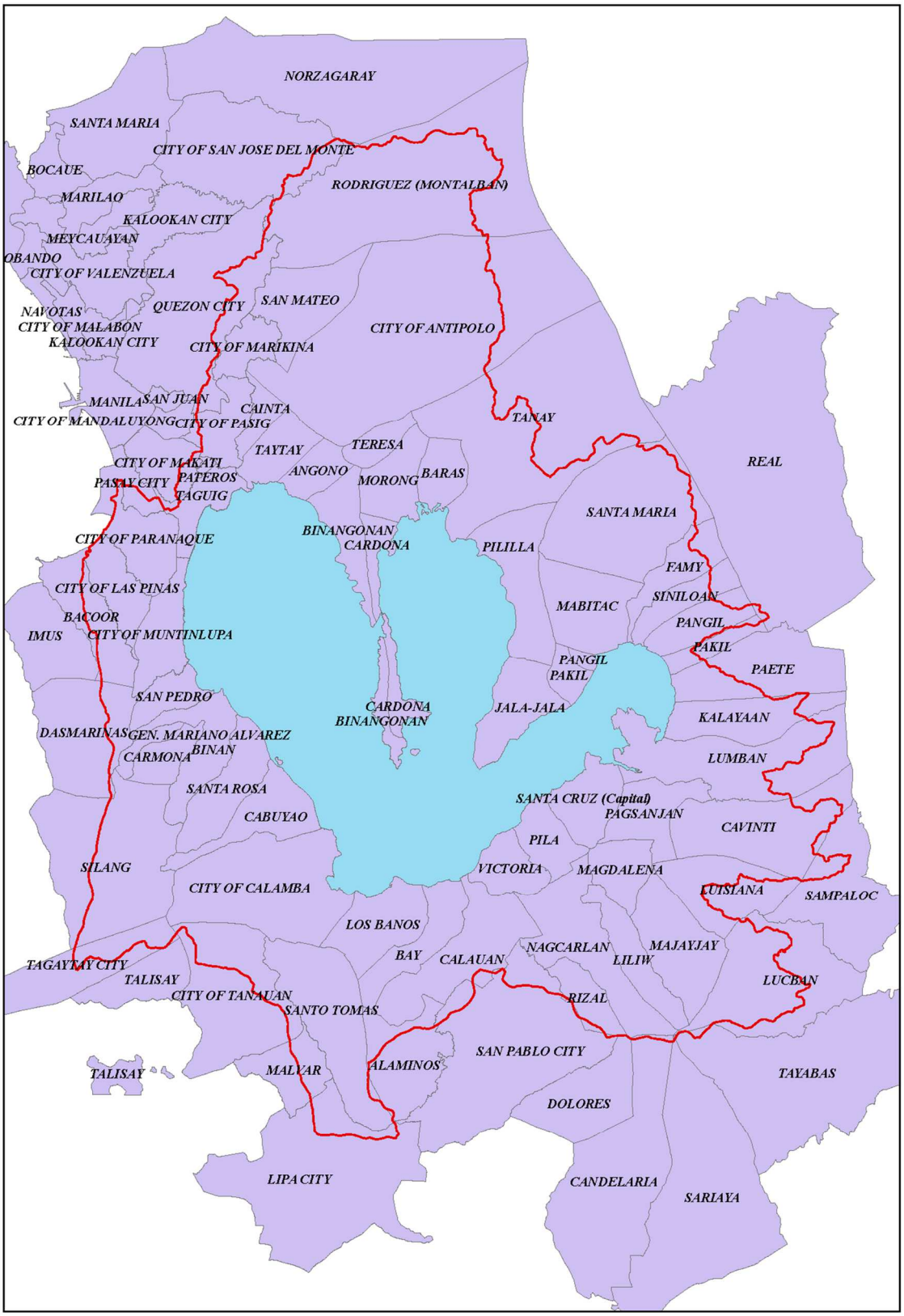
Source : LLDA

Appendix 2

Materials Related to Economic Analysis

Appendix 2-1 List of LGUs Subject to Flood Damage Analysis

ID	Province	Name of LGU	Population (2015 census)	Increase Rate (2015-20)	Population in 2020
1	NCR	CITY OF MUNTINLUPA	504,509	0.98%	529,719
2	NCR	TAGUIG	804,915	0.98%	845,136
3	LAGUNA	BAY	62,143	1.85%	68,108
4	LAGUNA	BINAN	333,028	1.85%	364,994
5	LAGUNA	CABUYAO	308,745	1.85%	338,380
6	LAGUNA	CALAUAN	80,453	1.85%	88,175
7	LAGUNA	CITY OF CALAMBA	454,486	1.85%	498,110
8	LAGUNA	FAMY	16,587	1.85%	18,179
9	LAGUNA	KALAYAAN	23,269	1.85%	25,503
10	LAGUNA	LOS BANOS	112,008	1.85%	122,759
11	LAGUNA	LUMBAN	30,652	1.85%	33,594
12	LAGUNA	MABITAC	20,530	1.85%	22,501
13	LAGUNA	PAETE	25,096	1.85%	27,505
14	LAGUNA	PAGSANJAN	42,164	1.85%	46,211
15	LAGUNA	PAKIL	20,659	1.85%	22,642
16	LAGUNA	PANGIL	24,274	1.85%	26,604
17	LAGUNA	PILA	50,289	1.85%	55,116
18	LAGUNA	SAN PEDRO	325,809	1.85%	357,082
19	LAGUNA	SANTA CRUZ (Capital)	117,605	1.85%	128,893
20	LAGUNA	SANTA ROSA	353,767	1.85%	387,724
21	LAGUNA	SINILOAN	38,067	1.85%	41,721
22	LAGUNA	VICTORIA	39,321	1.85%	43,095
23	RIZAL	ANGONO	113,283	2.08%	125,565
24	RIZAL	BARAS	69,300	2.08%	76,813
25	RIZAL	JALA-JALA	32,254	2.08%	35,751
26	RIZAL	MORONG	58,118	2.08%	64,419
27	RIZAL	PILILLA	64,812	2.08%	71,839
28	RIZAL	TANAY	117,830	2.08%	130,605
29	RIZAL	TAYTAY	319,104	2.08%	353,700
30	RIZAL	CARDONA	49,034	2.08%	54,350
31	RIZAL	BINANGONAN	282,474	2.08%	313,099
		Total	**4,894,585**		**5,317,892**


NORZAGARAY
SANTA MARIA
CITY OF SAN JOSE DEL MONTE
BOCAUE
RODRIGUEZ (MONTALBAN)
MARILAO
KALOOKAN CITY
MEYCAUAYAN
OBANDO
CITY OF VALENZUELA
QUEZON CITY
SAN MATEO
NAVOTAS
CITY OF MALABON
KALOOKAN CITY
CITY OF MARIKINA
CITY OF ANTIPOLO
MANILA
SAN JUAN
CAINTA
CITY OF MANDALUYONG
CITY OF PASIG
TAYTAY
TERESA
TANAY
REAL
CITY OF MAKATI
PATEROS
ANGONO
MORONG
BARAS
PASAY CITY
TAGUIG
SANTA MARIA
BINANGONAN
CARDONA
CITY OF PARANAQUE
PILILLA
FAMY
CITY OF LAS PINAS
SINILOAN
MABITAC
BACOOR
PANGIL
IMUS
CITY OF MUNTINLUPA
PAKIL
PANGIL
PAKIL
PAETE
SAN PEDRO
CARDONA
BINANGONAN
JALA-JALA
KALAYAAN
DASMARINAS
GEN. MARIANO ALVAREZ
BINAN
CARMONA
LUMBAN
SANTA ROSA
SANTA CRUZ (Capital)
PAGSANJAN
CABUYAO
CAVINTI
PILA
SILANG
VICTORIA
MAGDALENA
CITY OF CALAMBA
LUISIANA
SAMPALOC
LOS BANOS
NAGCARLAN
MAJAYJAY
BAY
CALAUAN
LILIW
TAGAYTAY CITY
TALISAY
LUCBAN
CITY OF TANAUAN
RIZAL
SANTO TOMAS
SAN PABLO CITY
TALISAY
MALVAR
ALAMINOS
TAYABAS
DOLORES
LIPA CITY
CANDELARIA
SARIAYA

Appendix 2-2 Damage to House and Household Goods by Height (PHP)

Economic Damage of Household Building and Asset (inc. indirect)

Elevation Range	Total	Metro Manila	Laguna	Rizal	1	2	3	4	5	6	7	8	9	10	11	12	13
					Metro Manila	Metro Manila	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna
					Taguig City	Muntinlupa City	San Pedro	Binan	Santa Rosa	Cabuyao	City of Calamba	Los Banos	Bay	Calauan	Victoria	Pila	Santa Cruz
<= 12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<= 12.6	183,605	18,232	118,340	47,034	9,939	8,293	2,933	41,960	6,057	10,350	3,969	5,806	7,594	0	7,025	1,694	22,669
<= 12.7	399,935	82,651	231,086	86,198	54,028	28,623	9,148	73,911	18,026	24,519	10,379	6,351	16,414	0	16,751	5,052	33,603
<= 12.8	1,082,305	155,419	678,296	248,589	100,786	54,633	22,686	224,414	46,796	63,768	24,359	25,154	42,026	235	44,229	9,828	117,318
<= 12.9	1,865,028	359,173	1,110,917	394,937	232,237	126,937	44,167	349,903	93,649	117,153	51,181	33,143	71,822	273	73,546	21,497	163,614
<= 13.0	2,707,126	487,819	1,647,919	571,388	318,235	169,584	72,371	494,505	139,758	190,896	68,984	45,605	95,676	1,075	105,386	28,954	244,782
<= 13.1	3,970,418	669,932	2,442,148	858,338	407,831	262,101	113,505	732,963	208,379	276,155	120,836	80,423	137,553	1,345	139,641	44,876	363,104
<= 13.2	5,520,093	1,065,531	3,271,723	1,182,838	654,813	410,718	186,698	928,365	270,717	437,356	163,268	91,106	178,811	1,865	183,545	71,406	441,811
<= 13.3	6,974,826	1,269,947	4,187,958	1,516,921	763,932	506,015	276,166	1,147,644	344,219	537,168	236,766	125,219	212,021	2,807	230,170	89,085	570,341
<= 13.4	8,670,091	1,680,447	5,108,611	1,881,033	1,028,594	651,852	389,332	1,369,764	405,344	675,107	297,903	155,791	236,059	2,887	258,467	111,883	672,074
<= 13.5	10,327,108	2,012,021	6,045,054	2,270,032	1,183,517	828,504	494,750	1,560,190	467,651	845,699	388,839	195,498	262,213	3,322	293,646	146,667	748,921
<= 13.6	13,022,914	2,427,081	7,650,938	2,944,895	1,384,987	1,042,094	652,927	1,937,889	576,430	1,050,476	507,636	257,203	322,284	3,692	368,704	193,625	973,724
<= 13.7	15,993,692	3,288,700	9,164,897	3,540,095	1,926,716	1,361,984	802,955	2,329,931	704,966	1,259,632	617,478	290,434	386,975	3,692	440,543	246,459	1,102,024
<= 13.8	18,898,502	3,759,754	10,978,660	4,160,087	2,152,672	1,607,082	970,290	2,749,705	865,437	1,478,147	751,453	353,511	435,517	4,930	519,654	302,175	1,327,380
<= 13.9	21,951,015	4,381,561	12,718,286	4,851,168	2,441,375	1,940,187	1,136,317	3,136,800	1,059,136	1,701,177	909,186	412,452	486,815	5,486	580,066	367,364	1,492,488
<= 14.0	25,382,625	5,142,737	14,642,647	5,597,241	2,831,007	2,311,731	1,338,652	3,476,056	1,232,832	2,040,699	1,038,446	471,053	554,342	7,224	631,894	458,169	1,651,929
<= 14.1	28,892,603	5,789,432	16,684,483	6,418,689	3,081,999	2,707,433	1,573,805	3,846,883	1,463,678	2,279,867	1,261,960	522,014	616,291	9,471	702,354	536,074	1,850,606
<= 14.2	32,581,887	6,783,904	18,644,657	7,153,326	3,653,378	3,130,526	1,848,310	4,257,669	1,675,830	2,534,027	1,445,649	570,029	657,554	12,079	757,278	598,241	2,009,334
<= 14.3	35,998,748	7,385,225	20,639,591	7,973,932	3,902,165	3,483,059	2,126,552	4,530,541	1,885,159	2,747,175	1,706,486	664,240	700,395	13,847	807,363	683,439	2,171,386
<= 14.4	39,564,092	8,152,651	22,558,792	8,852,649	4,274,856	3,877,795	2,395,011	4,745,661	2,096,667	2,998,281	1,957,642	716,991	744,067	19,034	873,918	756,166	2,325,864
<= 14.5	43,314,065	9,188,915	24,501,739	9,623,412	4,806,006	4,382,908	2,619,555	5,061,170	2,346,522	3,212,199	2,215,482	782,423	815,477	25,660	910,600	829,834	2,440,206
<= 14.6	48,870,572	10,183,373	27,763,740	10,923,460	5,189,560	4,993,813	2,864,180	5,796,994	2,708,961	3,561,538	2,496,092	895,415	951,000	34,868	1,028,754	930,064	2,860,202
<= 14.7	54,654,565	11,797,947	30,720,921	12,135,697	6,116,557	5,681,389	3,142,188	6,444,775	3,083,246	3,869,360	2,783,092	931,030	1,106,609	49,426	1,188,661	1,038,864	3,092,636

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Laguna	Rizal	Rizal	Rizal	Rizal	Rizal	Rizal	Rizal	Rizal	Rizal
Pagsanjan	Lumban	Kalayaan	Paete	Pakil	Pangil	Siniloan	Famy	Mabitac	Jalajala	Pililia	Tanay	Baras	Morong	Cardona	Binangonan	Angono	Taytay
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
454	1,009	0	4,477	169	1,893	0	0	280	358	334	8,362	1,677	318	2,263	13,398	4,625	15,698
645	2,775	0	7,791	794	1,893	86	0	2,949	5,320	3,147	15,450	2,387	2,959	2,747	16,942	8,149	29,098
1,798	6,622	0	27,198	3,058	8,745	4,835	1,257	3,969	7,947	6,304	43,427	7,241	5,460	9,046	61,031	25,719	82,415
3,661	13,728	0	37,379	5,250	9,874	5,243	1,311	14,523	22,973	13,948	65,494	9,790	13,621	12,392	93,244	38,583	124,892
3,661	20,096	227	65,534	9,909	16,437	21,320	5,166	17,578	28,288	22,534	105,327	14,600	19,767	14,304	123,256	68,720	174,592
8,568	32,251	500	85,932	15,486	23,321	24,026	5,519	27,766	36,964	25,278	137,873	20,718	26,018	26,661	219,914	103,010	261,901
9,571	54,991	1,455	118,834	17,517	27,349	39,971	7,673	39,415	51,433	40,080	220,742	32,529	41,392	30,479	249,114	162,585	354,485
12,073	70,392	2,146	156,755	31,195	34,805	56,396	11,615	40,973	66,083	48,815	256,616	36,702	53,958	37,984	311,490	224,063	481,210
16,857	112,027	3,107	181,340	34,715	43,584	76,570	13,502	52,296	77,026	56,528	303,945	48,626	72,404	48,772	401,226	278,360	594,146
21,035	134,210	3,589	214,793	35,823	56,951	94,494	17,260	59,500	96,562	68,826	383,349	59,111	89,488	54,018	469,821	355,383	693,472
25,369	174,885	4,168	268,313	45,690	81,730	118,479	19,503	68,213	108,551	78,803	479,615	85,196	104,202	78,379	610,109	453,695	946,346
30,354	228,878	4,971	317,494	50,476	90,154	151,139	22,897	83,443	141,433	105,378	561,060	95,971	139,014	92,254	707,590	540,009	1,157,387
35,824	278,360	5,146	382,697	62,860	116,037	218,785	32,706	88,049	174,564	130,689	656,501	110,948	166,150	103,329	845,303	634,956	1,337,649
46,832	341,832	5,146	415,350	69,118	139,570	257,492	38,367	117,292	198,617	153,715	735,019	134,023	190,721	128,463	1,059,677	722,837	1,528,096
56,334	414,194	6,987	477,503	74,229	161,630	374,734	45,710	130,028	224,275	183,522	898,767	163,082	215,117	142,189	1,155,982	860,422	1,753,885
61,770	488,071	10,050	525,366	100,749	186,828	459,676	51,168	137,803	250,187	222,172	974,632	182,555	236,118	166,746	1,295,016	1,029,909	2,061,352
72,999	604,570	13,864	568,700	108,813	201,131	509,102	59,234	140,245	271,232	248,441	1,064,852	203,820	284,223	184,887	1,447,093	1,127,435	2,321,342
88,665	684,728	21,022	618,471	120,665	251,662	601,247	67,310	149,239	334,798	297,074	1,182,590	233,674	323,502	205,365	1,618,727	1,228,069	2,550,134
94,002	777,992	26,749	647,447	137,680	308,384	685,221	79,224	172,792	357,868	333,629	1,273,655	279,146	351,054	231,410	1,785,771	1,363,053	2,877,063
108,069	862,446	36,721	680,152	146,686	362,740	774,364	88,789	182,646	372,870	368,630	1,339,410	290,090	398,423	255,018	1,964,551	1,470,453	3,163,966
125,355	955,000	48,453	774,009	162,411	438,653	832,717	96,282	202,790	400,191	420,762	1,522,304	343,136	431,698	300,352	2,286,355	1,600,791	3,617,872
142,970	1,050,072	60,692	849,719	189,409	470,356	867,565	109,270	250,980	477,020	515,480	1,668,749	370,911	504,307	327,799	2,547,095	1,705,938	4,018,398

Economic Damage of Industorial Asset (inc. indirect)

Elevation Range	Total	Metro Manila	Laguna	Rizal	1 Metro Manila Taguig City	2 Metro Manila Muntinlupa City	3 Laguna San Pedro	4 Laguna Binan	5 Laguna Santa Rosa	6 Laguna Cabuyao	7 Laguna City of Calamba	8 Laguna Los Banos	9 Laguna Bay	10 Laguna Calauan	11 Laguna Victoria	12 Laguna Pila	13 Laguna Santa Cruz
<= 12.5	**0**	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0
<= 12.6	**537,095**	**23,362**	**340,138**	**173,594**	442	22,920	12,351	71,363	14,068	40,897	15,770	18,525	32,225	0	18,388	8,552	45,737
<= 12.7	**1,098,096**	**78,405**	**682,700**	**336,991**	2,408	75,997	35,574	128,176	34,924	91,992	33,284	21,842	72,466	0	43,278	26,349	76,024
<= 12.8	**1,839,332**	**93,421**	**1,226,779**	**519,132**	3,393	90,027	52,710	208,630	64,735	161,813	52,888	44,112	108,717	815	70,998	30,156	154,634
<= 12.9	**2,509,623**	**162,210**	**1,655,653**	**691,760**	4,388	157,821	75,310	288,864	95,681	236,392	84,128	63,217	148,861	953	85,230	46,440	201,983
<= 13.0	**3,508,253**	**237,263**	**2,283,723**	**987,267**	5,842	231,421	117,005	356,927	124,687	416,255	108,431	68,660	187,948	1,707	106,602	74,522	254,585
<= 13.1	**5,054,286**	**333,801**	**3,204,862**	**1,515,623**	7,186	326,615	193,591	504,430	169,659	559,604	163,670	106,987	257,241	2,303	146,661	102,615	348,847
<= 13.2	**6,633,395**	**474,163**	**4,135,839**	**2,023,393**	12,577	461,586	297,700	645,660	205,926	745,379	208,623	126,730	315,712	2,345	184,955	139,378	432,957
<= 13.3	**8,335,684**	**548,973**	**5,260,393**	**2,526,318**	14,305	534,668	379,137	790,258	258,395	947,939	293,790	189,301	365,129	3,213	233,616	171,708	552,415
<= 13.4	**10,204,874**	**686,753**	**6,405,261**	**3,112,859**	17,041	669,712	494,239	906,572	313,576	1,199,144	389,464	236,033	410,723	3,354	267,410	228,405	653,016
<= 13.5	**12,327,379**	**897,818**	**7,690,157**	**3,739,404**	20,695	877,122	594,716	1,058,528	369,912	1,517,325	478,664	263,580	472,584	4,076	294,253	305,675	726,529
<= 13.6	**15,661,763**	**1,150,985**	**9,744,990**	**4,765,789**	23,427	1,127,558	752,780	1,374,176	468,895	1,864,708	634,676	335,862	589,804	4,677	368,306	425,680	913,977
<= 13.7	**18,857,202**	**1,446,371**	**11,673,479**	**5,737,353**	32,453	1,413,917	949,382	1,666,608	576,196	2,206,223	741,819	384,063	699,797	4,677	451,256	553,423	1,065,091
<= 13.8	**22,540,922**	**1,619,393**	**14,165,127**	**6,756,401**	36,749	1,582,645	1,128,483	1,948,088	694,781	2,596,772	886,041	498,792	808,126	6,409	533,762	694,968	1,331,516
<= 13.9	**26,481,218**	**1,953,683**	**16,595,027**	**7,932,508**	42,054	1,911,629	1,335,909	2,234,256	848,870	3,054,203	1,081,951	578,594	928,297	8,166	607,117	841,971	1,564,213
<= 14.0	**30,954,735**	**2,398,986**	**19,405,710**	**9,150,039**	49,054	2,349,932	1,572,373	2,543,036	1,000,096	3,691,415	1,247,187	635,919	1,062,301	11,930	672,798	1,011,622	1,778,075
<= 14.1	**35,342,355**	**2,786,746**	**22,049,021**	**10,506,587**	52,645	2,734,101	1,852,291	2,850,103	1,158,724	4,148,267	1,470,890	705,129	1,172,766	14,728	738,410	1,188,691	2,000,822
<= 14.2	**39,406,328**	**3,148,416**	**24,458,511**	**11,799,401**	62,355	3,086,060	2,151,842	3,185,532	1,288,099	4,580,571	1,629,612	785,855	1,249,833	18,481	803,256	1,337,702	2,205,991
<= 14.3	**43,839,687**	**3,481,489**	**27,184,958**	**13,173,239**	67,601	3,413,888	2,430,274	3,416,091	1,423,702	5,032,955	1,884,326	918,395	1,348,295	21,407	866,829	1,539,369	2,425,526
<= 14.4	**48,685,001**	**3,861,406**	**30,019,276**	**14,804,320**	74,580	3,786,826	2,741,270	3,597,873	1,591,643	5,584,987	2,123,972	1,002,312	1,424,358	31,620	943,137	1,704,757	2,684,416
<= 14.5	**53,382,636**	**4,412,180**	**32,837,274**	**16,133,182**	84,197	4,327,983	3,032,250	3,916,419	1,753,768	6,050,020	2,342,821	1,083,171	1,540,075	47,898	980,144	1,876,169	2,870,428
<= 14.6	**58,942,841**	**4,921,518**	**36,323,338**	**17,697,985**	89,491	4,832,027	3,321,963	4,313,848	1,977,540	6,595,088	2,645,139	1,182,125	1,690,624	61,203	1,057,068	2,120,562	3,210,274
<= 14.7	**64,142,495**	**5,427,969**	**39,454,025**	**19,260,501**	99,310	5,328,659	3,622,833	4,709,058	2,216,450	7,029,200	2,864,457	1,276,007	1,851,314	80,292	1,172,432	2,351,566	3,465,430

14 Laguna Pagsanjan	15 Laguna Lumban	16 Laguna Kalayaan	17 Laguna Paete	18 Laguna Pakil	19 Laguna Pangil	20 Laguna Siniloan	21 Laguna Famy	22 Laguna Mabitac	23 Rizal Jalajala	24 Rizal Pililia	25 Rizal Tanay	26 Rizal Baras	27 Rizal Morong	28 Rizal Cardona	29 Rizal Binangonan	30 Rizal Angono	31 Rizal Taytay
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,533	1,956	0	50,288	2,766	3,362	0	0	1,358	1,553	3,193	20,432	2,828	3,863	13,020	28,107	22,247	78,352
3,238	5,721	0	88,092	6,247	3,362	5,953	0	6,177	12,375	26,241	36,105	3,891	23,086	14,409	37,666	38,005	145,213
3,401	8,329	0	179,437	26,058	8,885	41,098	1,582	7,781	15,461	54,093	53,331	4,955	36,731	18,729	57,508	65,971	212,352
11,465	18,096	0	202,158	27,885	10,782	43,900	1,655	12,655	23,788	67,426	61,543	6,989	56,160	28,488	101,410	82,809	263,147
11,473	25,583	1,101	291,428	29,175	14,516	75,622	2,571	14,925	28,067	97,282	117,833	12,506	78,698	29,566	117,687	144,180	361,448
19,539	39,917	2,302	410,018	53,028	18,053	86,931	2,845	16,621	38,167	105,735	153,158	17,179	103,888	63,440	180,633	224,472	628,951
23,122	54,318	4,211	509,396	59,991	20,571	133,490	3,500	21,873	53,704	143,756	198,210	23,026	152,005	74,312	225,875	299,978	852,527
28,956	73,212	4,286	643,776	82,510	29,406	183,564	6,055	23,726	72,251	195,040	245,860	25,801	192,466	82,781	294,368	385,503	1,032,249
40,868	110,622	4,400	723,433	90,555	42,216	254,605	6,891	29,734	82,314	225,017	287,503	38,069	233,358	99,649	393,124	461,877	1,291,948
45,263	140,233	5,521	863,647	90,636	55,152	363,221	8,452	32,191	90,710	270,091	362,829	44,668	272,038	109,903	459,206	585,026	1,544,934
56,555	196,394	6,744	1,072,272	118,097	69,263	445,908	9,168	37,046	106,669	294,810	449,942	56,058	316,856	162,492	605,110	745,751	2,028,103
69,235	244,654	8,618	1,257,435	128,807	74,589	530,857	11,231	49,519	138,995	377,732	547,302	68,223	400,878	183,054	706,236	867,742	2,447,192
82,687	311,114	9,476	1,523,300	177,926	98,480	763,620	16,717	54,067	171,195	476,831	655,652	79,857	468,460	207,711	837,708	1,027,315	2,831,671
107,308	396,697	9,476	1,624,958	194,262	121,518	970,295	19,428	67,539	196,959	542,090	727,425	99,485	542,858	245,714	1,030,521	1,241,962	3,305,493
126,635	501,536	12,838	1,855,200	197,380	148,154	1,242,047	22,747	72,419	217,543	635,437	891,192	115,368	633,602	266,666	1,139,362	1,455,680	3,795,190
141,361	611,674	20,840	2,081,621	246,467	173,842	1,370,343	24,113	77,939	253,191	681,535	988,732	131,609	700,647	328,826	1,313,760	1,655,872	4,452,415
157,169	712,850	28,657	2,244,774	259,516	189,909	1,517,627	29,101	82,135	276,899	744,521	1,113,479	150,540	793,710	371,131	1,479,456	1,824,672	5,044,992
184,681	851,802	34,404	2,377,845	274,190	243,255	1,787,588	34,662	89,364	322,634	830,463	1,262,164	168,702	906,070	411,187	1,659,286	2,025,688	5,587,045
200,663	987,204	38,785	2,514,025	311,972	298,628	2,093,482	40,392	103,778	340,233	908,018	1,371,879	201,968	981,463	437,463	1,878,217	2,287,813	6,397,265
247,022	1,122,057	44,865	2,654,878	326,463	350,264	2,439,448	43,750	115,366	363,350	1,001,740	1,469,274	208,021	1,082,951	472,530	2,065,825	2,480,264	6,989,226
281,430	1,274,045	57,884	2,910,183	338,204	399,476	2,702,908	46,260	137,517	391,631	1,080,720	1,621,593	232,614	1,163,638	531,599	2,327,470	2,670,566	7,678,155
317,274	1,409,950	66,228	3,109,425	375,003	435,682	2,886,653	53,719	161,053	440,676	1,194,079	1,777,718	254,661	1,277,805	564,977	2,560,684	2,805,833	8,384,067

Appendix 2-4 Number of Establishments by Sector

Procince	LGU	C C - Manufacturing	F F - Construction	G G - Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	H H - Transport and Storage	I I - Accommodation and Food Service Activities	J J - Information and Communication	K K - Financial and Insurance Activities	L L - Real Estate Activities	P P - Education	Q Q - Human Health and Social Work Activities	R R - Arts, Entertainment, and Recreation	S S - Other Service Activities	Total
Total		9,324	607	32,645	793	10,431	4,138	4,130	1,888	2,009	2,939	916	6,217	76,037
Share		12%	1%	43%	1%	14%	5%	5%	2%	3%	4%	1%	8%	100%
NCR	Makati City	1,018	186	4,952	255	2,214	798	1,410	882	324	666	121	1,156	13,982
NCR	Muntinlupa City	444	62	2,617	62	632	216	286	82	146	222	55	362	5,186
NCR	Pasig City	1,051	146	4,467	126	1,189	511	649	374	270	424	139	752	10,098
NCR	Pateros	114	5	211	7	75	41	47	2	19	44	19	60	644
NCR	Taguig City	747	25	3,099	61	984	335	322	100	184	248	73	670	6,848
Rizal	Angono	179	4	700	4	202	78	46	22	33	76	23	136	1,503
Rizal	Baras	51	1	168	0	50	23	6	3	6	7	4	27	346
Rizal	Cainta	595	26	2,056	22	660	228	135	31	120	193	87	574	4,727
Rizal	Jalajala	26	0	88	0	31	16	3	1	8	2	3	14	192
Rizal	Morong	98	1	238	1	77	39	30	6	17	30	13	53	603
Rizal	Pililia	79	2	224	1	80	29	5	15	13	5	8	33	494
Rizal	Tanay	184	3	849	6	220	68	70	78	32	60	23	119	1,712
Rizal	Taytay	1,136	39	2,009	21	560	263	106	47	95	157	60	384	4,877
Rizal	Cardona	65	0	164	0	39	18	5	8	7	6	7	26	345
Rizal	Binangonan	239	9	1,232	7	317	129	73	2	60	62	20	168	2,318
Laguna	Bay	100	5	342	0	106	49	10	3	20	13	6	38	692
Laguna	Binan	456	8	938	51	202	114	89	28	68	64	24	164	2,206
Laguna	Cabuyao	394	15	1,502	41	308	202	76	59	103	81	27	239	3,047
Laguna	Calauan	39	0	154	1	32	13	15	0	8	10	2	16	290
Laguna	City of Calamba	736	24	1,854	51	1,095	233	215	51	139	146	74	364	4,982
Laguna	Famy	5	0	32	0	7	0	1	0	1	0	0	3	49
Laguna	Kalayaan	25	0	65	0	23	10	1	0	2	1	5	5	137
Laguna	Los Banos	100	2	485	7	241	61	65	23	36	37	10	80	1,147
Laguna	Lumban	144	2	117	0	29	42	8	1	5	2	2	17	369
Laguna	Mabitac	20	0	19	3	13	1	3	1	1	0	2	1	64
Laguna	Paete	80	0	164	0	43	25	14	0	6	7	5	22	366
Laguna	Pagsanjan	58	0	146	4	58	17	16	1	9	10	3	22	344
Laguna	Pakil	28	0	48	0	29	12	4	0	3	8	3	9	144
Laguna	Pangil	22	0	44	0	15	19	2	0	3	0	0	4	109
Laguna	Pila	70	2	181	0	45	27	8	3	10	21	3	28	398
Laguna	San Pedro	455	18	1,180	24	297	281	138	32	117	136	40	278	2,996
Laguna	Santa Cruz	128	2	719	6	150	60	94	5	33	50	12	84	1,343
Laguna	Santa Rosa	340	19	1,061	31	347	130	143	28	100	123	37	260	2,619
Laguna	Siniloan	61	1	377	1	41	24	28	0	5	27	5	31	601
Laguna	Victoria	37	0	143	0	20	26	7	0	6	1	1	18	259

Appendix 2-5 Crop Area of Each Crop, Harvest Volume, Price

Crop	Country		Laguna		Rizal		Farmgate Price (2017)
	Production (ton)	Area (ha)	Production (ton)	Area (ha)	Production (ton)	Area (ha)	(PHP/kg)
Palay	**18,967,826**	**4,739,672**	**130,904**	**30,619**	**27,243**	**8,073**	**10.46**
- Irrigated Palay	14,405,716	3,253,080	130,383	30,370	22,107	6,428	
- Raifed Palay	4,562,110	1,486,592	521	249	5,136	1,645	
Corn	**7,770,603**	**2,611,432**	**2,249**	**1,007**	**1,660**	**551**	**9.32**
- White Corn	2,262,234	1,290,213	1,455	797	759	363	
- Yellow Corn	5,508,369	1,321,219	794	210	901	188	
Major Cereal 'Total		**7,351,104**		**31,626**		**8,624**	
Coconut	14,696,298	3,502,011	96,110	62,200	720	270	7.84
Coffee	75,454	117,451	81	620	82	60	30.01
Sugarcane	25,029,880	432,026	11,250	146	0	0	**3.28**
Banana	8,884,857	442,751	15,867	6,642	3,347	2,042	9.99
Calamansi	160,740	20,065	360	420	719	72	19.94
Mango	885,038	188,092	557	187	1,241	813	25.16
Pinapple	2,507,098	61,643	12,670	1,020	513	42	12.03
Sweet Potato	519,855	88,968	1,125	157	751	96	14.99
Cassava	2,540,254	216,775	1,970	150	938	110	6.29
Eggplant	225,579	21,159	1,759	159	592	70	24.23
Peanut	29,196	25,048	19	9	38	56	31.33
Tomato	214,573	16,742	6,573	520	159	23	16.48
Other Crops Total		**5,186,574**		**72,284**		**3,661**	
Total		**12,537,678**		**103,910**		**12,285**	

Note: Price of Sugarcane is converted from the price of sugar price

Source : MAJOR CROPS STATISTICS OF THE PHILIPPINES, 2010-2014, PSA

添付資料 2-6 Economic Price Calculation of Rice and Corn

	Import Parity		
	Operation	US$/ton	PHP/Kg
1. Price Forecast of rice, Bangkok, Thailand, f.o.b.		344.0	
2. Quality Adjustment 95 (10% broken)		326.8	
3. Insurance, freight, etc.		30.0	
4. Forecast 2017 c.i.f. price of rice, Manila		356.8	
			18.36
5. Port handling, storage and losses	5% +		0.92
6. Transportation (port to wholesaler)	+		1.00
7. Ex-wholesaler price			20.28
8. Merketing Margin	10% -		2.03
9. Local transportation (village to wholesaler)	-		1.00
10. Value of Milled Rice			17.25
11. Conversion of Paddy	65%		11.21
12. Milling Cost	-		0.50
13. Revenue of Rice Bran	+		0.75
14. Transportation and Stabilization of Rice Bran	-		0.50
15. Local transportation (farm to village)	-		0.50
16. Economic farm gate price			**10.46**

1.Thai 5% broken rice, price forecast in nominal US$ in 2030, converted to 2017 constant price (Source: Commodity Market Outlook, April 2017, World Bank)

- Projection in 2030 440 USD/ton
- MUV index 2017-2030 1.280 USD/ton
- Projection in 2030 by constant price in 2017 344 USD/ton

4.1US$=51,45PHP (Oct./2017)

11.Milling recovery is assumed at 65% for paddy

Economic Price Calculation of Corn

	Import Parity		
	Operation	US$/ton	IDR/Kg
1. Price Forecast of maize, Gulf Ports, USA, f.o.b.		164.0	
2. Insurance, freight, etc.		40.0	
3. Forecast 2017 c.i.f. price of maize, Jakarta		204.0	
			10.50
4. Port handling, storage and losses	5% +		0.52
5. Transportation (port to wholesaler)	+		1.00
6. Ex-wholesaler price			12.02
7. Merketing Margin	10% -		1.20
8. Local transportation (village to wholesaler)	-		1.00
9. Local transportation (farm to village)	-		0.50
10. Economic farm gate price			**9.32**

1.USA maize, forecast in nominal US$ in 2030, converted to 2017 constant price (Source: Commodity Market Outlook, April 2017, World Bank)

- Projection in 2030210 USD/ton
- MUV index 2017-2030 1.280 USD/ton
- Projection in 2030 by constant price in 2017 164 USD/ton

4.1US$=51,45PHP (Oct./2017)

Appendix 3

Materials Related to Compensation Costs

Appendix 3-1 Compensation Cost for Land Acquisition for Development of Paranaque Spillway

Table Compensation Cost for Land Acquisition for Development of Paranaque Spillway

Case (Route)	Facility	Location		a. Area			b. Zonal Value		c. Market Value	d. Cost for land acquisition		e. Number of buildings	f. Unit cost of residential building	g. Replacement cost for residential buildings	h. Total cost for compensation	
		City	Barangay	a1. Length	a2. Width	a3. Area				in case of ZV	in case of MV				in case of ZV	in case of MV
				(m)	(m)	(m2)	(PhP./m2)	Year	(PhP./m2)	(million PhP.)	(million PhP.)	No.	(PhP.)	(million PhP.)	(million PhP.)	(million PhP.)
1. Lower Bicutan - Paranaque R.	Open Channel	Taguig	Lower Bicutan	1,200	83	99,346	9,464	2019	11,357	940	1,128	280	903,411	253	1,231	1,427
	Shaft (Departi	Taguig	Lower Bicutan	80	50	4,000	9,464	2019	11,357	38	45					
	Shaft (Arrival)	Paranaque	San Dionisio			1,000	15,772	2018	18,926	16	19	0	903,411	0	16	19
	Total	-	-	-	-	104,346	-	-	-	**994**	**1,193**	280	-	**253**	**1,247**	**1,446**
3. Sucat - Zapote R.	Open Channel	Muntinlupa	Sucat	600	83	49,673	24,905	2019	29,886	1,237	1,485	290	903,411	262	1,599	1,866
	Shaft (Departi	Muntinlupa	Sucat	80	50	4,000	24,905	2019	29,886	100	120					
	Shaft (Arrival)	Las Pinas	Pulang Lupa Uno			1,000	13,168	2017	15,802	13	16	0	903,411	0	13	16
	Total	-	-	-	-	54,673	-	-	-	**1,350**	**1,620**	290	-	**262**	**1,612**	**1,882**

Note)

a1. Width of land acquisition is the width of channel plus additional 12m necessary for acquisition of marginal areas of residential lot.

b. Zonal Value (ZV) provided by BIR (Bureau of Internal Revenue) , specifically average value of ZV in the barangay in question.

c. Market Value (MV) is calculated as 1.2 times as large as ZV for consistency with the case of Master Plan of this Project.

d. Average cost for land acquisition = a * b, or a * c

f. Data of average cost for construction of residential building (house) listed in a statistical book considering inflation.

h. Total cost for compensation = d + g

Appendix 3-2 Compensation Cost for Tunnel Section under Private Land of Paranaque Spillway Route 2-A

Table Compensation Cost for Tunnel Section (< 50m below ground level) under Private Land of Paranaque Spillway (Case 2-A)

Site	Location		a. Area			b. Zonal Value		c. Market Value	d. Value of land		e. Cost for compensation	
	City	Barangay	a1. Length	a2. Width	a3. Area				in case of ZV	in case of MV	in case of ZV	in case of MV
			(m)	(m)	(m2)	(PhP./m2)	Year	(PhP./m2)	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)
Tunnel section/ Laguna Lake side (Sucat)	Muntinlupa	Sucat	200	15.5	3,100	24,905	2019	29,886	77	93	15	19
Tunnel section/ Manila Bay side (San Dionisio River)	Paranaque	San Dionisio	320	15.5	4,960	33,580	2018	40,296	167	200	33	40
Total	-		**520**	-	**8,060**	-	-	-	**244**	**293**	**49**	**59**

Note)

a1. Length of tunnel under private land calculated on Google Earth.

a2. Width of perpetual easement is the width of tunnel (13.5m) + 2.0m of buffer area.

b. Zonal Value (ZV) provided by BIR (Bureau of Internal Revenue) , specifically average value of ZV in the barangay in question.

c. Market Value (MV) is calculated as 1.2 times as large as ZV for consistency with the case of Master Plan of this Project.

d. Lavue of land lot = a * b, or a * c

e. Compensation cost for perpetual easement for tunnel construction under private land. Compensation for structures, improvement, corps or trees are not considered.

Appendix 3-3 Compensation Cost for Tunnel Section under Private Land of Paranaque Spillway Route ルート2-B

Table Compensation Cost for Tunnel Section (< 50m below ground level) under Private Land of Paranaque Spillway (Case 2-B)

Site	Location		a. Area			b. Zonal Value		c. Market Value	d. Value of land		e. Cost for compensation	
	City	Barangay	a1. Length	a2. Width	a3. Area				in case of ZV	in case of MV	in case of ZV	in case of MV
			(m)	(m)	(m2)	(PhP./m2)	Year	(PhP./m2)	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)
Tunnel section/ Laguna Lake side (Sucat)	Muntinlupa	Sucat	200	15.5	3,100	24,905	2019	29,886	77	93	15	19
Tunnel section/ Manila Bay side (Zaopote River)	Paranaque	San Dionisio	670	15.5	10,385	33,580	2018	40,296	349	418	70	84
	Las Pinas	Manuyo Dos	1,030	15.5	15,965	27,176	2017	32,611	434	521	87	104
		Pulang Lupa Un	1,600	15.5	24,800	20,479	2017	24,575	508	609	102	122
	Total		3,300	-	51,150	-	-	-	1,290	1,549	258	310

Note)

a1. Length of tunnel under private land calculated on Google Earth.

a2. Width of perpetual easement is the width of tunnel (13.5m) + 2.0m of buffer area.

b. Zonal Value (ZV) provided by BIR (Bureau of Internal Revenue) , specifically average value of ZV in the barangay in question.

c. Market Value (MV) is calculated as 1.2 times as large as ZV for consistency with the case of Master Plan of this Project.

d. Lavue of land lot = a * b, or a * c

e. Compensation cost for perpetual easement for tunnel construction under private land. Compensation for structures, improvement, corps or trees are not considered.

Appendix 3-4 Compensation Cost for All Case

Table Compensation cost for Case 1, Case2-A,Case2-B, Case3

Facility/ Site	Case 1 (2020 Version)		Case 2-A		Case 2-B		Case 3 (2020 Version)	
	in case of ZV	in case of MV	in case of ZV	in case of MV	in case of ZV	in case of MV	in case of ZV	in case of MV
	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)	(million PhP.)
Open channel/Chaft (Departing)	1,231	1,427	1,599	1,866	1,599	1,866	1598.71775	1866.06346
Chaft (Arival)	16	19	13	16	13	16	13.168	15.8016
Tunnel section/ Laguna Lake side	0	0	15	19	15	19	0	0
Tunnel section/ Manila Bay side	0	0	33	40	258	310	0	0
Total	**1,247**	**1,446**	**1,661**	**1,940**	**1,885**	**2,210**	**1611.88575**	**1881.86506**

Appendix 3-5 Compensation Cost for River Channel Improvement

Table Calculation Result of Compensation Cost Necessary for River Channel Improvement

Location		River Name	a. Phase / Priority	b. Improvement Length	c. Width of River Improvement (m)			d. Area of Land Acquisition (ha)	e. Average Zonal Value (Php./m2)	f. Cost for Land Acquisition (million Php.)	g. Household Density by LGU			h. No. of Buildings in Land Acquisition Area (No.)	i. Unit Cost of Residential Building (Php.)	j. Replacement Cost for Residential Buildings (million Php.)	k. Total (f +j) (million Php.)	l. Project Affected People (PAPs)	
Province	City / Municipality			upto 15.0m	c1. average improvement width	c2. existing river width	c3. c1 - c2				g1. No. of Households (No.)	g2. Area of LGUs (ha)	g3. Household Density (No./ha)					l1. Average Family Size	ls. PAPs (No.)
Rizal	Angono	Angono River	I	1,170	36	13	23	2.69	871	23	25,325	2,622	9.7	26	533,997	14	37	4.5	117
Rizal	Taytay		I	0													0		0
NCR	Taguig	Magdaong River	I	390	23	10	13	0.51	10,886	55	198,256	4,521	43.9	22	903,411	20	75	4.1	91
NCR	Muntinlupa	Alabang River	I	1,630	32	17	15	2.45	36,804	900	122,286	3,975	30.8	75	903,411	68	968	4.1	308
		Bayanan Creek	I	690	30	10	20	1.38	36,804	508	122,286	3,975	30.8	42	903,411	38	546	4.1	174
		Poblacion River	I	400	30	10	20	0.80	36,804	294	122,286	3,975	30.8	25	903,411	22	317	4.1	101
		Magdaong River	I	630	27	12	15	0.95	36,804	348	122,286	3,975	30.8	29	903,411	26	374	4.1	119
		SB-23-5	I	850	30	20	10	0.85	36,804	313	122,286	3,975	30.8	26	903,411	24	336	4.1	107
		SB-23-6	I	520	25	15	10	0.52	36,804	191	122,286	3,975	30.8	16	903,411	14	206	4.1	66
Sub-total				6,280				10.14		2,633				262		227	2,860		1,083
Laguna	San Pedro	San Isidro River	II	1,340	41	16	25	3.35	3,482	117	73,030	2,405	30.4	102	615,368	63	179	4.5	458
		Tunasan River	II	790	32	10	22	1.74	3,482	61	73,030	2,405	30.4	53	615,368	32	93	4.5	237
Laguna	Binan	SB-20-4	II	770	39	15	24	1.85	2,434	45	86,752	4,350	19.9	37	615,368	23	68	3.8	140
		Binan River	II	2,890	52	30	22	6.36	2,434	155	86,752	4,350	19.9	127	615,368	78	233	3.8	482
Laguna	Santa Rosa	Sta. Rosa River	II	810	50	18	32	2.59	4,068	105	101,385	5,484	18.5	48	615,368	29	135	3.5	168
		SB-20-2	II	1,240	41	26	15	1.86	4,068	76	101,385	5,484	18.5	34	615,368	21	97	3.5	120
		SB-20-3	II	1,010	51	30	21	2.12	4,068	86	101,385	5,484	18.5	39	615,368	24	110	3.5	137
Laguna	Cabuyao		II	0													0		0
Laguna	Calamba	San Juan River	II	1,500	82	60	22	3.30	2,466	81	123,071	14,950	8.2	27	615,368	17	98	3.7	101
		San Cristobal River	II	1,450	71	50	21	3.05	2,466	75	123,071	14,950	8.2	25	615,368	15	91	3.7	93
		SB-17-6	II	710	27	13	14	0.99	2,466	25	123,071	14,950	8.2	8	615,368	5	30	3.7	30
		SB-17-7	II	750	37	15	22	1.65	2,466	41	123,071	14,950	8.2	14	615,368	8	49	3.7	50
		SB-17-8	II	1,410	47	15	32	4.51	2,466	111	123,071	14,950	8.2	37	615,368	23	134	3.7	137
Sub-total				14,670				33.37		977				551		339	1,316		2,154
Laguna	Los Banos	Los Banos River	III	2,100	51	20	31	6.51	1,921	125	29,020	5,422	5.4	35	615,368	21	146	3.9	136
		SB-17-3	III	450	24	10	14	0.63	1,921	12	29,020	5,422	5.4	3	615,368	2	14	3.9	13
		SB-17-4	III	430	33	10	23	0.99	1,921	19	29,020	5,422	5.4	5	615,368	3	22	3.9	21
		SB-17-5	III	1,550	33	20	13	2.02	1,921	39	29,020	5,422	5.4	11	615,368	7	45	3.9	42
Laguna	Bay	Colo River	III	1,070	32	25	7	0.75	1,419	11	15,149	4,266	3.6	3	615,368	2	12	4.1	11
Laguna	Calauan	Calauan	III	1,970	61	23	38	7.49	639	48	17,669	6,540	2.7	20	615,368	12	60	4.6	93
		SB-16-2	III	5,270	65	10	55	28.99	639	185	17,669	6,540	2.7	78	615,368	48	233	4.6	360
Laguna	Victoria	Pila	III	2,410	51	14	37	8.92	1,067	95	10,822	2,235	4.8	43	615,368	27	122	3.6	155
Laguna	Pila	SB-15-2	III	4,790	50	20	30	14.37	638	92	11,447	3,120	3.7	53	615,368	32	124	4.4	232
Laguna	Santa Cruz	Sta. Cruz River	III	2,650	69	60	9	2.39	1,964	47	27,982	3,859	7.3	17	615,368	11	57	4.2	73
Sub-total				22,690				73.04		672				269		165	837		1,136
Grand Total				**43,640**				**116.54**		**4,282**				**1,081**		**731**	**5,013**		**4,373**

Note)

a. Development Phase proposed by JICA Survey Team.

b. Longitudinal length of river improvement section measured on AutoCAD

c. Width of river improvement section given by JICA Survey Team.

d. Calculation by d=b x c3

e. Average Zonal Value calculated by affected barangay.

f. Calculation by f=d x e

g. Household density is estimated from number of households listed in statistical book in each LGU.

h. Approximation by h=d x g3.

i. Use the data of average cost for construction of residential building (house) listed in a statistical book considering inflation.

j. Calculation by j=h x i

k. Calculation by k=f+j

l. Calculation of Project Affected Persons (PAPs), l1 is average family size based on a statistical book. l2=h x l1.

Appendix 3-6 (1) Zonal Value for LGUs

Location		Phase	Effective Date (up-to-date)	Baragay	Residential Regular (RR)	Agricultural (A)					Average
Province	City / Municipality					A1	A2	A4	A50	Ave.	
Metro Manila	Taguig	I	2019/7/11	Lower Bicutan	9,464				7,500		11,351
				Bagunbayan	7,263				-		10,421
				Average	**8,364**				**7,500**	**7,500**	**10,886**
Metro Manila	Muntinlupa	I	2019/7/11	Sucat	24,905						47,203
				Buli	14,125						38,192
				Cupang	28,464						38,764
				Alabang	20,609						88,944
				Bayanan	12,692						23,318
				Putatan	12,738						16,182
				Poblacion	12,842						20,077
				Tunasan	13,406						21,750
				Average	**17,473**						**36,804**
Laguna	San Pedro	I	2020/1/3	Cuyab	3,880				1,000		3,681
				San Roque	1,763				750		3,047
				Landayan	3,375				2,750		3,719
				Average	**3,006**				**1,500**	**1,500**	**3,482**
Laguna	Binan	I	2019/6/13	Canlalay	3,442						3,661
				Dela Paz	1,861				875		1,856
				Malaban	2,214				625		1,786
				Average	**2,506**				**750**	**750**	**2,434**
Laguna	Santa Rosa	I	2019/6/13	Sinalhan	4,267				1,250		4,318
				Aplaya	4,600				1,250		4,278
				Caingin	4,083				1,250		3,607
				Average	**4,317**				**1,250**	**1,250**	**4,068**
Laguna	Cabuyao	II	2019/6/13	Bigaa	3,186				625		2,486
				Butong	3,071				875		2,518
				Marinig	2,413				875		2,070
				Gulod	2,543				875		2,111
				Baclaran	2,300				875		1,965
				Maratid	2,582				875		2,432
				Average	**2,683**				**833**	**833**	**2,264**
Laguna	Calamba	II	2017/10/15	Uwisan	2,425	400			310		1,474
				Looc	2,637	425			325		2,264
				Sampirulhan	2,660	500			325		2,086
				Palingon	1,867	550			367		1,380
				Lingga	2,600	475			367		1,881
				Lecheria	3,870	975			950		3,542
				Halang	3,969	738			638		3,366
				Bucal	3,876	767			438		3,359
				Pansol	3,613	988			788		3,229
				Sucol	3,381	575			400		2,679
				Masili	2,425	550			425		1,867
				Average	**3,029**	**631**			**485**	**558**	**2,466**
Laguna	Los Banos	II	2017/10/15	Tadlac	2,775	425		300	255		1,437
				Bambang	2,990	850		700	600		2,362
				Malinta	2,750	350		300	213		2,208
				Mayondon	2,750	425		340	255		1,873
				Bayog	2,375	750		650	600		1,725
				Average	**2,728**	**560**		**458**	**385**	**468**	**1,921**
Laguna	Bay	III	2017/10/15	Sto. Domingo	2,093				785		1,353
				San Antonio	3,106				393		2,463
				Tagumpay	800				800		442
				Average	**2,000**				**659**	**659**	**1,419**
Laguna	Calauan	III	2017/10/15	Lamot 1	800				250		573
				Lamot 2	910				67		704
				Average	**855**				**159**	**159**	**639**
Laguna	Victoria	III	2017/10/15	San Benito	867				229		602
				San Felix	1,000				283		672
				San Roque	1,792				325		1,456
				Nanhaya	1,850				467		1,700
				Pagalangan	925				598		907
				Average	**1,287**				**380**	**380**	**1,067**
Laguna	Pila	III	2017/10/15	Aplaya	825				250		400
				Bagong Pook	1,663				397		875
				Average	**1,244**				**324**	**324**	**638**
Laguna	Santa Cruz	III	2017/10/15	Duhat	1,778				450		1,255
				Gatid	2,118				522		1,118
				Bagumbayan	2,269				538		1,685
				Callios	3,125				550		2,919
				Santo Angel Nor	1,425				403		912
				Santisma Cruz	4,876				442		5,178
				San Pablo Norte	2,875				370		1,355
				San Pablo Sur	2,925				486		1,287
				Average	**2,674**				**470**	**470**	**1,964**

Appendix 3-6 (2) Zonal Value for LGUs

Location		Phase	Effective Date (up-to-date)	Baragay	Residential Regular (RR)	Agricultural (A)					Average
Province	City / Municipality					A1	A2	A4	A50	Ave.	
Laguna	Pagsanjan		2002/12/28	Binan	395	20			30	25	338
				Sampaloc	350				21	21	320
				San Isidro	400	200			86	143	370
				Average	**382**	**110**			**46**	**78**	**343**
Laguna	Lumban		2002/12/28	Maytalang II	815				40		221
				Wawa	395				26		211
				Poblacion	815				40		805
				Bagong Silang	770				35		518
				Average	**699**				**35**	**35**	**439**
Laguna	Kalayaan		2002/12/28	San Juan	626		30	23	45	33	589
				Longos	667		38	20	43	34	560
				Average	**647**		**34**	**22**	**44**	**33**	**575**
Laguna	Paete		2002/12/28	Ibada del Sur	375				68		344
				Ibada del Norte	375				68		322
				Average	**375**				**68**	**68**	**333**
Laguna	Pakil		2002/12/28	Baño	451				13		433
				Burgos	438				16		287
				Saray	50				5		20
				Taft	408				14		317
				Banilan	200				11		74
				Kabulusan	175				49		112
				Matikim	130				19		56
				Casimsim	110				20		50
				Average	**245**				**18**	**18**	**169**
Laguna	Pangil		2002/12/28	Balian	350				75		264
				Poblacion	350				17		361
				Sulib	210				16		140
				Dambo	175				75		119
				Asufre	175				59		98
				Average	**252**				**48**	**48**	**196**
Laguna	Siniloan		2002/12/28	Laguio	495				13		254
				Average	**495**				**13**	**13**	**254**
Laguna	Famy		2002/12/28	Butuhan	RR	A26	A4	A48	A5	Ae.	
					240	8	11	11	11	10	168
				Average	**240**	**8**	**11**	**11**	**11**	**10**	**168**
Laguna	Mabitac		2002/12/28	Lambac	350				33		278
				Numero	83				19		51
				Average	**217**				**26**	**26**	**165**
Rizal	Jaly-jala		2015/5/8	Bagumbong	475	150			100		432
				Lubo	490	150			100		489
				Pagkalinawan	480	150			100		450
				Palaypalay	475	100			100		423
				Punta	575	150			100		414
				Bayugo	490	150			100		425
				Poblacion-1st di	527	150			100		538
				Poblacion-2st di	533	150			100		531
				Poblacion-3st di	500	150			100		503
				Sipsipin	500	150			100		447
				Average	**505**	**145**			**100**	**123**	**465**
Rizal	Pililla		2015/5/8	Malaya	911	150			100		838
				Niogan	914	150			120		821
				Quisao	838	150			120		783
				Halayhayin	919	150			100		896
				Wawa	765	150			120		746
				Takungan	762	150			120		831
				Average	**852**	**150**			**113**	**132**	**819**
Rizal	Tanay		2015/5/8	Plaza-Aldea	1,746	150			100		1,910
				Wawa	1,391	150			100		1,365
				San Isidro	1,695	150			100		1,702
				Kaybuto	1,742	150			100		1,737
				Average	**1,644**	**150**			**100**	**125**	**1,679**
Rizal	Baras		2015/5/8	Evangelista	861	200			150		735
				Mabini	870	200			100		797
				Average	**866**	**200**			**125**	**163**	**766**

Appendix 3-6 (3) Zonal Value for LGUs

Location		Phase	Effective Date (up-to-date)	Baragay	Residential Regular (RR)	Agricultural (A)					Average
Province	City / Municipality					A1	A2	A4	A50	Ave.	
Rizal	Morong		2015/5/8	San Pedro	1,088	150			120		1,160
				Bombongan	1,700	150			120		774
				Average	**1,394**	**150**			**120**	**135**	**967**
Rizal	Cardona		2015/5/8	Calahan	1,121	150	130		100		949
				Patunhay	963	200			100		819
				Dalig	789	130			100		688
				Looc	954	150			100		943
				Sampad	240	100			50		200
				Nagsulo	250	100			50		125
				Ticulio	225	75			50		163
				Average	**649**	**129**	**130**		**79**	**113**	**555**
Rizal	Binagonan		2015/5/8	Pipindan	478	100			100		388
				Kalinawan	240	100			50		181
				Ithan	288	100			50		236
				Pila-pila	1,065	400			200		970
				Lunsad	741	100			90		666
				Libid	1,658	300			200		1,901
				Calumpang	1,330	150			80		1,362
				Pantok	1,638	600			500		1,593
				Palangoy	1,757	850			650		1,729
				Bilibiran	1,988	150			100		1,859
				Tagpos	1,967	100			100		1,625
				San Carlos	2,529						2,567
				Tayuman	1,971	300			200		1,958
				Pag-asa	1,753	200			100		1,680
				Average	**1,386**	**265**			**186**	**226**	**1,337**
Rizal	Angono	I	2015/5/8	Kalayaan	887	400			400		864
				San Vincente	921	400			300		917
				Bagumbayan	894	300			-		832
				Average	**901**	**367**			**350**	**358**	**871**
Rizal	Taytay	I	2015/5/8	Muzon	1,011				150		1,223
				Average	**1,011**				**150**	**150**	**1,223**

Source: Website of Bureau of Internal Revenue (BIR)

Appendix 3-7 Compensation Cost for Lakeshore Diking System

Table : Calculation Result of Compensation Cost Necessary for Land Acquisition and Affected Buildings for Dike Construction

Location		a. Phase / Priority	b. Length of Lakeshore Dike (m)	c. Areas by land use within lakeside of Lakeshore Dike (ha)					d. Zonal Value (Php./m2)		e. Cost for Land Acquisition (million Php.)			f. No. of Buildings/ Unit Area (No./ha)					g. No. of Buildings (Nos.)	h. Unit Cost of Residential Building (Php.)	i. Replacement Cost for Residential Buildings (million Php.)	j. Total (e4+i) (million Php.)	k. Project Affected People (PAPs)	
Province	City / Municipality			c1. Built-up	c2. Agricultural	c3. Fishpond	c4. Others	c5. Total	d1. RR	d2. A	e1. Residential Area	e2. Agricultural Area	e4. Total	f1. (No./ 2,500 m2)	f2. (No./ 2,500 m2)	f3. (No./ 2,500 m2)	f4. Ave. (No./ 2,500m2)	f5. Ave. (No./ha)					k1. Average Family Size	k2. PAPs (Nos.)
Rizal	Angono	I	3,310	0.8	3.8	0.0	320.6	325.2	901	358	7	14	21	35	19	36	30.0	120	92	533,997	49	70	4.5	415
Rizal	Taytay	I	1,350	0.0	31.9	0.0	51.9	83.9	1,011	150	0	48	48	35	19	36	30.0	120	0	533,997	0	48	4.3	0
NCR	Taguig	I	2,490	0.0	0.0	0.0	27.0	27.0	8,364	7,500	0	0	0	9	49	47	35.0	140	0	903,411	0	0	4.1	0
NCR	Muntinlupa	I	9,870	0.5	0.0	0.0	27.0	27.5	17,473		94	0	94	9	49	47	35.0	140	75	903,411	68	162	4.1	309
Sub-total			17,020	1.3	35.7	0.0	426.5	463.6			101	61	163						168		117	280		725
Laguna	San Pedro	II	4,080	0.2	0.0	0.0	26.6	26.8	3,006	1,500	5	0	5	25	51	37	37.7	151	25	615,368	15	20	4.5	112
Laguna	Binan	II	4,660	1.6	1.2	0.0	37.9	40.8	2,506	750	41	9	51	25	51	37	37.7	151	249	615,368	153	204	3.8	944
Laguna	Santa Rosa	II	5,780	1.7	0.0	0.0	26.4	28.0	4,317	545	73	0	73	25	51	37	37.7	151	254	615,368	156	229	3.5	889
Laguna	Cabuyao	II	8,390	1.1	0.0	0.0	84.0	85.1	1838	833	19	0	19	43	29	25	32.3	129	137	615,368	84	104	3.8	520
Laguna	Calamba	II	9,920	1.4	10.8	0.0	36.6	48.8	3,029	558	42	60	102	43	29	25	32.3	129	180	615,368	111	213	3.7	667
Sub-total			32,830	6.0	12.0	0.0	211.5	229.5			181	70	250						845		520	770		3,134
Laguna	Los Banos	III	8,240	3.3	2.8	0.0	11.1	17.2	2,728	468	90	13	103	43	29	25	32.3	129	426	615,368	262	365	3.9	1,661
Laguna	Bay	III	3,780	1.9	17.8	0.0	9.0	28.6	2,000	659	37	117	154	28	17	13	19.3	77	144	615,368	89	243	4.1	592
Laguna	Calauan	III	840	0.0	15.0	0.0	1.8	16.8	855	159	0	24	24	28	17	13	19.3	77	0	615,368	0	24	4.6	0
Laguna	Victoria	III	6,470	0.4	33.2	0.0	28.4	61.9	1,287	380	5	126	131	28	17	13	19.3	77	29	615,368	18	149	3.6	104
Laguna	Pila	III	4,750	0.7	24.7	0.0	31.6	56.9	1,244	324	8	80	88	28	17	13	19.3	77	53	615,368	32	121	4.4	232
Laguna	Santa Cruz	III	8,820	2.2	124.5	0.0	96.8	223.5	2,674	470	58	585	643	28	17	13	19.3	77	167	615,368	103	746	4.2	703
Sub-total			32,900	8.4	217.9	0.0	178.6	405.0			198	946	1,144						819		504	1,648		3,293
Total for Priority Area (I+II+III)			82,750	15.6	265.7	0.0	816.7	1,098.0			480	1,077	1,557						1,832		1,142	2,699		7,151
Laguna	Pagsanjan		1,160	0.0	13.8	0.0	0.0	13.8	382	251	0	35	35	18	18	21	19.0	76	0	615,368	0	35	4.3	0
Laguna	Lumban		8,900	0.1	523.9	0.0	402.4	926.4	699	35	1	185	185	18	18	21	19.0	76	8	615,368	5	190	4.2	33
Laguna	Kalayaan		3,840	0.4	56.3	0.0	9.1	65.8	647	33	3	19	21	18	18	21	19.0	76	33	615,368	21	42	4.5	150
Laguna	Paete		2,730	0.0	49.9	0.0	11.2	61.0	375	68	0	34	34	18	18	21	19.0	76	0	615,368	0	34	4.5	0
Laguna	Pakil		6,300	0.5	91.0	0.0	21.1	112.6	245	18	1	17	18	18	18	21	19.0	76	35	615,368	22	40	4.5	158
Laguna	Pangil		4,260	0.5	135.0	0.0	14.2	149.7	252	48	1	65	67	18	18	21	19.0	76	42	615,368	26	92	4.4	183
Laguna	Siniloan		1,590	0.0	55.2	0.0	7.2	62.3	495	0	0	0	0	18	18	21	19.0	76	0	615,368	0	0	4.5	0
Laguna	Famy		600	0.0	20.6	0.0	6.6	27.3	240	10	0	2	2	18	18	21	19.0	76	0	615,368	0	2	4.0	0
Laguna	Mabitac		4,960	0.1	163.4	0.0	7.8	171.3	217	26	0	42	43	18	18	21	19.0	76	6	615,368	4	47	4.5	28
Rizal	Jala-jala		23,310	2.8	29.1	0.2	91.0	123.1	505	123	14	36	50	18	18	21	19.0	76	215	533,997	115	165	4.7	1,009
Rizal	Pililla		17,320	4.2	131.3	0.0	15.0	150.5	852	132	36	173	209	18	18	21	19.0	76	321	533,997	171	380	4.4	1,412
Rizal	Tanay		4,530	1.2	41.3	0.0	28.5	71.1	1,644	125	20	52	72	18	18	21	19.0	76	94	533,997	50	122	4.6	433
Rizal	Baras		3,290	0.2	115.6	0.0	13.1	129.0	866	163	2	188	190	18	18	21	19.0	76	19	533,997	10	200	4.1	76
Rizal	Morong		5,670	0.2	245.1	0.0	35.0	280.4	1,394	135	3	331	334	18	18	21	19.0	76	16	533,997	9	343	4.4	73
Rizal	Cardona		13,110	1.4	1.9	0.0	112.0	115.2	649	113	9	2	11	18	18	21	19.0	76	103	533,997	55	66	4.0	413
Rizal	Binangonan		19,110	16.9	49.8	0.0	361.4	428.1	1,386	226	234	112	346	35	19	36	30.0	120	2,024	533,997	1,081	1,427	4.0	8,096
Sub-total			120,680	28.6	1723.2	0.2	1135.5	2,887.5			325	1,292	1,617						2,916		1,567	3,184		12,064
Grand Total			**203,430**	**44.3**	**1988.9**	**0.2**	**1952.2**	**3,985.5**			**805**	**2,369**	**3,174**						**4,748**		**2,709**	**5,883**		**19,216**

Note)

a. Development Phase proposed by JICA Survey Team.

b. Length of the Proposed Lakeshore Dike delineated on Google Earth.

c. Area calculated on GIS. Classification of land use compiled by Department of Agriculture is used with adjustment. c4. others (non-productive land use) includes grass land, bush, forests, etc.

d. Calculation of land price by land use in each LGU based on the Zonal Value provided by BIR (Bureau of Internal Revenue)

e. Calculation is done as follows: e1=c1 x d1, e2=(c2+c3) x d2, e4=e1+e2

f. Estimation is done as follows: 1) Set a square with a size of 50m by 50m (unit area) on representative location (3 sites in each area). 2) Calculate the no. of buildings in each square. 3) Average the three sets of data and convert it to no./ha as an average value.

g. Number of affected buildings located within the lakeside area of the proposed Lakeshore Dike. g=c1 x f4

h. Use the data of average cost for construction of residential building (house) listed in a statistical book considering inflation.

i. Replacement cost for affected buildings. i=g x h

j. j=e4+i

k. Calculation of Project Affected Persons (PAPs), k1 is average family size based on a statistical book. K2=g x k1.

Appendix 3-8 (1) Zonal Value for LGUs

Table: BIR Zonal Value by LGU

Location		Phase	Effective Date (up-to-date)	Baragay	Residential Regular (RR)	Agricultural (A)					Average
Province	City / Municipality					A1	A2	A4	A50	Ave.	
Metro Manila	Taguig	I	2019/7/11	Lower Bicutan	9,464				7,500		11,351
				Bagunbayan	7,263				-		10,421
				Average	**8,364**				**7,500**	**7,500**	**10,886**
Metro Manila	Muntinlupa	I	2019/7/11	Sucat	24,905						47,203
				Buli	14,125						38,192
				Cupang	28,464						38,764
				Alabang	20,609						88,944
				Bayanan	12,692						23,318
				Putatan	12,738						16,182
				Poblacion	12,842						20,077
				Tunasan	13,406						21,750
				Average	**17,473**						**36,804**
Laguna	San Pedro	I	2020/1/3	Cuyab	3,880				1,000		3,681
				San Roque	1,763				750		3,047
				Landayan	3,375				2,750		3,719
				Average	**3,006**				**1,500**	**1,500**	**3,482**
Laguna	Binan	I	2019/6/13	Canlalay	3,442						3,661
				Dela Paz	1,861				875		1,856
				Malaban	2,214				625		1,786
				Average	**2,506**				**750**	**750**	**2,434**
Laguna	Santa Rosa	I	2019/6/13	Sinalhan	4,267				1,250		4,318
				Aplaya	4,600				1,250		4,278
				Caingin	4,083				1,250		3,607
				Average	**4,317**				**1,250**	**1,250**	**4,068**
Laguna	Cabuyao	II	2019/6/13	Bigaa	3,186				625		2,486
				Butong	3,071				875		2,518
				Marinig	2,413				875		2,070
				Gulod	2,543				875		2,111
				Baclaran	2,300				875		1,965
				Maratid	2,582				875		2,432
				Average	**2,683**				**833**	**833**	**2,264**
Laguna	Calamba	II	2017/10/15	Uwisan	2,425	400			310		1,474
				Looc	2,637	425			325		2,264
				Sampirulhan	2,660	500			325		2,086
				Palingon	1,867	550			367		1,380
				Lingga	2,600	475			367		1,881
				Lecheria	3,870	975			950		3,542
				Halang	3,969	738			638		3,366
				Bucal	3,876	767			438		3,359
				Pansol	3,613	988			788		3,229
				Sucol	3,381	575			400		2,679
				Masili	2,425	550			425		1,867
				Average	**3,029**	**631**			**485**	**558**	**2,466**
Laguna	Los Banos	II	2017/10/15	Tadlak	2,775	425		300	255		1,437
				Bambang	2,990	850		700	600		2,362
				Malinta	2,750	350		300	213		2,208
				Mayondon	2,750	425		340	255		1,873
				Bayog	2,375	750		650	600		1,725
				Average	**2,728**	**560**		**458**	**385**	**468**	**1,921**
Laguna	Bay	III	2017/10/15	Sto. Domingo	2,093				785		1,353
				San Antonio	3,106				393		2,463
				Tagumpay	800				800		442
				Average	**2,000**				**659**	**659**	**1,419**
Laguna	Calauan	III	2017/10/15	Lamot 1	800				250		573
				Lamot 2	910				67		704
				Average	**855**				**159**	**159**	**639**

Appendix 3-8 (2) Zonal Value for LGUs

Location		Phase	Effective Date (up-to-date)	Baragay	Residential Regular (RR)	Agricultural (A)					Average
Province	City / Municipality					A1	A2	A4	A50	Ave.	
Laguna	Victoria	III	2017/10/15	San Benito	867				229		602
				San Felix	1,000				283		672
				San Roque	1,792				325		1,456
				Nanhaya	1,850				467		1,700
				Pagalangan	925				598		907
				Average	**1,287**				**380**	**380**	**1,067**
Laguna	Pila	III	2017/10/15	Aplaya	825				250		400
				Bagong Pook	1,663				397		875
				Average	**1,244**				**324**	**324**	**638**
Laguna	Santa Cruz	III	2017/10/15	Duhat	1,778				450		1,255
				Gatid	2,118				522		1,118
				Bagumbayan	2,269				538		1,685
				Callios	3,125				550		2,919
				Santo Angel Norte	1,425				403		912
				Santisima Cruz	4,876				442		5,178
				San Pablo Norte	2,875				370		1,355
				San Pablo Sur	2,925				486		1,287
				Average	**2,674**				**470**	**470**	**1,964**
Laguna	Pagsanjan		2002/12/28	Binan	395	20			30	25	338
				Sampaloc	350				21	21	320
				San Isidro	400	200			86	143	370
				Average	**382**	**110**			**46**	**78**	**343**
Laguna	Lumban		2002/12/28	Maytalang II	815				40		221
				Wawa	395				26		211
				Poblacion	815				40		805
				Bagong Silang	770				35		518
				Average	**699**				**35**	**35**	**439**
Laguna	Kalayaan		2002/12/28	San Juan	626		30	23	45	33	589
				Longos	667		38	20	43	34	560
				Average	**647**		**34**	**22**	**44**	**33**	**575**
Laguna	Paete		2002/12/28	Ibada del Sur	375				68		344
				Ibada del Norte	375				68		322
				Average	**375**				**68**	**68**	**333**
Laguna	Pakil		2002/12/28	Baño	451				13		433
				Burgos	438				16		287
				Saray	50				5		20
				Taft	408				14		317
				Banilan	200				11		74
				Kabulusan	175				49		112
				Matikim	130				19		56
				Casimsim	110				20		50
				Average	**245**				**18**	**18**	**169**
Laguna	Pangil		2002/12/28	Balian	350				75		264
				Poblacion	350				17		361
				Sulib	210				16		140
				Dambo	175				75		119
				Asufre	175				59		98
				Average	**252**				**48**	**48**	**196**
Laguna	Siniloan		2002/12/28	Laguio	495				13		254
				Average	**495**				**13**	**13**	**254**
Laguna	Famy		2002/12/28	Butuhan	RR	A26	A4	A48	A5	Ae.	
					240	8	11	11	11	10	168
				Average	**240**	**8**	**11**	**11**	**11**	**10**	**168**
Laguna	Mabitac		2002/12/28	Lambac	350				33		278
				Numero	83				19		51
				Average	**217**				**26**	**26**	**165**
Rizal	Jala-jala		2015/5/8	Bagumbong	475	150			100		432
				Lubo	490	150			100		489
				Pagkalinawan	480	150			100		450
				Palaypalay	475	100			100		423
				Punta	575	150			100		414
				Bayugo	490	150			100		425
				Poblacion-1st district	527	150			100		538
				Poblacion-2st district	533	150			100		531
				Poblacion-3st district	500	150			100		503
				Sipsipin	500	150			100		447
				Average	**505**	**145**			**100**	**123**	**465**

Appendix 3-8 (3) Zonal Value for LGUs

Location		Phase	Effective Date (up-to-date)	Baragay	Residential Regular (RR)	Agricultural (A)					Average
Province	City / Municipality					A1	A2	A4	A50	Ave.	
Rizal	Pililla		2015/5/8	Malaya	911	150			100		838
				Niogan	914	150			120		821
				Quisao	838	150			120		783
				Halayhayin	919	150			100		896
				Wawa	765	150			120		746
				Takungan	762	150			120		831
				Average	**852**	**150**			**113**	**132**	**819**
Rizal	Tanay		2015/5/8	Plaza-Aldea	1,746	150			100		1,910
				Wawa	1,391	150			100		1,365
				San Isidro	1,695	150			100		1,702
				Kaybuto	1,742	150			100		1,737
				Average	**1,644**	**150**			**100**	**125**	**1,679**
Rizal	Baras		2015/5/8	Evangelista	861	200			150		735
				Mabini	870	200			100		797
				Average	**866**	**200**			**125**	**163**	**766**
Rizal	Morong		2015/5/8	San Pedro	1,088	150			120		1,160
				Bombongan	1,700	150			120		774
				Average	**1,394**	**150**			**120**	**135**	**967**
Rizal	Cardona		2015/5/8	Calahan	1,121	150	130		100		949
				Patunhay	963	200			100		819
				Dalig	789	130			100		688
				Looc	954	150			100		943
				Sampad	240	100			50		200
				Nagsulo	250	100			50		125
				Ticulio	225	75			50		163
				Average	**649**	**129**	**130**		**79**	**113**	**555**
Rizal	Binagonan		2015/5/8	Pipindan	478	100			100		388
				Kalinawan	240	100			50		181
				Ithan	288	100			50		236
				Pila-pila	1,065	400			200		970
				Lunsad	741	100			90		666
				Libid	1,658	300			200		1,901
				Calumpang	1,330	150			80		1,362
				Pantok	1,638	600			500		1,593
				Palangoy	1,757	850			650		1,729
				Bilibiran	1,988	150			100		1,859
				Tagpos	1,967	100			100		1,625
				San Carlos	2,529						2,567
				Tayuman	1,971	300			200		1,958
				Pag-asa	1,753	200			100		1,680
				Average	**1,386**	**265**			**186**	**226**	**1,337**
Rizal	Angono	I	2015/5/8	Kalayaan	887	400			400		864
				San Vincente	921	400			300		917
				Bagumbayan	894	300			-		832
				Average	**901**	**367**			**350**	**358**	**871**
Rizal	Taytay	I	2015/5/8	Muzon	1,011				150		1,223
				Average	**1,011**				**150**	**150**	**1,223**

Source: Website of Bureau of Internal Revenue (BIR)