DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES

PREPARATORY SURVEY FOR CAVITE INDUSTRIAL AREA FLOOD RISK MANAGEMENT PROJECT IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT

VOLUME 1: SUMMARY

(FOR PRIOR DISCLOSURE)

July 2017

JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO., LTD.

NIPPON KOEI CO., LTD.

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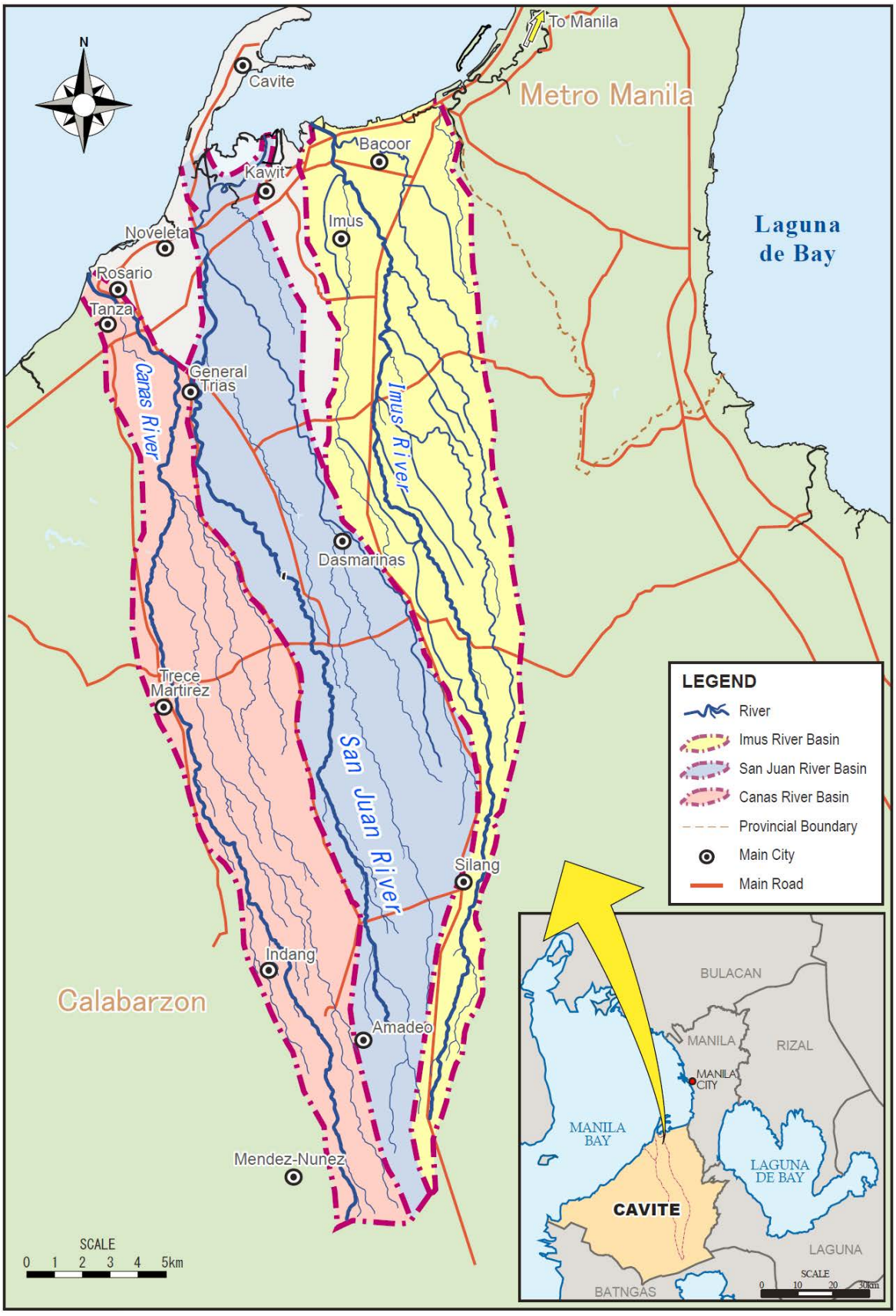


Source : THE STUDY ON COMPREHENSIVE FLOOD MITIGATION FOR CAVITE LOWLAND AREA IN THE REPUBLIC OF THE PHILIPPINES (FINAL REPORT), 2009

LOCATION MAP

LIST OF REPORTS

Volume 1: Summary

Volume 2: Master Plan Study

Volume 3: Feasibility Study

Volume 4: Appendix

EXECUTIVE SUMMARY

1. Background of the Study

The Study Area is situated in the eastern part of Cavite Province close to the boundary of Metro Manila rapidly growing into a highly industrial and urbanized zone. In spite of such industrial and urbanized development, the lower reaches of the Study Area are especially vulnerable to floods because of the extremely low ground elevation and the insufficient flow capacity of the river/drainage channels. The vulnerability is further being aggravated by the ongoing excessive urbanization in the middle and upper reaches, which decreases the basins' flood detention capacity and increases the peak runoff discharge. Flood overflows from the rivers have occurred almost every 2 years causing serious flood damages in the Study Area. The floods in 2009 and 2013 in particular resulted in loss of lives and damage of some hundreds houses. Moreover, most of the residents in the lowland area of the river basins also suffer from chronic inundation by storm rainfall and/or high tide every year.

2. Objective of the Study

In order to cope with the vulnerability to floods in the Study Area, a mater plan study and feasibility study had been carried out through the Study on Comprehensive Flood Mitigation for Cavite Lowland Area through technical assistance of JICA in 2009. The objective of this Study is to propose the definite flood mitigation project for the Study Area based on the results of review of the said master plan and feasibility study and the updated socio-economic conditions of the Study Area.

3. Outline of Proposed Priority Project

3.1 Structural Flood Mitigation Project

The principal features of the structural flood mitigation project proposed as the priority project are as described hereinafter:

(1) Project Area

There are three (3) major river basins, namely Imus, San Juan, and Canas flowing right across the Study Area. Of these major river basins, Canas River Basin has the far larger channel flow capacity seldom causing the flood overflow and, therefore it is excluded from the objectives of the river flood mitigation project. As for the remaining two (2) river basins, San Juan River Basin is evaluated to be more suitable as the priority project area judging from the several advantages over Imus River Basin such as; (a) higher economic viability of the project, (b) less social impact by the project, and (c) more rapid and intensive progress of urbanization. The flood mitigation plan for Imus River Basin is proposed to be included into the mid-term program, which is subject to the project implementation subsequent to San Juan River basin after 2023.

Maalimango Drainage Area is also selected as the objective area of drainage improvement project under the priority project. San Juan River has a catchment area of 146.8km^2, while the Maalimango Drainage Area 4.7km^2 adjacent to downstream of San Juan River running right across the Cavite Economic Zone, one of the major economic zones in the Philippines.

(2) Design Flood Level

The design flood levels as listed below are set taking account of several factors such as: (a) the design standard of the DPWH, (b) the early effect of flood mitigation, (c) the present prevailing design flood levels in Philippines, (d) the economic viability and (e) the recorded maximum flood levels.

- San Juan River Flood Mitigation: 1/25 years flood frequency*; and
- Maalimango Creek Drainage Improvement: 1/15 years of flood frequency.

* The design flood level of 1/25 year flood frequency is subject to increase to 1/50 years flood frequency upon completion of the two (2) new flood retarding basins in 2030 as

proposed as a part of the long-term program.

(3) Project Components and Contract Packaging

The scope of the project is broadly divided into (a) San Juan River Flood Mitigation and (b) Maalimango Creek Drainage Improvement. These project scopes include the following principal civil works

Table 3.1 Composition of the Priority Project

Item	Principal Civil Works
San Juan River Flood Mitigation	1 Construction of San Juan Diversion
	2 Channel Improvement of Rio-Grande River
	3 Channel Improvement of Ylang-Ylang River.
Maalimango Creek Drainage Improvement	4 Construction of Maalimango Diversion-I
	5 Improvement of Maalimango Creek
	6 Construction of Maalimango Diversion-II

The above project works are to be implemented through the following five (5) contract packages considering the amount of direct construction cost, the geographic layout of each segment for construction, the trafficability of construction equipment/material, and the construction technologies required (refer to Figure 3.1):

Table 3.2 Contract Package of the Priority Project

Package No.	Principal Project Works	Ancillary Structure	Bidding Procedure
1	Construction of San Juan Drainage Channel	Not disclosed	Not disclosed
	Construction of Maalimango Diversion-l		
2	Improvement of Rio Grande River		
3	Improvement of Ylang-Ylang River		
4	Improvement of Maalimango Creek		
	Construction of Maalimango Diversion –II		
5	Development of Resettlement Site		

The Package 1 takes charge of the downstream channel works and therefore, it has to be first completed ahead of the Packages 2 to 4 for the upstream channel works. At the same time, the Package 1 contains rather many ancillary structures. In order to attain the earlier effect of the structures under the Package 1, the works of the Package is further divided into four (4) components taking the early effect of flood mitigation and the necessary construction period of each structure into account (refer to Figure 3.2) into account:

Table 3.3 Components of Package 1

Compo-nent No.	Objective Structure	Target Completion Period
1	Lower San Juan Diversion Channel (0+000 to 0+800), Malimango Diversion-1 and One (1) Bridge of 2 Traffic Lanes	Not disclosed
2	One (1) Arterial Bridge of 6 Traffic Lanes	
3	Diversion Weir (Fixed Weir)	
4	Upper San Juan Drainage Channel (0+800 to 2+400) and Four (4) Bridges of 2 Traffic Lanes	

Figure 3.1 Location Map of Structures under Each Contract Package of Priority Project

Not disclosed

Figure 3.2 Location Map of Structures under Each Components of Contract Package 1

4. Non-structural Flood Mitigation Project

The non-structural flood mitigation project could bring about the earlier effect of flood mitigation with less cost of implementation than the structural flood mitigation project. The following are the proposed non-structural flood mitigation project:

(1) Removal of Deposits at Waterways

To strengthen the institutional setup, and provide the necessary technical guidance relevant to cleanup of waterways so as to prevent rivers and/or drainage channel from clogging of garbage and other drift materials.

(2) Management of River Area and Flood Control Area

To designate the river/flood control areas in accordance of the Presidential Decree 1067 and develop the database/asset management system for them so as to facilitate efficient management of the rivers and the flood control areas.

(3) Enactment of Ordinance for On-site Flood Regulation Pond:

To support the Cavite Provincial Government to make effect the Ordinance, which aims at obligating the land developer to construct an on-site flood regulation pond at the downstream end of every new subdivision, so as to offset the increment of flood runoff discharge caused by development of the subdivision.

(4) Development of Flood Forecasting and Monitoring System

To provide the relevant LGUs with the technical support for the effective flood forecasting and monitoring system so as to attain the more accurate and earlier results of flood forecast.

(5) Development of Flood Warning and Evacuation System:

To prepare the rules for flood warning and evacuation including the standard flood water level for the issuance of flood evacuation so as to achieve the earlier and more effective flood warning and evacuation.

(6) Establishment for Management System for Flood Warning and Evacuation:

To conduct the capacity development of the relevant government agencies for management of flood warning and evacuation so as to enhance the more reliable and sustainable institutional setup for flood warning and evacuation

5. Project Implementation Schedule

The project implementation schedule is as listed below (refer to Figure 5.1).

Table 5.1 Implementation Schedule

Item	Start	End
1. Loan Agreement	Not disclosed	
2. Procurement of Consultant for D/D & C/S		
3. Land Acquisition and Resettlement		
3-1 Package 1		
3-2 Package 2, 3, 4		
4. Consulting Service		
5. D/D and Procurement of Contrator for Package 1		
6. D/D and Procurement of Contrator for Package 2,3,4		
7. D/D and Procurement of Contrator for Package 2,3,4		
8. Construction		
8-1 Package 1: Components 1 to 3		
8-2 Package 1: Components 4		
8-3 Package 2		
8-4 Package 3, 4		
8-5 Package 5		
9/ Non-structural Flood Mitigation Works		

Not disclosed

Figure 5.1 Project Implementation Schedule

6. Project Cost

The initial project investment costs for the structural and non-structural flood mitigation measures are estimated at pesos as shown in Table 6.1. The non-structural flood mitigation project is undertaken through the consultant service and its necessary cost is included into the consultant service cost.

Table 6.1 Project Cost

(Unit: million pesos)

Item	JICA Portion	GOP Funds	Total
Civil Works	Not disclosed		
Land Acquisition			
Engineering Services			
Administration Cost			
Price Escalation			
Physical Contingency			
VAT			
Subtotal			
Interest during Construction			
Front End Fee			
Subtotal			
Total			

7. Project Evaluation

The priority projects for structural flood mitigation are evaluated to be economically viable having their economic internal rate of return (EIRR) over the shadow discount rate (SDR) of 15% recommended by NEDA as shown in Table 7.1.

Table 7,1 EIRR of Project

Project Component	EIRR
San Juan River Flood Mitigation	Not disclosed
Maalimango Creek Drainage Improvement	
Priority Project as a Whole	

As the results of scoping undertaken as a part of the environmental impact assessment (EIA) in the Study, the priority project was evaluated not to cause any significant impact to the natural environment on the premises of applying of the appropriate mitigation measures against the negative impact, At the same time, the principal construction works to be undertaken in the project are composed of river channel improvement and construction of diversion channel, the flood diversion weirs, the flood gates and the bridges. All of these works have been experienced in the Philippines and any technical difficulties in the said works are not foreseeable.

Table 7.2 Number of PAFs

City/Municipality	Number of Project Affected Families		
	Formal	Informal	Total
General Trias	129	40	169
Kawit	25	3	28
Noveleta	351	216	567
Imus	0	0	0
Rosario	73	40	113
Total	578	299	877

On te other hand, the priority project would require 877 project affected families (PAFs) as shown in Table 7.2. Such substantial number of PAFs may be the key issue for the successful project implementation. In order to cope with the issue, DPWH, the project proponent has held a series of the public consultation meeting in three times developing consensus building with the PAFs. Moreover, DPWH decided to develop the resettlement sites for both of formal and informal settler PAFs in the vicinity of their present houses so as to minimize the adverse effects to their present living circumstances. These utmost efforts of DPWH for resettlement are judged to have attained the substantial consensus of the PAFs on the project implementation.

Final Report

Volume 1: Summary

Table of Contents

PART II: FEASIBILITY STUDY

List of Tables

List of Figures

ACRONYMS AND ABBREVIATIONS

AASHTO	:	American Association of State Highway and Transportation Officials
ABC	:	Association of Barangay Captains
ADB	:	Asian Development Bank
AFP	:	Armed Forces of the Philippines
AMS	:	Asset Management System
ARF	:	Area Reduction Factor
ARMM	:	Autonomous Region in Muslim Mindanao
ASTI	:	Academy of Science and Technology Institute
AUD	:	Australian Dollar
AusAID	:	Australian Agency for International Development
BCM	:	Business Continuity Management
BCP	:	Business Continuity Plan
BDC	:	Barangay Development Council
BDRRMC	:	Barangay Disaster Risk Reduction and Management Committee
BDRRMO	:	Barangay Disaster Risk Reduction and Management Office
BFAR	:	Bureau of Fisheries and Aquatic Resources
BFP	:	Bureau of Fire Protection
BMS	:	Bridge Management System
BOC	:	Bureau of Construction
BOD	:	Biochemical Oxygen Demand
BOE	:	Bureau of Equipment
BOM	:	Bureau of Maintenance
CALAX	:	Cavite Laguna Expressway
CAR	:	Cordillera Administrative Region
CAVITEX	:	Cavite Expressway
CBFEWS	:	Community-Based Flood Early Warning System
CBFW	:	Community-based flood forecasting and warning
CCC	:	Climate Change Commission
CCSR	:	Center of Climate System Research
CCTV	:	Closed-Circuit Television
CDOR	:	Cagayan De Oro River
CENRO	:	Community Environment and Natural Resources Office
CEZ	:	Cavite Economic Zone
CFMP	:	Comprehensive Flood Mitigation Plan
CIAFMP	:	Cavite Industrial Area Flood Management Project
CLLEX	:	Central Luzon Link Expressway
CLUP	:	Comprehensive Land Use Plan
CLZURD	:	Committee on Land Use, Zoning, Urban and Rural Development
CO	:	Construction Supervision
CODIX	:	Central Office Disaster Information Coordinating Center
CPDC	:	City Planning and Development Coordinator
CPDO	:	City Planning and Development Office
CRM	:	Climate Risk Management
CS	:	Construction Supervision
CSCAND	:	Collective Strengthening on Community Awareness on Natural Disasters
CSG	:	Cemented Sand and Gravel
CSOs	:	Civil Society Organizations
CTII	:	CTI Engineering International Co., Ltd.
C/P	:	Counterpart
DA	:	Department of Agriculture
DB	:	Database
DBM	:	Department of Budget and Management
DCSR	:	Division of Climate System Research
DED	:	Detailed Engineering Design

DEM	:	Digital Elevation Model
DENR	:	Department of Environment and Natural Resources
DEO	:	District Engineering Office
DF/R	:	Draft Final Report
DGCS	:	Design Guidelines, Criteria and Standards
DHI	:	Danish Hydraulic Institute
DIC	:	Data Information Centers
DILG	:	Department of the Interior and Local Government
DND	:	Department of National Defense
DO	:	Dissolved Oxygen
DO	:	Department Order
DOC	:	Disaster Operations Center
DOE	:	Department of Energy
DOF	:	Department of Finance
DOH	:	Department of Health
DOJ	:	Department of Justice
DOST	:	Department of Science and Technology
DOTC	:	Department of Transportation and Communications
DPWH	:	Department of Public Works and Highways
DRM	:	Disaster Risk Management
DRRMC	:	Disaster Risk Reduction and Management Council
DRRM-CP	:	Disaster Risk Reduction and Management, Contingency Plan
DRRMO	:	Disaster Risk Reduction and Management Office
DRRMP	:	Disaster Risk Reduction Management Plan
DSM	:	Digital Surface Model
DSWD	:	Department of Social Welfare and Development
D/D	:	Detailed Design
ECC	:	Environmental Compliance Certificate
EFCOS	:	Effective Flood Control Operation System
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EMB	:	Environmental Management Bureau
EMoP	:	Environmental Monitoring Plan
EMP	:	Environmental Management Plan
ENRO	:	Environment and Natural Resources Office
EPZA	:	Export Processing Zone Authority
ESC	:	Environmental and Social Considerations
EWBS	:	Emergency Warning Broadcast System
FCMC	:	Flood Control Management Cluster
FCSEC	:	Flood Control and Sabo Engineering Center
FMC	:	Flood Mitigation Committee
FRIMP	:	Flood Risk Management Project
FRIMP-CTI	:	Flood Risk Management Project for Cagayan, Tagoloan and Imus River
F/S	:	Feasibility Study
GDP	:	Gross Domestic Product
GIS	:	Geographical Information System
GMMA	:	Greater Metro Manila Area
GOCC	:	Government-Owned and Controlled Corporation
GOJ	:	Government of Japan
GOP	:	Government of Philippine
GPS	:	Global Positioning System
HHWL	:	Higher High Water Level
HLURB	:	Housing and Land Use Regulatory Board
ICAS	:	institute for Global Change Adaptation Science
ICC	:	Investment Coordinate Committee
ICT	:	Information-communication Technologies
IC/R	:	Inception Report

IDW	:	Inverse Distance Weighted
IEC	:	Information Education Communication
IEE	:	Initial Environmental Examination
IFSAR	:	Interferometric Synthetic Aperture Radar
IRA	:	Internal Revenue Allotment
ISFs	:	Informal Settler Families
IT/R	:	Interim Report
IWRM	:	Integrated Water Resource Management
IWRMCT	:	Integrated Water Resources Management Coordination Team
IYRR-WQMA	:	Imus-Ylang-Ylang-Rio Grande Rivers - Water Quality Management Area
JICA	:	Japan International Cooperation Agency
JST	:	JICA Survey Team
LCB	:	Local Competitive Bid
LC/MP	:	League of Cities/Municipalities of the Philippines
LDRRMF	:	Local Disaster Risk Reduction and Management Fund
LDRRMO	:	Local Disaster Risk Reduction and Management Office
LDRRMP	:	Local Disaster Risk Reduction and Management Plan
LGA	:	Local Government Academy
LGOO	:	Local Government Operations Officer
LGU	:	Local Government Units
LiDAR	:	Light Detection And Ranging
LRT	:	Light Rail Transit
LWUA	:	Local Water Utility Administration
MBCO	:	Manila Bay Coordinating Office
MC	:	Memorandum Circular
MDRRMO	:	Municipal Disaster Risk Reduction and Management Office
MENRO	:	Municipal Environmental and Natural Resources Office
MES	:	Monitoring and Evaluation System
MGB	:	Mines and Geosciences Bureau
MHWS	:	Mean High Water Spring
MMDA	:	Metropolitan Manila Development Authority
MOA	:	Memorandum of Agreement
MPDC	:	Municipal Planning and Development Coordinator
MPDO	:	Municipal Planning and Development Office
MRF	:	Materials Recovery Facility
MSL	:	Mean Sea Level
MYPS	:	Multi-Year Programming Schedule
M/P	:	Master Plan
NADP	:	National Association of Disaster Prevention
NAMRIA	:	National Mapping and Resources Information Authority
NBCP	:	National Building Code of the Philippines
NCR	:	National Capital Region
NDCC	:	National Disaster Coordinating Council
NDRRMC	:	National Disaster Risk Reduction and Management Council
NDRRMF	:	National Disaster Risk Reduction and Management Fund
NEDA	:	National Economic Development Agency
NEDA-ICC	:	National Economic Development Authority Investment Coordinating Committee
NETIS	:	New Technology Information System
NGA	:	National Grains Authority
NGO	:	Nongovernmental Organization
NHA	:	National Housing Authority
NHRC	:	National Hydraulics Research Center
NIA	:	National Irrigation Administration
NOAH	:	Nationwide Operational Assessment of Hazard
NPC	:	National Power Corporation
NRIMP	:	National Roads Improvement and Management Program
NSCB	:	National Statistical Coordination Board

NSCP	:	National Structural Code of the Philippines
NSO	:	National Statistic Office
NWRB	:	National Water Resources Board
NWRMC	:	National Water Resource and Management Council
OCD	:	Office of Civil Defense
ODA	:	Official Development Assistance
OP	:	Operational Policy
PAF	:	Project Affected Family
PAGASA	:	Philippines Atmospheric Geophysical and Astronomical Services Administration
PDPFP	:	Philippines Development Physical Framework Plan
PDPP	:	Provincial Development and Physical Flame-work Plan
PDRRMD	:	Provincial Disaster Risk Reduction and Management Division
PDRRMF	:	Provincial Disaster Risk Reduction and Management Fund
PDRRMO	:	Provincial Disaster Risk Reduction and Management Office
PENRO	:	Provincial Environment and Natural Resources Office
PEO	:	Provincial Engineering Office
PEZA	:	Philippines Economic Zone Authority
PG-COPS	:	Provincial Government-Cavite Office of Public Safety
PG-ENRO	:	Provincial Government – Environment and Natural Resources Office
PG/R	:	Progress Report
PHIVOLCS	:	Philippine Institute of Volcanology and Seismology
PHP	:	Philippine Peso
PLUC	:	Provincial Land Use Committee
PMS	:	Pavement Management System
PNP	:	Philippine National Police
PNRC	:	Philippine National Red Cross
PNS	:	Philippine National Standards
POW	:	Program of Works
PPA	:	Philippine Ports Authority
PPDO	:	Provincial Planning and Development Office
PPFP	:	Postpartum Family Planning
PQ	:	Pre-Qualification
QGIS	:	Quantum Geographic Information System
QRF	:	Quick Response Fund
RA	:	Republic Acts
RAP	:	Resettlement Action Plan
RBCO	:	River Basin Control Office
RBIA	:	Road and Bridge Information Application
RDC	:	Regional Development Council
RDRRMC		Regional Disaster Risk Reduction and Management Council
REDAS	:	Rapid Earthquake Damage Assessment System
REVCOM	:	Review Committee
RIMSS	:	Road Information Management Support System
RLUC	:	Regional Land Use Committee
RMMS	:	Routine Maintenance Management System
RO	:	Regional Office
ROW	:	Right of Way
RTIA	:	Road Traffic Information Application
SA	:	Supplemental Agreements
SC	:	Steering Committee
SEA	:	Strategic Environmental Assessment
SEPP	:	Socio-Economic and Physical Profile
SLEX	:	South Laguna Expressway
SLF	:	Sanitary Landfill
SMB	:	Sverdrup- Munk- Bretschneider
SPM	:	Suspended Particulate Matter
SS	:	Suspended Solid

STEP	:	Special Terms for Economic Partnership
SUDS	:	Sustainable Urban Drainage Systems
SWM	:	Solid Waste Management
SWMP	:	Solid Waste Management Plan
TARAS	:	Traffic Accident Recording and Analysis System
TIGS	:	Transdisciplinary Initiative for Global Sustainability
TOR	:	Terms of Reference
TWG	:	Technical Working Group
ULAP	:	Union of the Local Authorities of the Philippines
UN	:	United Nations
UNDP	:	United Nations Development Programme
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
UPMO	:	Unified Project Management Office
UTC	:	Universal Time Coordinated
VOM	:	Valenzuela-Obando-Meycauayan Area
WDF	:	Waste Disposal Facility
WB	:	World Bank
WS	:	Workshop

MEASUREMENT UNITS

(Length)			(Time)		
mm	:	millimeter(s)	s, sec	:	second(s)
cm	:	centimeter(s)	min	:	minute(s)
m	:	meter(s)	h, hr	:	hour(s)
km	:	kilometer(s)	d, dy	:	day(s)
			y, yr	:	year(s)
(Area)					
mm^2	:	square millimeter(s)	(Volume)		
cm^2	:	square centimeter(s)	cm^3	:	cubic centimeter(s)
m^2	:	square meter(s)	m^3	:	cubic meter(s)
km^2	:	square kilometer(s)	l, ltr	:	liter(s)
ha	:	hectare(s)	MCM	:	million cubic meter(s)
(Weight)			(Speed/Velocity)		
g, gr	:	gram(s)	cm/s	:	centimeter per second
kg	:	kilogram(s)	m/s	:	meter per second
ton	:	ton(s)	km/h	:	kilometer per hour

PART I: MASTER PLAN STUDY

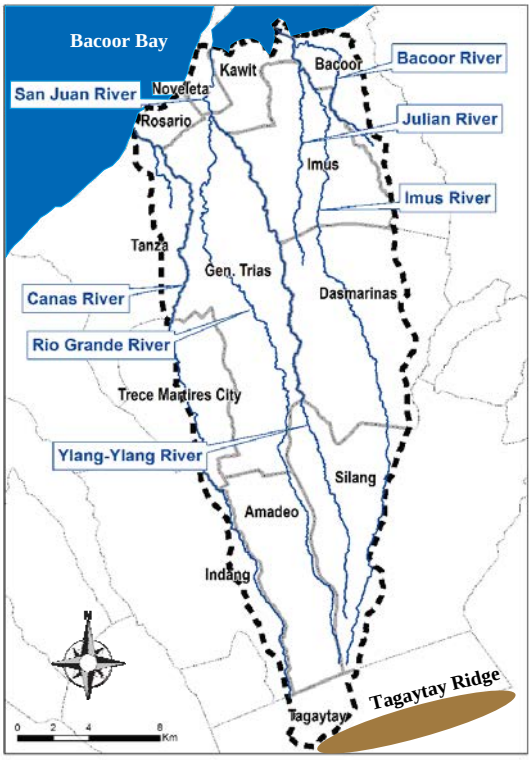
1. PURPOSE OF THE STUDY AND LOCATION OF THE STUDY AREA

1.1 Purpose of the Study

The Study aims at (1) reviewing and updating the previous "Study on Comprehensive Flood Mitigation for Cavite Lowland Area, February 2009, JICA" (hereinafter referred to as "the JICA Study 2009"; (2) selecting the priority flood mitigation projects for the Study Area; and (3) carrying out the feasibility study on the selected priority projects.

1.2 Objective Study Area

The objective Study Area has a total extent of 407.4 km^2 covering the Imus River Basin, the San Juan River Basin, the Canas River Basin and the residual small river basins surrounded by the said three (3) river basins. These river basins administratively belong to the 12 cities/ municipalities located in the eastern part of Cavite Province and/or adjacent to Metro Manila (refer to Figure 1.1). Of the 13 cities/ municipalities in the Study Area, Kawit, Noveleta, Rosario and Bacoor, in particular, are wholly within the lowland area and, further, parts of Imus and General Trias in the Study Area are also located in the same lowland area.



Source: JICA Study Team

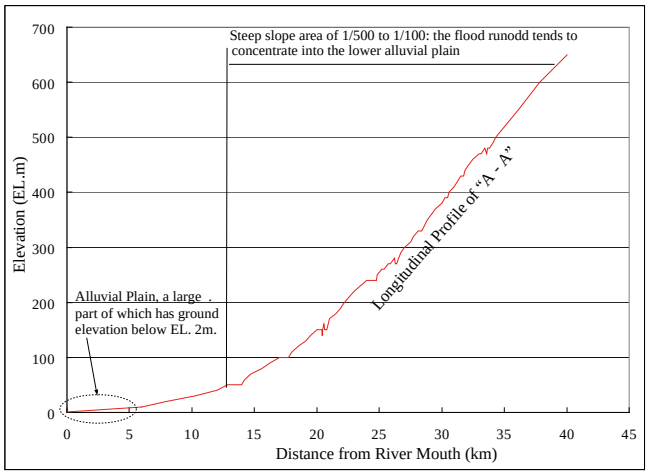
Figure 1.1 Administrative Boundaries of the Study Area

2. THE NATURAL ENVIRONMENT OF THE STUDY AREA

2.1 Topography

The Study Area is on the slope from Tagaytay Ridge, which has the highest elevation of 650 m above MSL, toward the Bacoor Bay to the North. The middle and upper reaches of the Study Area has the ground slope of 1/200 to 1/50, while the lower reaches, especially the lowland area of 4 to 5 km in width along the Bacoor Bay forms the low and flat alluvium plain with the ground level of less than 2 m above MSL (refer to Figure 2.1). The basin runoff discharges flow down through the aforesaid

three rivers of Imus, San Juan, and Canas concentrating into the lowland area and causing the vast flood inundation area therein.



Source: JICA Study Team

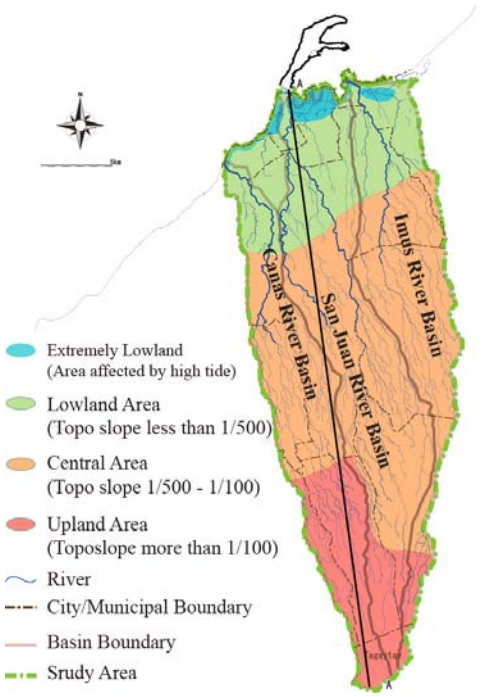
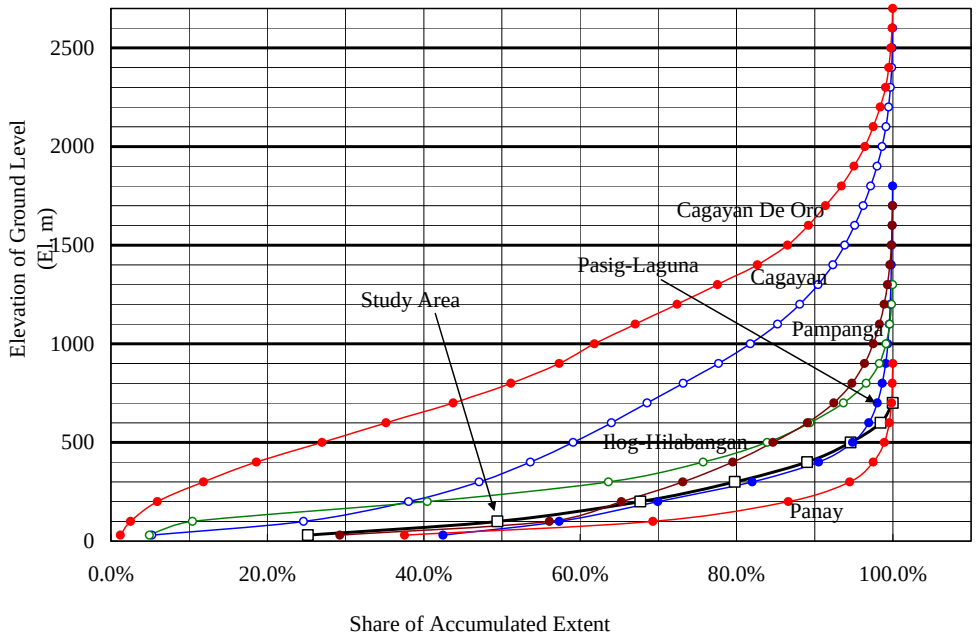


Figure 2.1 Longitudinal Profile of the Study Area

The Study Area and other six (6) major river basins in the Philippines cover the extents accumulated in proportion to increment of ground elevation as shown in Figure 2.2. The numerals of 30 to 700 shown in the Figure indicate the ground elevation (EL. m above mean sea level), whereby the ground elevation of about 50% of the Study Area is estimated to be below EL. 100m. This geographical feature of the Study Area resembles that of the Pasig-Laguna River Basin, which is expressed by the blue-line curve: both of the Study Area and Pasig-Laguna River Basin has the second largest share of low ground elevation next to Panay River Basin among the river basins shown in Figure 2.2 Hence these two (2) river basins would be classified to the river group, which contain the rather extensive area of low ground elevation in Philippines.

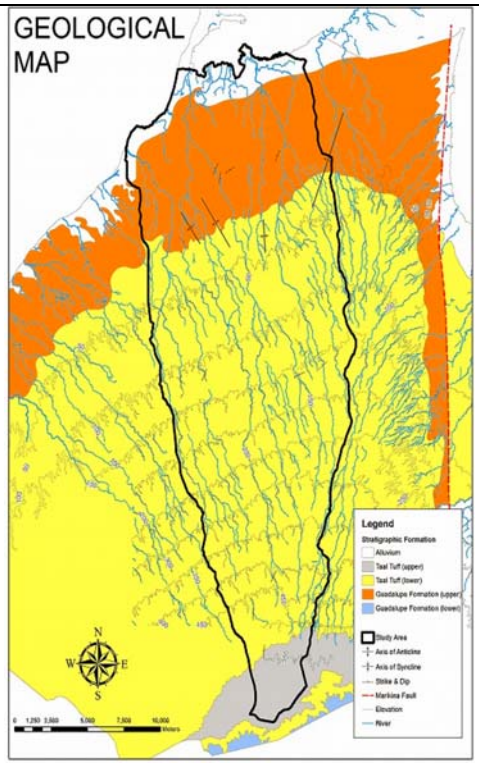


Source：JICA Study Team

Figure 2.2 Share of Extent Accumulated in Proprtion to Ground Elevation in the Study Area and Other Major River Basins in Philippines

2.2 Geography

The Study Area has two geologically different stratums. The upper strata is the Quaternary volcanic products composed of the Taal Tuff and the sedimentary rocks called “Guadalupe Formation”, and the lower strata is the Neogene Period Products composed of andesite and sediment rocks. The Taal Tuff in the Quaternary Strata in particular is widely distributed in the middle and upper reaches of more than 30m above MSL, where most of the river channels form the V-shape gorge and the Taal Tuff is exposed at the riverbeds.



Note: : Taal Tuff（Upper）is widely distributed in the Study Area but not presented in the Map, because its layers are thin excepth those around Tagytay. Ridge.

Figure 2.3 Geological Map of the Study Area

2.3 Catchment Area and Present Flow Capacity of Rivers

Of the aforesaid three major rivers, Imus River has the two (2) major tributaries, Bacoor River and Julian River, which meet the mainstream at about 1.5 km and 3.0 km upstream from the river mouth. San Juan River has also two (2) major tributaries, Rio Grande and Ylang-Ylang rivers, which meet the mainstream at about 4.8 km upstream from the river mouth. The catchment areas of

the rivers are as listed in Table 2.1 (refer to Figure 2.4).

Table 2.1 Catchment Area of the Mainstream and Tributaries in the Study Area

Name of Mainstream	Sub-Basin Divisions	Catchment Area (km^2)
Imus River	Bacoor River Basin	19.62
	Julian River Basin	19.78
	Imus River Main Stream Basin	84.20
	Sub-total	**115.50**
San Juan River	San Juan/Rio Grande River Basin	88.20
	Ylang-Ylang River Basin	58.56
	Sub-total	**146.76**
Canas River	Canas River Basin	**112.32**
Residual		**32.84**
Grand Total		**407.43**

Source: JICA Study Team

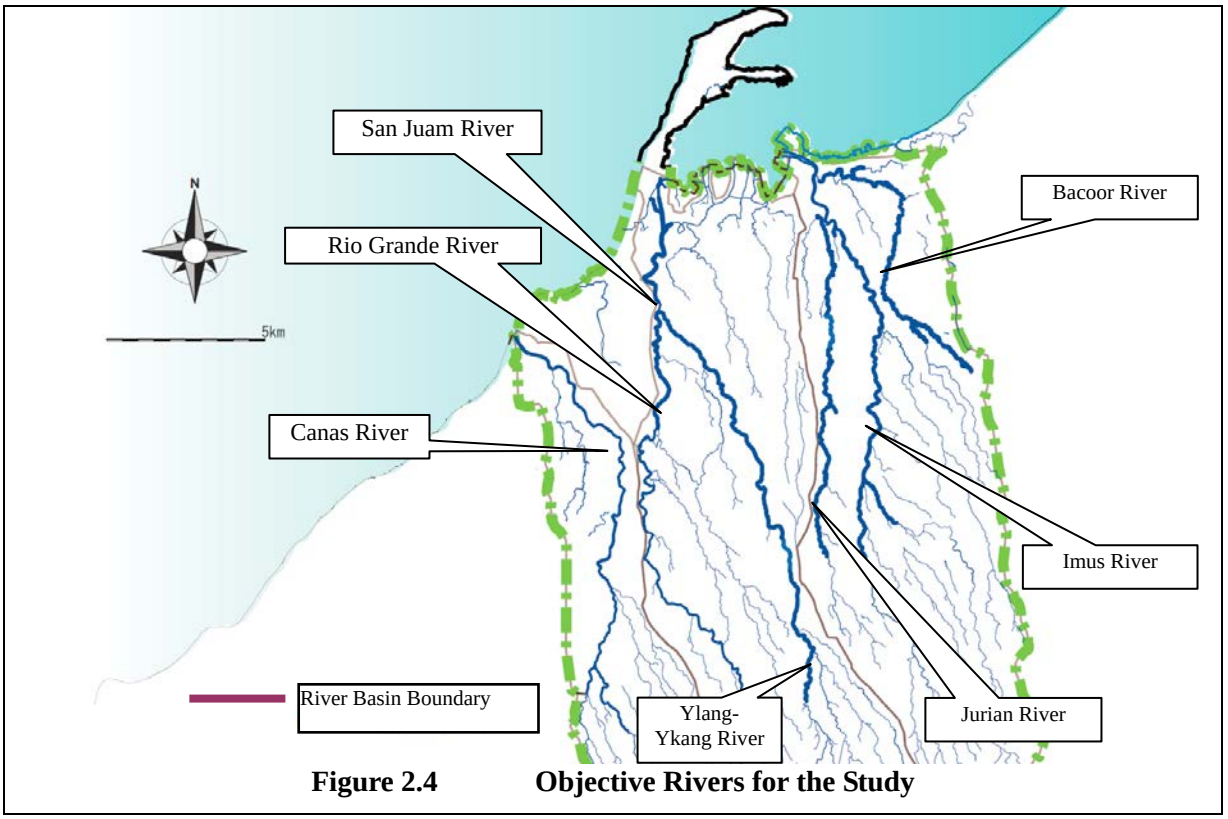


Figure 2.4 Objective Rivers for the Study

As stated above, the river channels in the middle and upper reaches form the V-shape gorge with the exposed volcanic tuff at the riverbed, which leads to the small riverbed fluctuation. On the other hand, the rivers in the lowland area tend to have U-shaped channel sections with rather gentle river slope where the progress of sedimentation is seen.

There exist numerous irrigation dams and headworks on the three rivers and their tributaries. Channel revetments have been further constructed along the downstream stretches of the rivers. Some of these river facilities are, however, heavily damaged and certain extents of rehabilitation work are required.

Most of the river and drainage channels in Imus and San Juan rivers could hardly cope with the probable flood discharges of even a 1/2 years flood frequency (refer to Annex-F 2.2.4 in VOLUME 2). As for Canas River, however, all sections except the downstream of about 800 m in length from the

river mouth and the upstream from Plucena Dam, which is located at about 7.6 km from the river mouth could cope with the flood runoff discharge of a 1/50 years flood frequency .

2.4 Climate and Flood Damage

The climate of the Study Area is strongly influenced by the seasonal monsoons, which provide the typical dry season from November to April and rainy season from May to October. Annual rainfall ranges from about 1,500 mm. to 2,000 mm. in and around the Study Area. More than 80% of the annual rainfall concentrates into the rainy season because of the influence of southwest monsoon (called "Habagat" in the Philippines) and typhoons.

The tropical monsoons and typhoons are the most influential to floods in the Study Area and many of them occur during June to October. The Study Area was hit by five (5) major floods since 2006 as shown in Table 2.2.

Table 2.2 Recent Major Floods in the Study Area

Cause of Flood	Year of Occurrence	Damage			
		Houses Totally Damaged	Death	Missing	Injured
Milenyo	2006	5,880	59	7	32
Frank	2008	43	-	-	-
Santi	2009	155	1	-	13
Pedring	2011	67	-	1	-
Southwest Monsoon	2013	660	12	4	3

Source: Cavite Provincial Government, National Disaster Risk Reduction and Management Council (NDRRMC)

2.5 Ecology

There is no endangered species of fauna and flora within the Study Area according to the results of the previous relevant study and interview survey. Particular attention is, however, given to the reduction of mangrove area in the Study Area.

The Provincial Environment and the Natural Resources Office (PENRO) of Cavite estimated the approximate extent of mangrove areas at about 20.4 ha in total as of 2012 in Bacoor City, Kawit Municipality, Noveleta Municipality, and Rosario Municipality. On the other hand, the mangrove area as of 2003 in the same municipalities/cities was estimated at 18.6 ha in the JICA Study 2009 as shown in Table 2.3. Accordingly, the total extent of the mangrove area in the municipalities/cities is deemed to have slightly increased from 2003 to 2012.

Insofar as the extent of mangrove area in Bacoor City is concerned, however, the 3.3 ha in 2003 was reduced to 0.26 ha in 2012. This means that almost 90% of the mangrove area as of 2003 in the City were extinct in 2012. The construction of Manila-Cavite Highway along the coastal area of Bacoor City could be regarded as the principal reason of such large reduction of the mangrove area.

Table 2.3 Extents of Mangrove Area in the Study Area as of 2003 and 2012

Municipality/City	Extent of Mangrove Area (ha.)	
	2003	2012
Bacoor	3.3	0.3
Kawit	10.1	13.1
Noveleta	2.5	4.1
Rosario	2.7	3.0
Total	18.6	20.4

Source: The JICA Study 2009 and Provincial Environment and Natural Resources Office (PENRO), Trece Martires City

3. SOCIO-ECONOMIC CONDITION OF THE STUDY AREA

3.1 Population

The population of Cavite Province is about three million as of 2010. Of this provincial total population, about 1.8 million or 60% are in the Study Area, and more than half of the population in the Study Area (about one million) are concentrated in the lowland area (refer to Table 3.1).

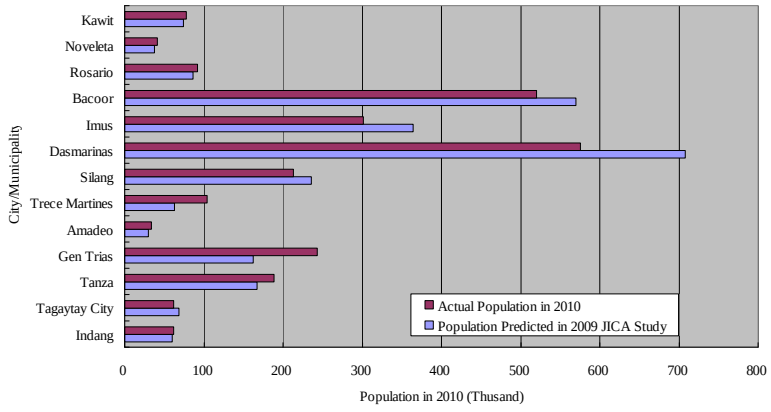
Table 3.1 Population in Cavite Province and the Study Area

Description	Area (km^2)	2010 (Recorded)*		2020 (Predicted)**	
		Population (Thousand)	Population Density (person/km^2)	Population (Thousand)	Population Density (person/km^2)
Provincial Total	1,427	3,090	2,165	4,361	3,056
The Study Area	491	1,767	3,599	2,444	6,005
Lowland Area in the Study Area	279	1,044	3,742	1,341	6,773

Source: *NSO,
** JICA Study 2009

The JICA Study 2009 assumed that the population in Cavite Province would continue to increase but its incremental rate would slow down in the future. In fact, the actual population growth in the province has been slowing down since 1990. The principal reasons for such trend of the population growth could be due to several factors such as (a) reduction of construction of the new houses through development of subdivisions since about 1990; (b) restriction of migration into Cavite Province from other provinces in the Philippines; (c) reduction of birth rate; and (d) control of land development and dwellings in the flood hazard area, the nature reserve area and the strategic agricultural development area.

The JICA Study 2009 had predicted the future population for each city/municipality in the Study Area based on the results of the comprehensive analysis on the trend of the past annual population growth from 1990 to 2000 and the future inhabitable area. When the population in 2010 predicted in the JICA Study 2009 is compared with the actual population as of 2010, the said predicted values is almost the same with the actual population recorded in 2010 as shown Figure 3.1. For this reason, the future population predicted by the JICA Study 2009 is judged to be appropriate and the population in the Study Area in 2020 is estimated at about 2.4 million based on the results of prediction by the JICA 2009 as shown in Table 3.1.



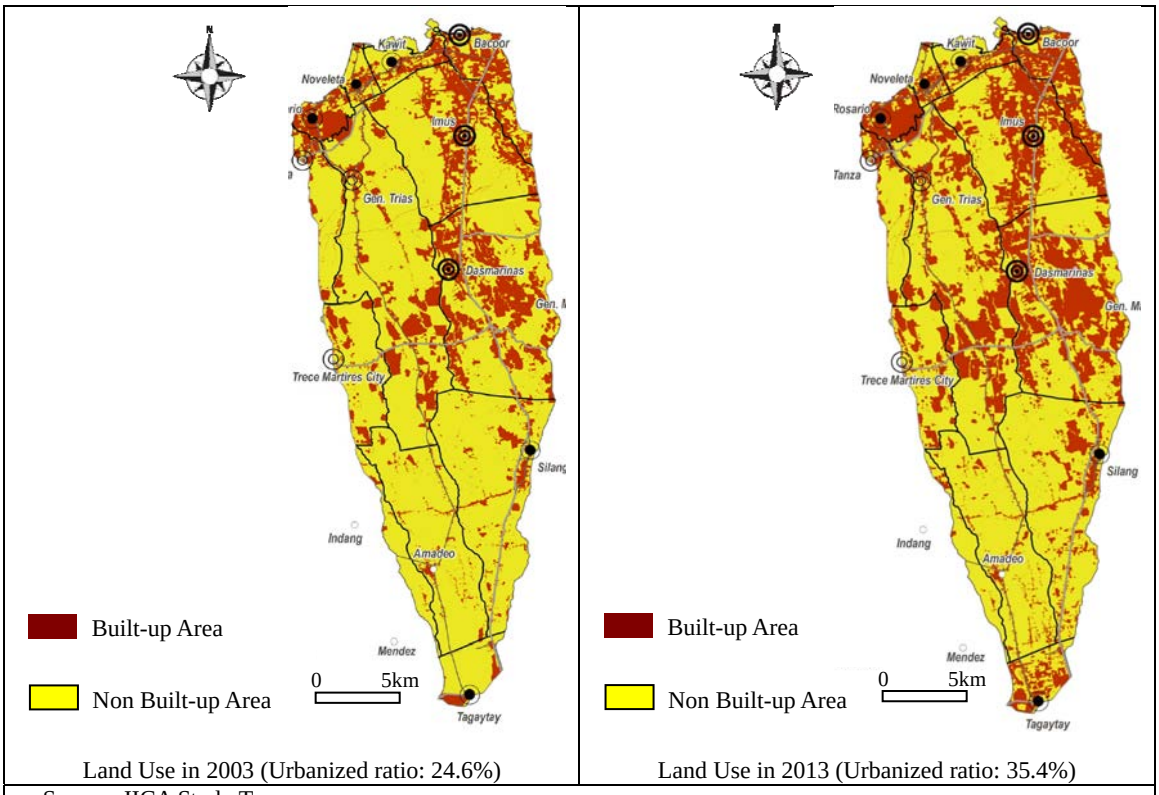
Source: JICA Study Team

Figure 3.1 Comparison between Predicted and Actual Population in 2010

3.2 Land Use

3.2.1 Past and Existing Land Use of the Study Area

The land use status of the Study Area as of 2003 and 2013 have been analyzed based on the satellite images. As the result, the urbanized ratios of the Study Area is estimated to have increased from 24.6% in 2003 to 35.4% in 2014 (refer to Figure 3.2). This expansion of urban area could be basically attributed to the location of Study Area adjacent to Metro Manila and the recent expansion of the transportation networks.



Source: JICA Study Team

Figure 3.2 Change of Land Use in the Study Area from 2003 to 2013

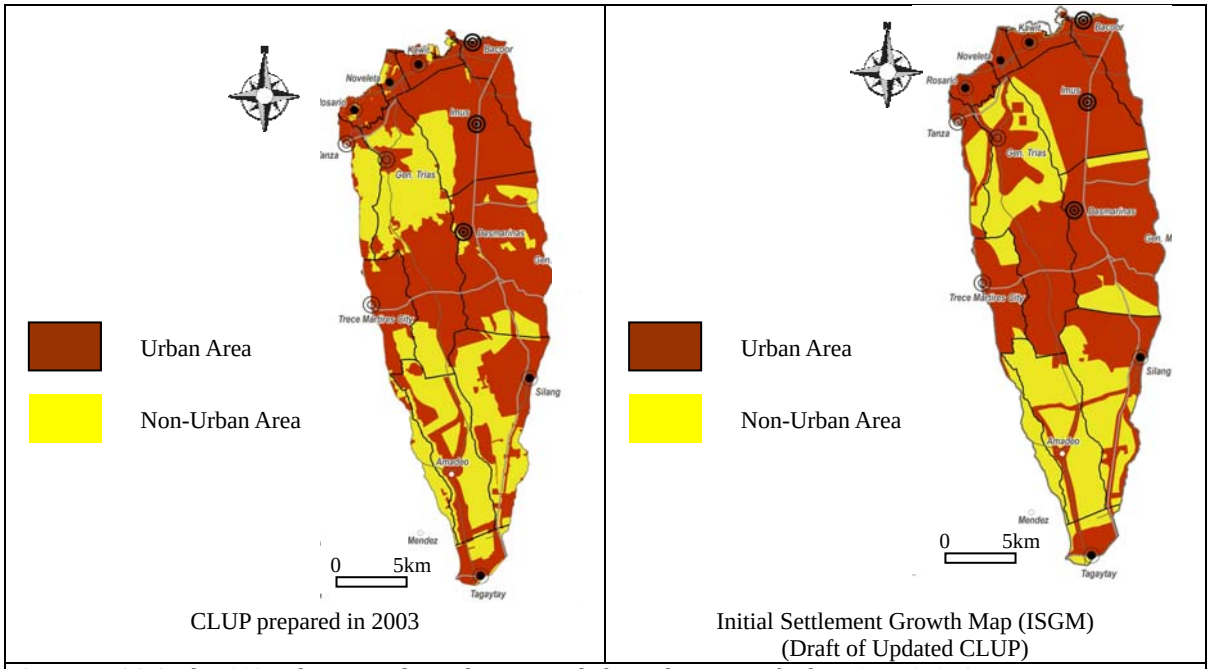
3.2.2 Projected Land Use and Development in the Study Area

The cities/municipalities in the Study Area are now updating the Comprehensive Land Use Plan (CLUP) prepared in 2003; however, updating of the CLUP for the whole Study Area has not been completed yet. The Provincial Government of Cavite has developed the Initial Settlement Growth Map (ISGM), which presents the zoning of the built-up area and the non-built-up area including the nature reserve, under the "Provincial Development and Physical Framework Plan 2011-2020 (PDPFP 2011-2020)". This ISGM would be considered as the draft of the updated CLUP for the whole of Cavite Province.

The built-up area within the Study area as of 2013 is limited to 35.4% of the entire area as shown in Figure 3.2. On the other hand, both of the CLUP prepared in 2003 and the ISGM in 2012 estimated that about 65% of the Study Area would be developed as the built-up area in the future. This means

that 46% of the existing non built-up area in the Study Area has to be converted into a built-up area in the future. Such extremely extensive land for conversion to built-up area includes the existing Bacoor fishponds and the paddy field/grassland in the middle reaches of Imus and Bacoor river basins. Since these lands currently have the important role of basin detention of flood, their conversion would cause serious adverse effects to flood mitigation.

The aforesaid conversion of 46% of the Study Area also violates Memorandum Circular No. 54 of 1933 released by the President, which prohibits conversion of more than 15% of agricultural land into a built-up area. Moreover, the built-up area projected in the aforesaid CLUP and ISGM would cover an extent of 26,600 ha, which is estimated to accommodate the population of about 3.5 million assuming that the standard extent of urban area per person is 75 m^2/person. The population in the Study Area in 2020 is estimated at about 2.4 million only as described above. Thus, the urban area projected in both the CLUP and the ISGM are deemed to largely deviate from the aforesaid MC No. 54, 1993 and project the extremely large population growth.



CLUP prepared in 2003

Initial Settlement Growth Map (ISGM)
(Draft of Updated CLUP)

Source: JICA Study 2009 and Provincial Development and Physical Framework Plan 2011-2020, Cavite Province

Figure 3.3 Future Land Zoning Projected in CLUP-and ISGM

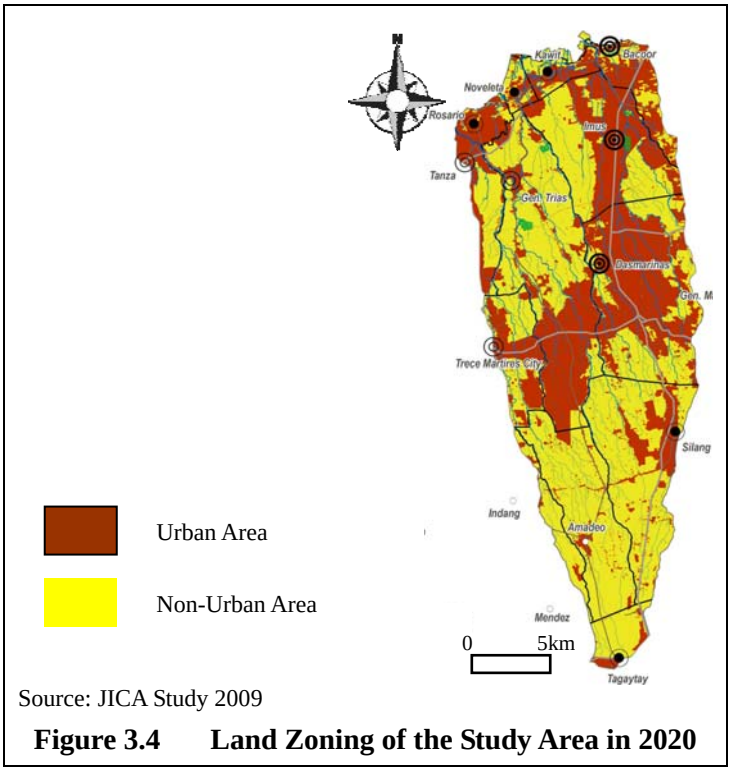
The JICA 2009 Study examined the appropriate urbanized ratio of the Study Area in 2020, which could accommodate the projected population in 2020 and comply with the above MC No. 54, 1993. As a result, the Study has set the appropriate urbanized ratio of 42.7% as shown in Table 3.2.

The Study further delineated the land zoning in 2020 as shown in Figure 3.4 taking into account the appropriate urbanized ratio, the distribution of urbanized area in 2003, the land reserved for nature and flood mitigation. The urbanized area in 2020 estimated in the JICA Study shows the tendency that the actual urbanized area in 2013 will expand along the main roads toward 2020. This tendency coincides with the actual expansion of the urbanized area from 2003 to 2013. From this point of view, the urbanized area in 2020 is judged to be appropriate and thus adopted in this Study.

Table 3.2 Land Use Plan for 2020 Proposed in the JICA Study 2009

Land Use		Area (ha)	Share
Built-up Area	Residential	14,561	35.7%
	Industrial	1,426	3.5%
	Institutional	407	1.0%
	Commercial	1,019	2.5%
	Built-up/Mixed Use	0	0.0%
	Sub-total	**17,413**	**42.7%**
Non Built-up Area	Agricultural	15,323	37.6%
	Grassland/Open Area	4,149	10.2%
	Tree Plantation	3,105	7.6%
	Bodies of Water	733	1.8%
	Unclassified	21	0.1%
	Sub-total	**23,330**	**57.3%**
Total		40,743	100.0%

Source: JICA Study Team



Source: JICA Study 2009

Figure 3.4 Land Zoning of the Study Area in 2020

3.3 Economy

3.3.1 Economic Indices

The average family income and per capita GDP of Cavite Province are higher than the national averages but far smaller than those in Metro Manila as shown in Table 3.3. That is, the per capita GDP is limited to less than 50% of that in Metro Manila. However, Cavite Province is one of the five (5) provinces which make the CALABARZON Economic Development Zone the highest priority area for economic development in the Philippines. The current annual average income of Cavite Province is the second highest next to Rizal Province and it has the largest number of population among five (5) provinces in CALABARZON (refer to Annex-T 2.4.3 VOLUME 2). From this point of view, Cavite Province is deemed to take the role as core of CALABARZON.

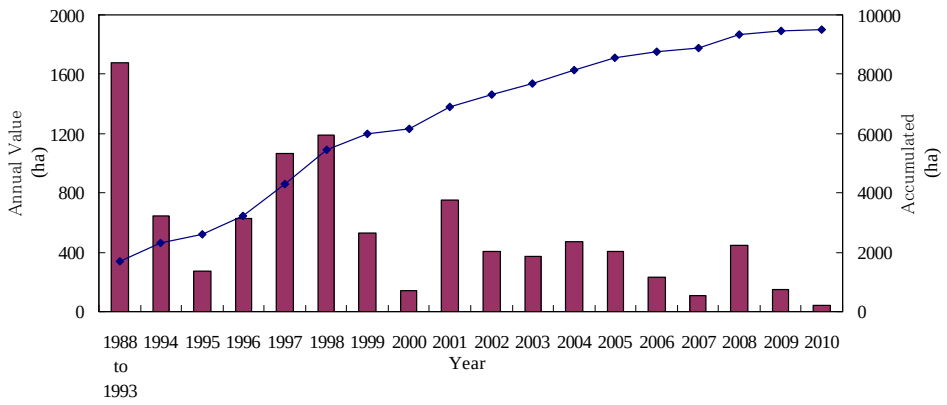
Table 3.3 Economic Indices of Cavite Province

Item	Philippines	Cavite Province	Metro Manila
Area (km^2)	343,282	1,427	620
Average Annual Family Income (pesos/family/year)*1	206,000	282,606	356,000
Per Capita GDP (pesos/person)*2	88,180	109,592	245,500

Source: National Statistics Office
Note *1: The Average Annual Family Income is the value as of 2009.
*2: Per Capita GDP is the value as of 2009 and the value of Cavite Province is represented by the average value of Region IV-A

3.3.2 Development of Residential Subdivisions

The intensive development of residential subdivisions had been made in Cavite Province due to the continuous influx of resettled people from Metro Manila as well as other provinces. As a result, the subdivisions for dwelling with a total land area of about 9,500 ha were developed in 2010. The land developed for the subdivisions corresponds to 6.8% of the total land area of Cavite Province and 16.5% of the total built-up area. It is herein noted that the number of development of subdivisions reached peak in the late 1990's, while it has declined since 2002 (refer to Figure 3.5). The chronological changes in number of subdivisions could well coincide with the aforesaid changes of annual average population growth in Cavite Province. Hence, the development of subdivisions would be one of the dominant factors to influence the population growth of Cavite Province.



Source: JICA Study 2009

Figure 3.5 Chronological Changes in Number of Subdivisions

3.3.3 Development of Industrial Estates

The development of industrial estates has been made ever since 1980 and there exist 32 industrial estates in operation and 29 industrial estates are under development or proclaimed as of 2014 in Cavite Province. The Cavite Economic Zone (CEZ) in particular was established in Municipality of Rosario as the first industrial estate of Cavite Province in 1980 and there are 284 actively operating factories in CEZ and 105 of them are under management of the Japanese companies as of December 31, 2014.

Among the industrial estates in Cavite Province, the CEZ has the largest area of land among the existing industrial estates (278.51 ha. or about 20% of the entire land of all industrial estates in Cavite Province).

3.3.4 Agriculture

The municipalities/cities, which cover the whole or part of the Study Area, have a land area of 86,904 ha, of which 34,807 ha or about 40.1% is used as agricultural land as of 2010. However, the agricultural land is biased to the municipalities/cities located in upland areas such as Dasmariñas, Silang, Trece Martires, Amadeo, Tagaytay, and Indang, where about 53.7% of the total land still remains as agricultural land. On the other hand, agricultural land is limited to 23.2% in the municipalities/cities located in the lowland areas such as Kawit, Noveleta, Rosario, Bacoor, Imus, Gen. Trias, and Tanza. Moreover, agricultural land especially in the lowland areas is being reduced and converted to urban areas.

3.3.5 Aquaculture

Cavite Province has about 85 km of shoreline in Bacoor, Kawit, Noveleta, Rosario, and Tanza. Coastal fishery is actively made in the Bacoor Bay. Inland fish cultivation is also actively pursued in the Study Area. However, many of the fishponds for inland fish cultivation are being reclaimed and converted to residential areas.

3.3.6 Development of Infrastructure

Several infrastructure projects for traffic and transportation are being implemented in Cavite Province including the Study Area. Upon completion of all of these projects, the condition of traffic and transportation for Cavite Province connecting Metro Manila, Laguna Province, and Batangas Province would be much improved. The major infrastructure projects for traffic and transportation are as enumerated below:

(1) Extension of LRT1：The extension of Railway Transit 1 (LRT-1) from Baclaran n Metro Manila to Bacoor in Cavite Province was contracted in February 2015 and its construction work is scheduled to start in June 2016..

(2) Connection of DAANG HARI to SLEX LINK ROAD: The existing Daang Hari Road had been extended by 4 km to connect with the existing South Luzon Expressway (SLEX) in July 2015.

(3) Development of CAVITE-LAGUNA (CALA) EXPRESSWAY: The detailed design for the CALA Expressway of 44.6 km in length had been completed in July 2016 and operation of the expressway is scheduled to start connection Manila, Cavite Province, and Laguna Province in July 2020.

4. ONGOING AND PROJECTED STRUCTURAL FLOOD MITIGATION PROJECTS

The major flood mitigation projects in the Study Area consist mainly of river dredging works, river revetment works, and construction of street drains. No consistent master plan with a definite design flood level was formulated before the commencement of the JICA Study 2009. After Typhoon Milenyo caused serious flood damage in the Study Area, the Master Plan of comprehensive flood mitigation for Imus, San Juan, and Canas river basins was formulated through the JICA Study 2009.

Among the flood mitigation measures proposed in the Master Plan, the project for the flood retarding basins in Imus River Basin was selected as the priority project. Then, the implementation of the priority project was launched through the Flood Risk Management Project for Cagayan, Tagoloan, and Imus River (FRIMP-CTI), a JICA Yen Loan assistance project, in 2014 receiving financial assistance of the international yen loan by JICA. The detailed design for the flood retarding basins had been completed at the end of 2014 and the construction works are now in progress with the target completion year of 2019. The structural features and locations of the flood retarding basins in Imus River Basin are as shown in and Figure 7.8.

The southwest monsoon caused serious flood damage especially in the lower reaches of Imus River as well as the San Juan River in 2013. Due to the extensive flood damages incurred, the DPWH has decided to undertake the FRIMP-CS-SA No. 1 (the supplemental agreement for the aforesaid FRIMP-CTI), which aims at extending the flood mitigation works to San Juan River. Under the FRIMP-CS-SA No. 1, the pre-feasibility study and the detailed design for flood retarding basins in the San Juan River are currently being conducted. The structural features and location of the flood retarding basins in Imus River Basin are as shown in Table 4.1and Figure 7.9.

Table 4.1 Structural Features of Ongoing Flood Retarding Basin in Imus and San Juan River Basins

Name of River System and River		Structural feature		Name of Project
River System	River	Storage Capacity (million m^3)	Extent of ROW (ha)	
Imus	Bacoor	0.25	8.9	FRIMP-CTI
	Imus	2.00	35.0	
San Juan	Ylang-Ylang	0.79	19.9	FRIMP-CTII-CS SA No.1
	Rio-Grande	1.56	37.0	

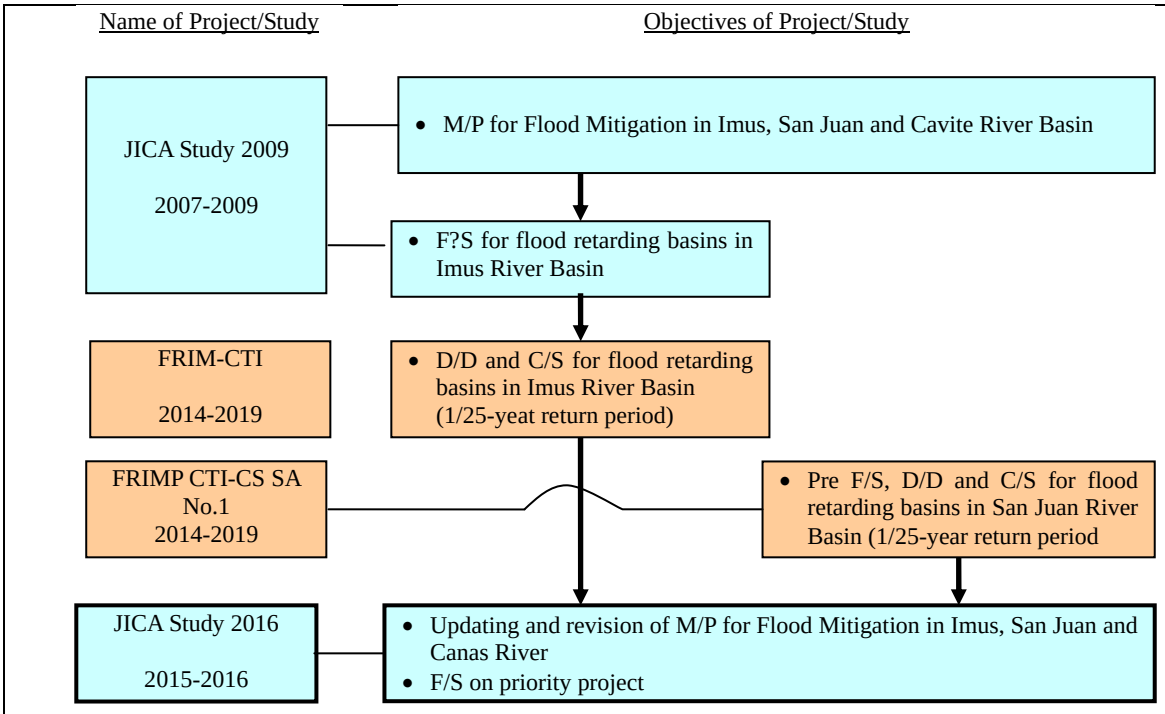
Source: Study Team
Note: The location of the above flood retarding basins are as shown in Figure 7.8.

The design flood level of both of the above flood retarding basin projects in Imus and San Juan River Basins was set as 1/25 years flood frequency. However, the flood retarding basins alone would hardly fulfill the said design flood level unless river channel improvement and/or other measures to increase the channel flow capacity are supplemented to the flood retarding basins as contemplated in the JICA Study 2009.

On the other hand, land development has been intensively made in the Study Area, leading to the comparatively large difference of flooding conditions with the result of the JICA Study 2009. Hence,

this present Study was commenced in 2015 to clarify the integrated flood mitigation schemes through updating and/or revision of the master plan and the results of feasibility study made in the JICA Study 2009.

The aforesaid series of flood mitigation works starting from the JICA 2009 Study is as shown in Figure 4.1.



Source: JICA Study Team

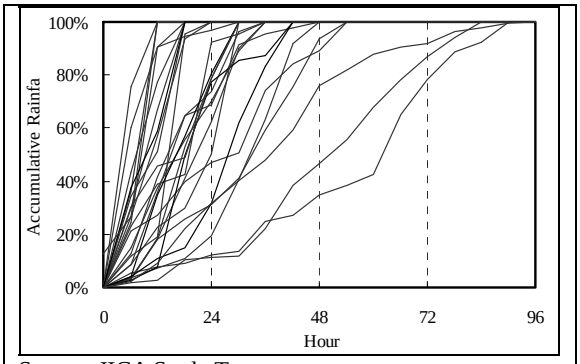
Figure 4.1 Plans and Projects Relevant to Flood Mitigation in the Study Area

5. HYDROLOGICAL AND HYDRAULIC ANALYSIS

5.1 Rainfall Analysis

5.1.1 Duration of Storm Rainfall

The duration of consecutive storm rainfall is an important factor to set up the design storm. The rainfall data at Sangley Point Station (* the location of the station is as shown in Figure 5.2) were utilized to estimate the representative duration of the consecutive storm rainfall, because it is the only station that has a substantial gauging period (i.e., from 1978 to present) of short-term (6-hour) rainfall in the Study Area.



Source: JICA Study Team

Figure 5.1 Accumulative Rainfall Curve of Heavy Rainstorm Events at Sangley Point Station

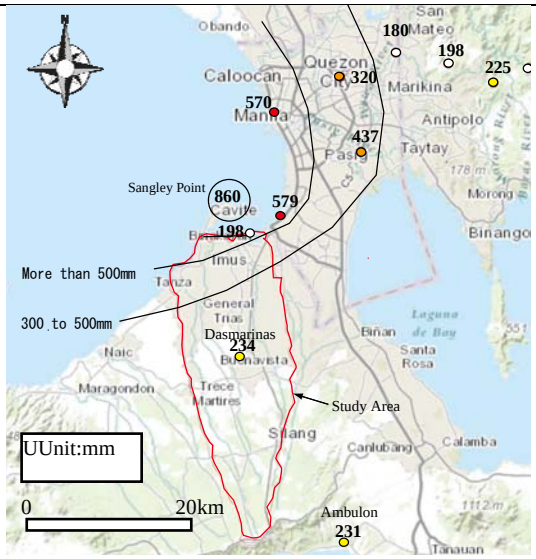
The major storms with one-day rainfall of more than 150 mm gauged at Sangley Point from 1978 up to the present were selected and their durations of rainfall were analyzed. Based on the data analysis, most of the storms rainfall lasted up to 48 hours (refer to Figure 5.1). Hence, the representative duration of design storm in the Study Area was set at 2 days (48 hours).

5.1.2 Spatial and Temporal Distribution of Storm Rainfall

The spatial and temporal distributions of the two (2) major storm rainfalls caused by Typhoon Milenyo in 2006 and the Southwest Monsoon in 2013 have been examined, as described hereinafter.

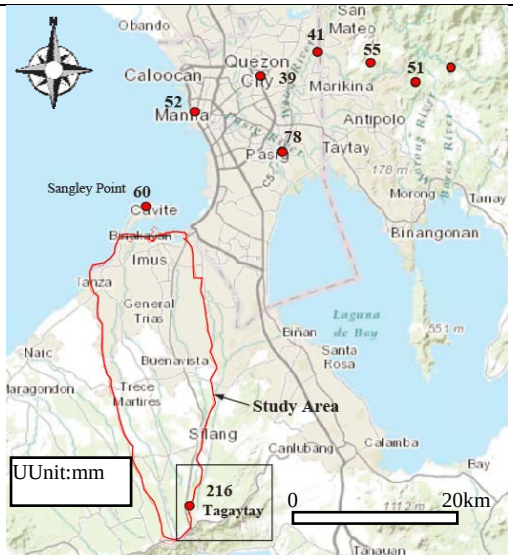
As for the spatial distribution, the Southwest Monsoon in 2013 caused the heavy downpour such that the maximum 2-day rainfall of more than 500 mm concentrated at the coastal area centering on Sangley Point where the largest 2-day rainfall of 860 mm was observed as shown Figure 5.2(1). In contrast with the coastal area, the interior area had the 2-day rainfall within the range of 180 mm to 230 mm only.

The Typhoon Milenyo in 2006 caused the spatial distribution of rainfall such that the maximum 6-hour rainfall of 216 mm at Tagaytay was outstandingly large as compared with those of less than 80 mm gauged at the seven (7) telemetry stations located in Metro Manila, as shown in Figure 5.2(2).



(1) 2-day Rainfall by Southwest Monsoon in 2013

Note: The numeric values in the Figure indicate the peak 2-day rainfall depth during the Flood.



(2) 6-hour-Rainfall by Typhoon Milenyo in 2006

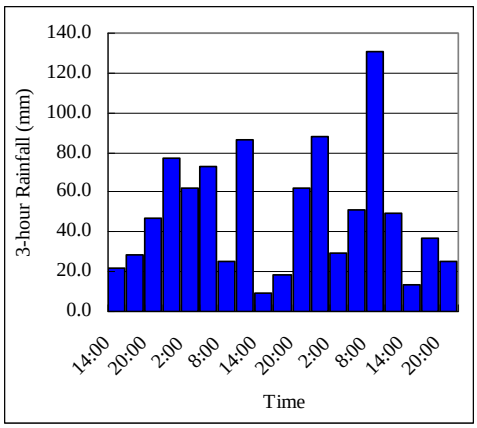
Note: The numeric values in the Figure indicate the peak t6-hour rainfall depth during the Flood.

Source: JICA Study Team

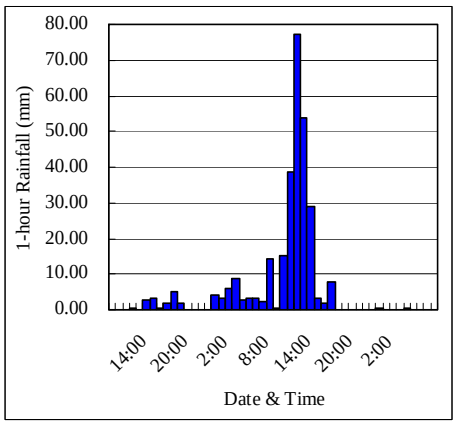
Figure 5.2 Spatial Distribution of Rainfall during the Two Most Recent Major Floods

The temporal distribution of rainfall during the Southwest Monsoon in 2013 is as shown in Figure 5.3(1). The Southwest Monsoon in 2003 brought about the maximum 3-hour rainfall of 130 mm, which corresponds to the recurrence probability of 1/10 years flood frequency and relatively small. However, the Southwest Monsoon kept the 3-hour rainfall intensity of 20 mm/hour for 48 hours without declining and the accumulated 48-hour rainfall reached the extremely large depth of 860 mm, which corresponds to the recurrence probability of 1/400 years flood frequency.

The temporal distribution of rainfall during Typhoon Milenyo in 2006 is as shown in Figure 5.3(2). Of the total rainfall of 291 mm, 261 mm or 74% concentrated within 6 hours during Typhoon Milenyo. The recurrence probability of the said maximum 6-hour rainfall of 261 mm corresponds to about 1/30 years flood frequency, according to the rainfall duration-intensity curves at Port Area. .On the other hand, the recurrence probability for 48-hour duration dropped to 1/5 years flood frequency.



(1) 3-hour Rainfall during Southwest Monsoon in 2013



(2) Hourly Rainfall during Typhoon Milenyo in 2006

Source: JICA Study Team

Figure 5.3 Temporal Distribution of Rainfall during the Two Most Recent Major Floods

5.2 Probable Basin Mean Rainfall

5.2.1 Probable 2-day Basin Mean Rainfall

The annual maximum 2-day basin mean rainfall was estimated through the Thiessen Polygon Method using the available rainfall data at each rainfall station from 1978 to 2013. Based on the said annual maximum 2-day basin mean rainfall, the probable basin mean 2-day rainfall was estimated, as shown in Table 5.1. The estimated probable values in this Study are larger than those estimated by the JICA Study 2009 because of the 2-day rainfall gauged in the Southwest Monsoon in 2013 is included in the population for frequency analysis in this Study.

Table 5.1 Probable Two-day Basin Mean Rainfall

(Unit: mm)

Flood Frequency	JICA Study 2009	This Study
1/5 years	258	269
1/10 years	295	310
1/25 years	Not Estimated	354
1/50 years	360	383
1/100 years	383	408

Source: The JICA Study 2009 and JICA Study Team

5.2.2 Probable Basin Mean Short-Term Rainfall Intensities

The probable basin mean short-term rainfall is indispensable to develop the design hyetograph mentioned below. Gauging data of short-term duration rainfall such as hourly rainfall is very limited within the Study Area. However, the probable rainfall observed at 6-hour interval at Sangley Point well fits the probable rainfall intensity-duration curves at Port Area. For this reason, the probable short-term point rainfall intensity in the Study Area is estimated based on the said curves of the Port Area Station.

The probable basin mean rainfall has to drop to the smaller value as compared with the probable point rainfall, as the catchment area becomes wider. Hence, the area reduction factor (ARF) is assumed as the factor to convert the probable point rainfall to the probable basin mean rainfall. The actual values of ARF are estimated assuming them as the ratio of "(a) the probable 2-day basin mean rainfall (as shown in the above Table 5.1)" to "(b) the probable point rainfall, which could be estimated from the rainfall intensity-duration curves at Port Area". Hence, the estimated probable basin mean rainfall intensities for various rainstorm durations are converted from the probable point rainfall intensities by the ARFs as shown in Table 5.2

Table 5.2 Probable Basin Mean Rainfall Intensities for Different Rainstorm Duration

Unit : mm/hour

Flood Frequency	Basin Mean Rainfall Intensity for Different Rainstorm								
	1 hour	6 hours	12 hours	18 hours	24 hours	30 hours	36 hours	42 hours	48 hours
1/2 years	52.0	17.1	10.7	8.0	6.6	5.6	4.9	4.4	4.0
1/5 years	64.2	22.1	14.0	10.6	8.7	7.5	6.6	5.9	5.4
1/10 years	70.7	24.9	16.0	12.2	10.1	8.7	7.7	7.0	6.4
1/25 years	80.6	28.9	18.7	14.4	11.9	10.3	9.1	8.2	7.5
1/50 years	89.2	32.2	20.9	16.1	13.3	11.5	10.2	9.2	8.4
1/100 years	95.6	34.9	22.7	17.6	14.6	12.6	11.2	10.2	9.3

Source: JICA Study Team

5.3 Recurrence Probability of Recorded Maximum Rainfall

The recurrence probability of recorded maximum rainfall could be one of the important gauges to set the design flood scale for the flood mitigation plan. Judging from the recorded number of houses collapsed by floods and other flood damages, the results of interview survey on the flood damages and/or the rainfall records, either the Typhoon Milenyo in 2006 or the Southwest Monsoon in 2013 have most likely caused the recorded maximum flood.

The 2-day rainfall of 860 mm gauged at Sangley Point during the Southwest Monsoon in 2013 corresponds to the recurrence probability of 1/400 years flood frequency, when the recurrence probability is estimated from the annual maximum values of point rainfall. However, such extremely large rainfall is deemed to be limited within a very small extent around Sangley Point. The basin mean 2-day rainfall of the Southwest Monsoon in 2013 was estimated at 349 mm through Thiessen Method using the rainfall data at 3 gauging stations, namely, Sangley Point, Dasmariñas and Ambulong, which are located at the downstream tip, the center and the upstream tip of the Study Area, respectively. The recurrence probability of the estimated basin mean 2-day rainfall corresponds to about 1/25 years flood frequency only (refer to Table 5.1).

The recurrence maximum 6-hour rainfall gauged at Tagaytay during Typhoon Milenyo is estimated at 1/30 years flood frequency. The rainfall during Typhoon Milenyo was gauged at Sangley Point and Tagaytay, which are located at the downstream and upstream tip of the Study Area, respectively. Since no rainfall record in the central part of the Study Area for Typhoon Milenyo is available, it is virtually difficult to estimate the spatial distribution of the rainfall as well as the basin mean rainfall.

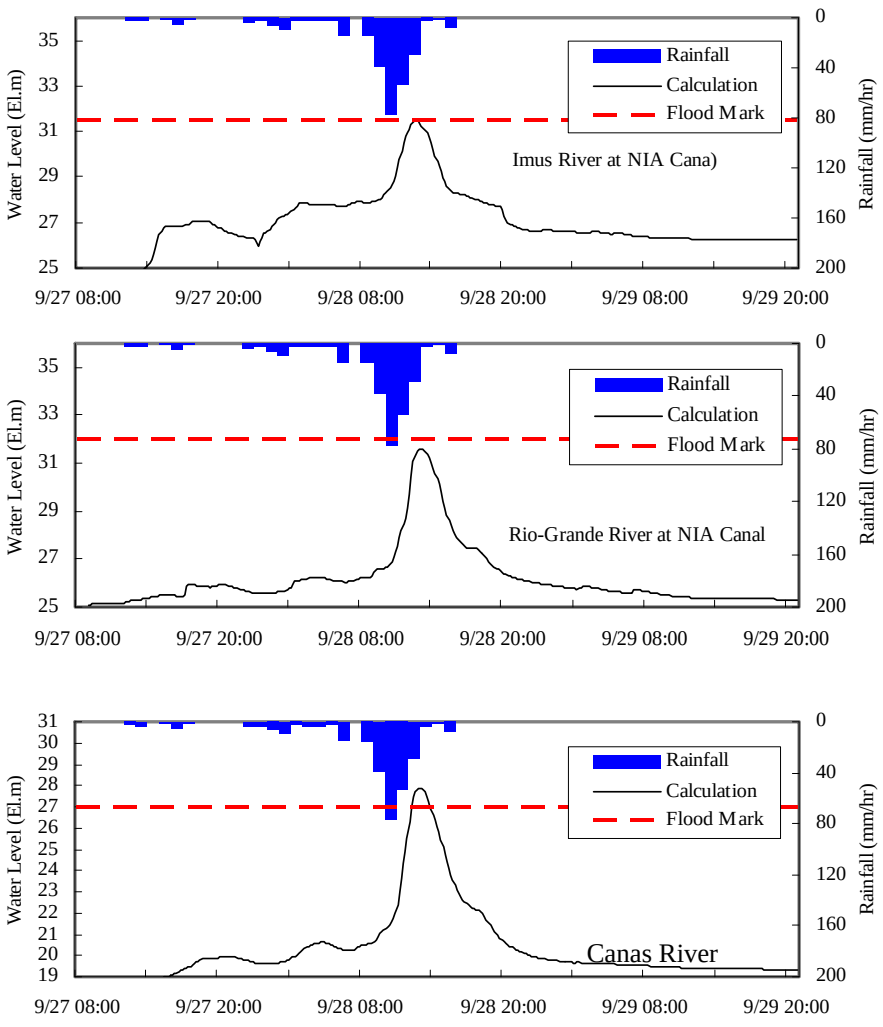
The flood by Typhoon Milenyo caused the recorded maximum flood damage including collapse of 5,880 houses. Moreover, according to the results of interview survey and the field reconnaissance on the flood marks undertaken in the JICA Study 2009, almost all of the lower reaches of the Study Area were inundated. Accordingly, the strong rainfall intensity gauged at Tagaytay is deemed to be dominant over a large extent. From this point of view, the basin runoff discharge in Typhoon Milenyo was simulated assuming the point rainfall gauged at Tagaytay as the basin average rainfall in the JICA Study 2009. As the results of simulation, it was verified that the river water level converted from the simulated runoff discharge at the reference points coincide well with the flood marks as shown in Figure 5.4 For this reason, the rainfall gauged at Tagaytay could be assumed as not only the point rainfall but also the value almost equal to the basin average rainfall.

The maximum 6-hour rainfall intensity of Typhoon Milenyo was gauged as 36 mm/hour at Tagaytay. Taking the approximate flood concentration time of about five (5) hours for the Study Area, the said maximum 6-hour rainfall intensity could be regarded as the basin average rainfall that governs the basin peak runoff discharge. As shown in the foregoing Table 5.2, the basin average 6-hour rainfall for the recurrence probability of 1/100years flood frequency is estimated at 34.9 mm/hour, which is almost equivalent to the above maximum 6-hour rainfall intensity of Typhoon Milenyo.

It is concluded based on the above clarification that the past major floods Typhoon Milenyo in 2006 and Southwest Monsoon in 2013 would have the following recurrence probabilities, whereby the flood caused by Typhoon Milenyo is the recorded maximum with the recurrence probability of 1/100 years flood frequency:

Typhoon/Southwest Monsoon	Point Rainfall Gauged in and/or around the Study Area	Basin Average Rainfall of the Study Area
Typhoon Milenyo in 2006	The peak 6-hour rainfall gauged at Tagaytay has the recurrence probability of about **1/30 years flood frequency.**	The basin average 6-hour rainfall has the recurrence probability of about **1/100 years flood frequency**.
Southwest Monsoon in 2013	The 2-day rainfall gauged at Sangley Point has the recurrence probability of about **1/400 years flood frequency**.	The basin average 2-day rainfall has the recurrence probability of about **1/25 years flood frequency**.

Source: JICA Study Team



Source: JICA Study Team

Figure 5.4 Comparison of Maximum River Water Levels Estimated from Flood Marks and Runoff Simulation for Typhoon Milenyo in 2006

5.4 Runoff Analysis

The probable runoff discharges are estimated based on the following conditions and information:

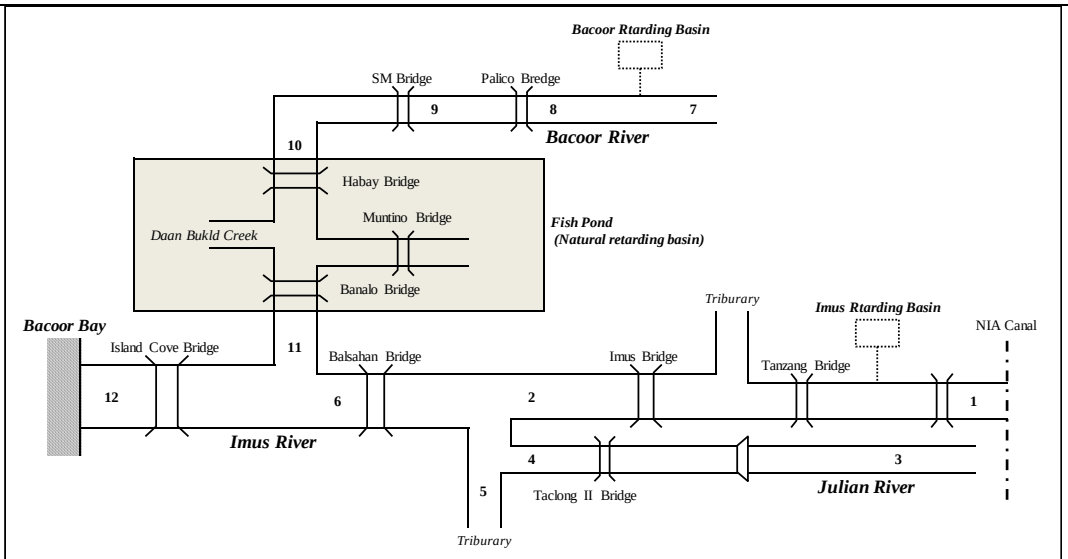
(4) Hyetograph: Center-Concentrated Type adopted as the design hyetograph (refer to Subsection 6.2.3)

(5) Runoff simulation model: The simulation model is composed of the following[1]:

- Basin Runoff Model: The Quasi-Linear Storage Type Model applicable to simulating the basin runoff discharge influenced by the changes of land use conditions in the basin.
- River Routing Mode: One-dimensional unsteady flow model

(6) Land Use: The land use as of 2020 (refer to the foregoing Figure 3.4)

(7) River cross sections and longitudinal profile: The results of river channel survey undertaken by CTI Engineering International Co., Ltd. (CTII) in 2011 and through this Study in 2015

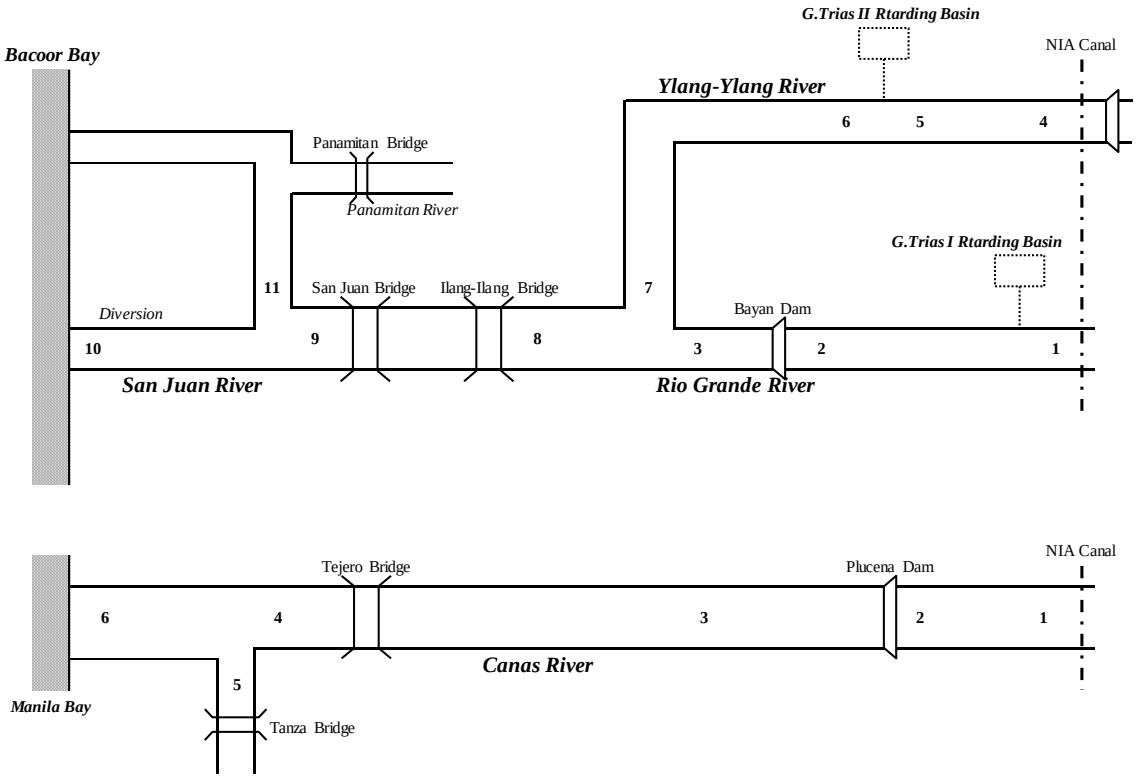


Point No.	Peak Discharge for Each Flood Frequency (m^3/s)					
	2-year	5-year	10-year	25-year	50-year	100-year
1	330	460	550	700	800	850
2	420	650	750	900	1,100	1,200
3	130	170	180	200	220	220
4	210	270	290	320	350	370
5	40	50	55	60	65	70
6	650	850	1,000	1,200	1,400	1,500
7	35	45	55	60	65	70
8	80	110	120	140	160	160
9	140	190	220	250	280	290
10	150	200	230	270	300	310
11	85	110	120	140	160	170
12	700	950	1,100	1,300	1,500	1,600

Source: JICA Study Team

Figure 5.5 Probable Flood Runoff Discharge for Imus River

[1] he peak water levels of the flood in Typhoon Milenyo in 2006 calculated through the simulation model using the observed hourly rainfall (only one series of hourly rainfall gauged in the Study Area), are judged to well coincide with the actual flood marks given in the same flood as shown in Figure 5.4. From this viewpoint, the results of the simulation model of the past floods are judged to be acceptable.



Point No.	Peak Discharge for Each Flood Frequency, San Juan River (m^3/s)					
	2-year	5-year	10-year	25-year	50-year	100-year
1	170	270	410	600	700	750
2	180	300	440	600	750	800
3	230	380	550	750	850	950
4	290	410	600	750	850	900
5	280	410	550	700	850	900
6	280	410	550	700	850	900
7	280	420	550	750	850	900
8	440	750	1,000	1,300	1,500	1,700
9	440	750	1,000	1,300	1,500	1,700
10	320	550	700	900	1,100	1,200
11	130	230	310	420	490	550

Point No.	Peak Discharge for Each Flood Frequency, Canas River (m^3/s)					
	2-year	5-year	10-year	25-year	50-year	100-year
1	330	600	850	1,200	1,400	1,600
2	330	600	850	1,200	1,400	1,600
3	330	600	850	1,200	1,400	1,500
4	350	600	900	1,200	1,400	1,600
5	45	60	75	95	110	120
6	370	650	950	1,300	1,500	1,700

Source: JICA Study Team

Figure 5.6 Probable Peak Flood Discharge of San Juan River and Canas River

5.5 Flood Inundation Analysis

The extent and depth of inundation caused by the aforesaid probable peak flood discharges are estimated based on the following conditions:

(1) Simulation model: The simulation model is composed of (a) one-dimensional unsteady model to the river routing, (b) formula for overflow of weir to express the river overflow, and (c) two-dimensional unsteady model to express the movement of overflow discharge in flood plain.

(2) Boundary condition: The mean spring high tide of 0.8 m above MSL is assumed as the water level at the river mouth.

(3) Ground level: The ground level of the flood plain is estimated based on the digital elevation model (DEM) generated from aerial survey by DOST-ASTI in 2011 and by NAMRIA in 2014.

(4) River cross sections and longitudinal profile: The results of river channel survey undertaken by CTII in 2011 and through this Study in 2015.

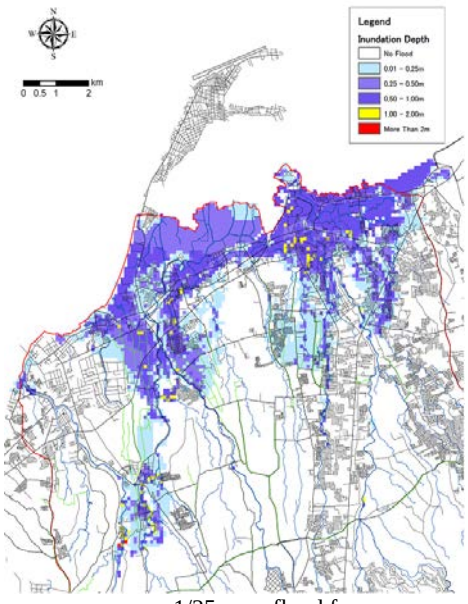
The results of flood inundation analysis for the river overflow are as shown in Table 5.3 and Figure 5.7. As shown in the table and figure, the river overflow by the 2years flood frequency causes the flood inundation area of more or less 10 km^2 each in Imus and San Juan River Basin due to the extremely small channel flow capacity. Moreover, in the case of probable flow of 25years flood frequency, the flood inundation area will cover almost the whole lowland area of Imus and San Juan River Basin. In contrast with Imus and San Juan River, the Canas River is estimated not to cause flood overflow/inundation along the entire section except to a part of downstream end and upstream sections.

Table 5.3 Extent of Probable Flood Inundation by River Overflow

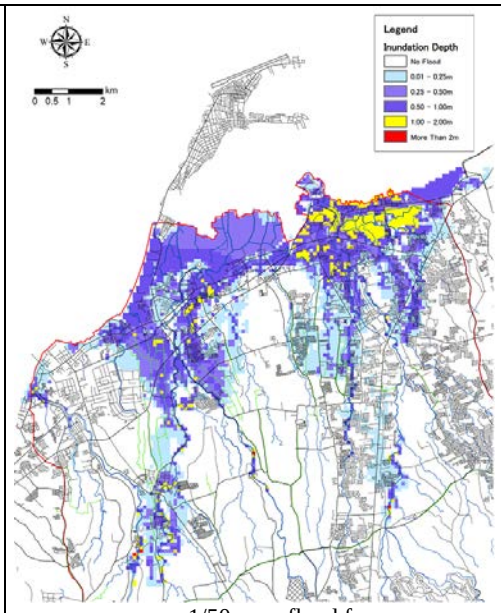
(Unit: km^2)

River Basin	1/2 years	1/5 years	1/10 years	1/25 years	1/50 years	1/100 years
Imus	10.96	13.66	14.56	16.03	19.08	20.54
San Juan	8.47	13.6	16.7	20.74	22.19	24.06
Canas	0	0.1	0.42	1.12	1.53	1.75
Total	19.43	27.36	31.68	37.89	42.79	46.35

Source: JICA Study Team



1/25years flood frequency



1/50years flood frequency

Source: JICA Study Team

Figure 5.7 Probable Flood Inundation Area by River Overflow

As for the local inundation caused by the storm water, the San Juan River Basin will have the largest extent of inundation followed by the Imus River Basin as shown in Figure 5.8. The three (3) drainage

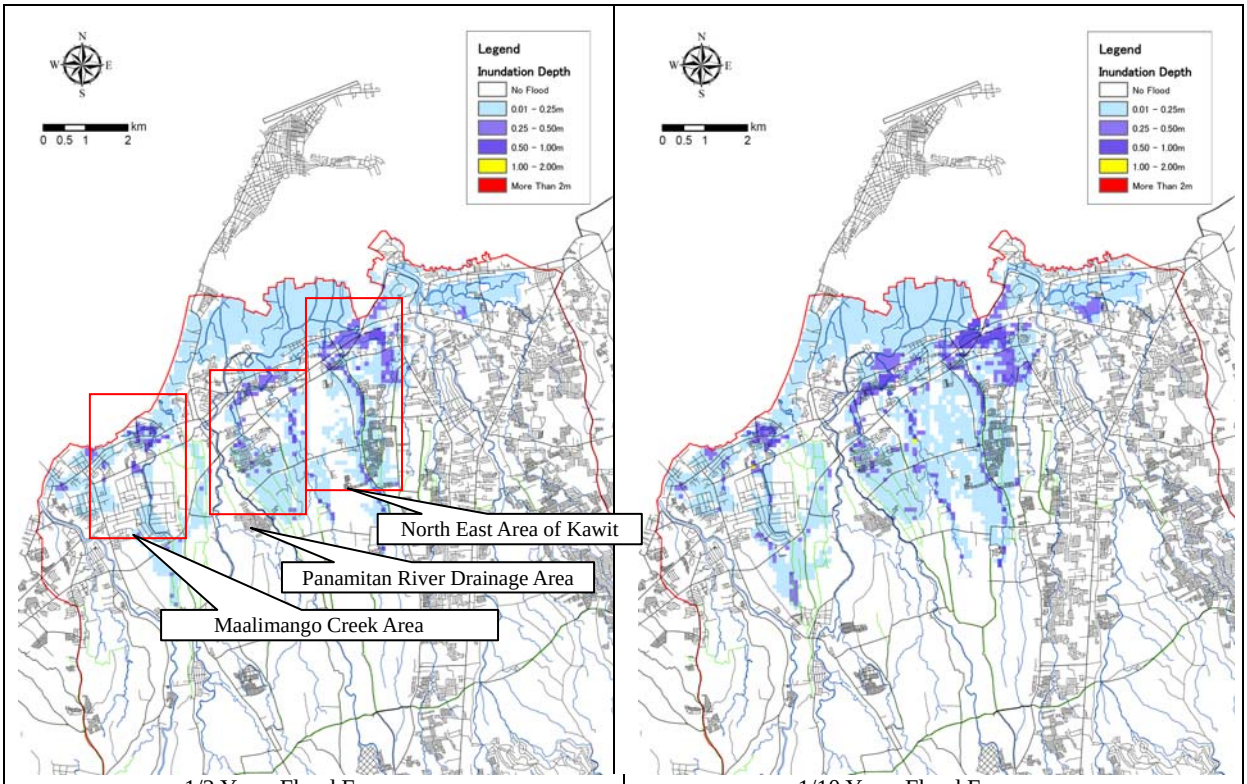
areas; namely, Maalimango Creek Area, the Panamitan River Area and North-East Area of Kawit in San Juan River Basin in particular would have the most serious inundation. In contrast, the Canas River would have little inundation.

Table 5.4 Extent of Probable flood Inundation by Storm Water

(Unit : km^2)

River Basin	1/2 years	1/5 years	1/10 years	1/25 years	1/50 years	1/100 years
Imus	2.96	3.56	5.2	6.78	7.88	8.44
San Juan	7.73	11.26	15.19	18.54	21.14	22.01
Canas	0.35	0.45	0.94	1.19	1.36	1.41
Total	11.03	15.27	21.33	26.5	30.38	31.86

Source: JICA Study Team



1/2 Years Flood Frequency | 1/10 Years Flood Frequency

Source: JICA Study Team

Figure 5.8 Probable Flood Inundation Area by Storm Water

6. PLANNING FRAMEWORK OF FLOOD MITIGATION

6.1 Target Area of Flood Mitigation Plan

The flood mitigation plan consists of three (3) components; namely, (a) plan for river flood mitigation, (b) plan for storm drainage improvement, and (c) plan for storm surge. The target areas of these components of the plan are as enumerated below:

(1) Plan for flood mitigation: Imus River Basin, San Juan River Basin and Canas River Basin

(2) Storm Water Drainage Plan：The aforesaid Maalimango Creek Drainage Area, Panamitan River Drainage Area and North-East Area of Kawit Drainage Area

(3) Plan for Storm Surge: The coastal area along Bacoor Bay in the Study Area

6.2 Planning Framework for River Flood Mitigation

6.2.1 Design Flood Level

In accordance with the Memorandum by the Secretary of DPWH on "Upgrades on Flood Control and Drainage Project" dated on June 21, 2011, the following design flood levels are adapted to the plan for river flood mitigation[2]:

- Rivers with a catchment area of 40 km^2: 50years flood frequency
- Rivers with a catchment area below 40 km^2: 25years flood frequency[3]

The alternative flood mitigation plans would be examined to attain the above design flood levels as described later in Subsection 7.2.3. Of these alternative plans, some would be examined on the premises of the stepwise grading up of the design flood level from 25years flood frequency in the short/mid-term project to 50years flood frequency in the long-term project taking the following conditions into account:

(1) Early Flood Mitigation Effect: The ongoing flood retarding basins in Imus and San Juan River Basin are designed to cope with the design flood level of 25years flood frequency. However, the flood retarding basin alone would hardly attain the said design flood level for the entire river basin unless supplementary flood mitigation measures such as river channel improvement are introduced to the bottleneck sections. For this reason, the early flood mitigation measure with the design scale of 25years flood frequency could be expected, when the project for supplementary flood mitigation measures is implemented in the short/mid-term project.

(2) Current Prevailing Design Flood Level in the Philippines: Most of the recent and/or ongoing flood mitigation projects for major river basins adopt the design flood level of 25years flood

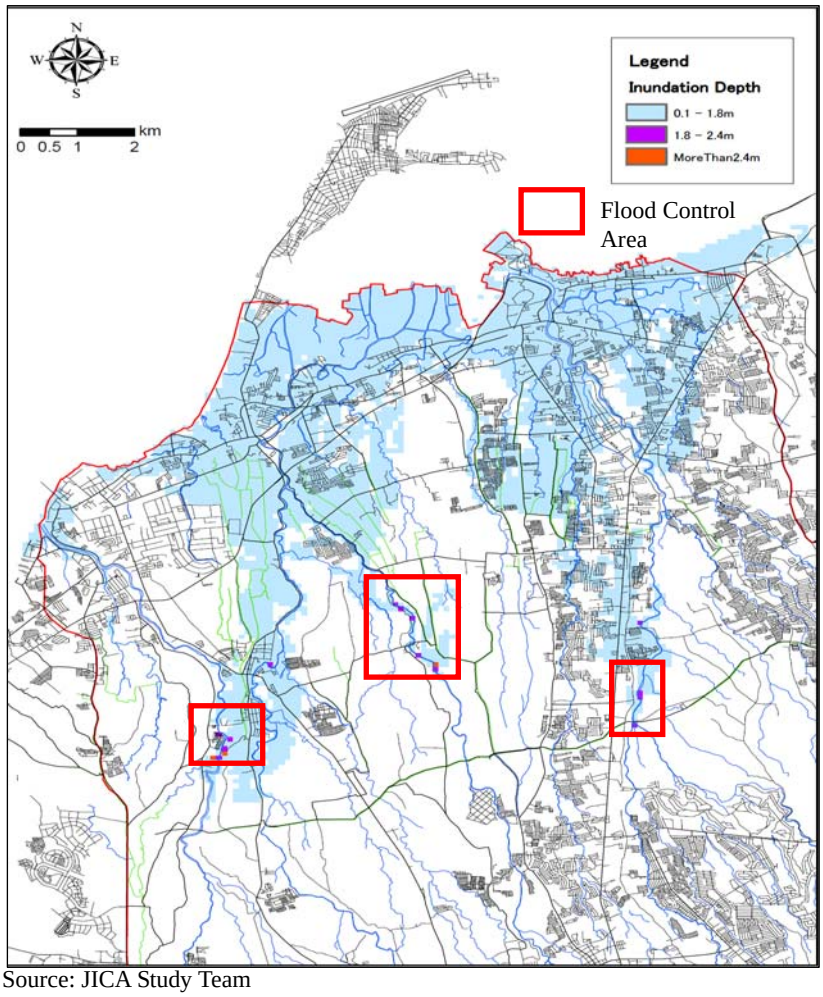
[2] The standard design flood levels were updated through Design Guideline, Criteria and Standards (DGCS), DPWH" in the end of 2015. On the other hand, the design flood levels had been determined before publish of DGCS and approved in the Steering Committee Meeting in June 2016. Due to this background, the design flood level accords to the Memorandum by the Secretary of DPWH as stated above.

[3] Bacoor River and Julian River, both of which are the tributaries of Imus River, belong to this group.

frequency in the Philippines. From this point of view, the design flood level of 25years flood frequency adopted as the short/mid-term project is judged to be adequate.

(3) Economic Viability: The economic internal rate of return (EIRR) of the flood mitigation projects both for the design flood levels of 25-year and 50years flood frequency could exceed 15% assuring the economic viabilities for project implementation (refer to Table 9.1).

(4) Relationship between the Recorded Maximum Flood Level and the Design Flood Level: As described in the foregoing Section 5.3, Typhoon Milenyo is most likely to have caused the maximum flood level of 100years flood frequency. It is, however, hardly justified to adopt the said recorded maximum flood level as the design flood level taking the currently prevailing design flood level in the Philippines. Moreover, the serious flood risk areas, where the death calamity by the flood of 100years flood frequency is expected to be within the limited areas of the Study Area as shown in Figure 6.1, provided that the short/mid-term project with the design scale of 25years flood frequency is introduced [refer to Subsection 7.2.1(2) below]. Hence, this Study proposes to designate such serious flood risk areas as the flood control area, where the settlement should be refrained [refer to Subsection 7.2.1(2)].



Source: JICA Study Team

Figure 6.1 Flood Risk Areas with Death Calamity in 1/100years Flood Frequency

6.2.2 Target Project Completion Year

The following target project completion years are proposed taking into account the target completion year of the ongoing flood retarding basin projects and the subsequent project implementation:

Table 6.1 Target Project Completion Years for Implementation of River Flood Mitigation Works

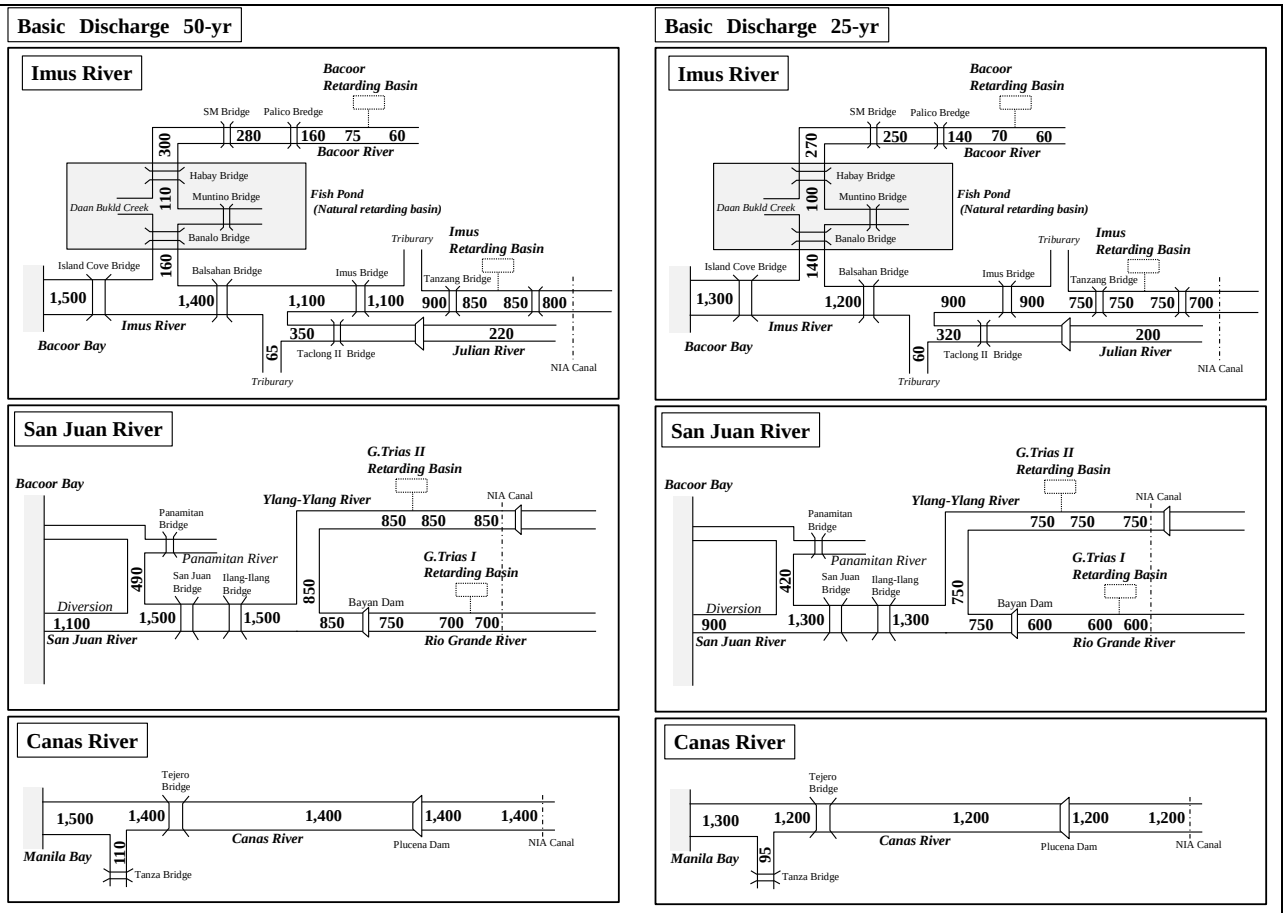
Classification of Projects	Design Scale	Contents of Projects	Target Project Completion Year
Ongoing Project	1/25year	Construction of Flood Retarding Basin	Not disclosed
Short-Term Project	1/25year	Priority Projects proposed in the Study	
Mid-Term Project	1/25year	Projects proposed other than the priority projects (1/2)	
Long-Term Project	1//50year	Projects proposed other than the priority projects (2/2)	

Source: JICA Study Team

6.2.3 Design Hyetograph and Basic Design Discharge

Two (2) types of model hyetograph were examined as candidates of the design hyetograph. One was derived from the enlargement of several rainfall patterns actually observed in the past major floods. Another was developed from the probable rainfall intensity-duration curve at Port Area (the rainfall distribution pattern was, herein, assumed as the center-concentrated type). Then, the model hyetograph which generate the largest peak discharge at the reference point was selected as the representative design hyetograph. The selected model hyetograph is that of the above center-concentrated type rainfall pattern developed from the probable rainfall intensity-duration formulas/curves.

The basic design discharges for the design level of 1/25 years and 1/50 years are estimated on the premises of the above design hyetograph as shown in Figure 6.2. This estimated design discharge is subject to the projected land use as of 2020 shown in the foregoing Table 3.2 and Figure 3.4, considering the increment of the flood runoff discharges due to expansion of the urbanized area. The further increment of the peak flood discharges from 2020 onwards is assumed to be managed by a new ordinance on the on-site flood regulation pond, which would be constructed at the downstream end of each new subdivision in order to offset the increment of the flood runoff discharges by development of the new subdivisions.



Source: JICA Study Team

Figure 6.2 Basic Design Discharge for River Flood Mitigation Plan

6.3 Planning Framework for Storm Water Drainage

6.3.1 Planning Concept

In the JICA Study of 2009, the drainage facilities were planned with gravity flow canals and retarding basins for the whole lowland of the Study Area. Results of the Study show that the EIRR for the proposed storm water drainage project was too low to undertake the Feasibility Study (F/S) for the project. However, in this Study, the following different approaches, which are expected to be economically viable, are applied to formulate the alternative storm drainage projects:

(1) Increase of Project Benefit: Selection of the objective areas for the drainage improvement with high demand of countermeasures for floods.

(2) Decrease of Project Cost: Study on constructing diversion drainages and/or retarding basins in non-built-up areas to minimize the house relocations and other structures to be affected by the projects.

In the JICA Study 2009, the drainage pumping was excluded from the scope of the Study because of the high-priced operation and maintenance cost, which would be hardly shouldered by the relevant LGUs. In accordance with the request from DPWH to the Study Team; however, the eligibility of the

drainage pumping would be clarified through this study especially for the areas where the drainage of floodwater by gravity is difficult due to extremely low ground elevations.

6.3.2 Design Flood Level

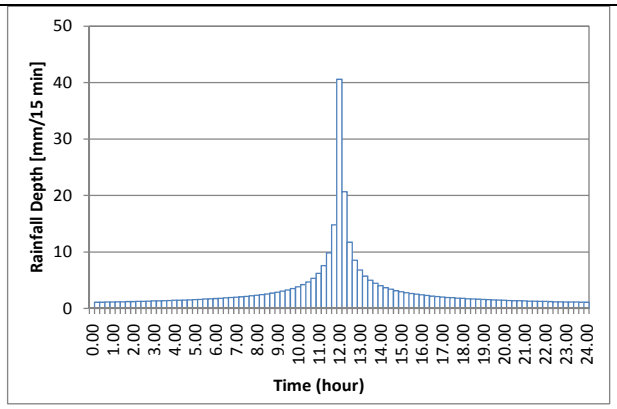
The design flood level for the storm water drainage improvement is set at 15years flood frequency in accordance with the Memorandum issued by the Secretary of DPWH in 2011.

6.3.3 Target Project Completion Years

The target project completion year is assumed as , which is the same as that for the short-term river flood mitigation projects and should be applied to only economically viable projects.

6.3.4 Design Hyetograph

In order to keep consistency with the aforesaid river flood mitigation project, the temporal rainfall variation for the design hyetograph is assumed as the center-concentrated type and, the design hyetograph was developed based on the the rainfall intensity-duration curve at Port Area rainfall station. The rainfall duration is set at 24 hours, and interval is 15 minutes (refer to Figure 6.3).



Source: JICA Study Team

Figure 6.3 Design Rainfall Pattern for Storm Drainage Improvement Plan (1/15 Years Flood Frequency)

6.3.5 Conditions of Planning Target Area

The three (3) drainage areas of Maalimango Creek, Panamitan River, and north-east areas of Kawit are selected as the objective of the storm water drainage improvement based on criteria of the present seriousness of flood damages, needs of flood countermeasures, and low ground level as shown in Table 6.2.

Table 6.2 Target Drainage Improvement Area

Name of Drainage Area		Code No.	Selection Criteria
Maalimango Creek		D-13	- Serious flood damage - Needs of flood countermeasure for CEZ and Municipality of Rosario
Panamitan River		D-7	- Serious flood damage - Needs of flood countermeasure (Municipality of Kawit)
North-East Area of Kawit	Binakayan	D-4	- Serious flood damage - Low ground level (potential site for pumping scheme)
	Malamok River	D-5	
	Tirona	D-6	

Source: JICA Study Team

As stated in the foregoing Section 6.2, Imus River, San Juan River, and Canas River were studied and selected as the objective river basins of the river flood control project. The Maalimango Creek

Drainage Area and Panamitan River Drainage Area are located adjacent to San Juan River Basin. Likewise, the Kawit East Area of Kawit Drainage Area connects to Imus River Basin as shown in Figure 6.4. Due to the locations of these target drainage areas, the synergy effect is expected between the river flood control for Imus River and San Juan River and the drainage improvement of the target drainage areas.

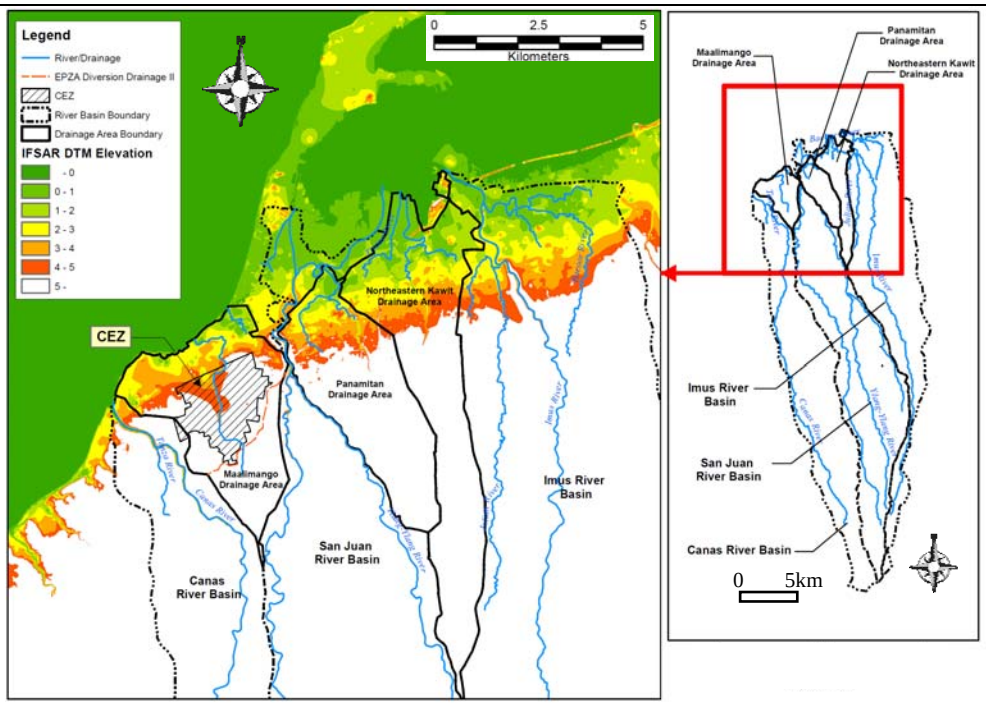


Figure 6.4 Location of Target Storm Water Drainage Improvement Area

6.4 Planning Framework for Countermeasures against Storm Surge

6.4.1 Design High Tide Level

The alternative three (3) methodologies to determine the design high tide level (DHTL) are preliminarily considered as shown in Table 6.3. Among the alternative methodologies, however, the methodologies 2 and 3 in the Table are hardly applied due to the insufficient number of samples for probability analysis. On the other hand, the methodology 1, which is to determine the design high tide based on the observed highest tide level, is judged to be most reliable. Accordingly, the value of EL. 1.4 m above MSL estimated from the methodology 1 is applied as the design high tide.

Table 6.3 Alternative Methodologies for Determination of Design High Tide Level

No.	Method	Description	Proposed DHTL	Remarks
1	Recorded Highest Tide Level	➢ Highest water level: 1.4 m ➢ From NAMRIA, highest water level occurred in September 2011	1.4 m (above M.S.L)	➢ Observed tide level from 2007 shall be verified.
2	Syzygy average high water level + Probable storm surge	➢ Syzygy average high water level: 0.80 m ➢ Using syzygy water level from April to December ➢ Probable storm surge: 1.0 m ➢ In Japan, 50 year-flood frequency is employed as design scale. Storm surge of 50 year-flood frequency is 101.6 cm	1.8 m (above M.S.L)	➢ Observed tide level from 2007 shall be verified. ➢ Number of sample is 8 years only, which is not enough for statistical analysis. Therefore, this value is treated as reference.
3	Syzygy average high water level + Highest storm surge	➢ Syzygy average high water level: 0.80 m ➢ Using Syzygy water level from April to December ➢ Maximum storm surge: 0.76 m ➢ This storm surge occurred at Typhoon Pedring in September 2011.	1.6 m (M.S.L)	➢ Observed tide level from 2007 shall be verified. ➢ Since number of storm surge data is 8 years only (from 2007 to 2014), old data before 2007 should be examined.

Source: JICA Study Team

6.4.2 Target Project Completion Year

According to the results of interview survey, the damages by the storm surge are judged to be far smaller than those by the river flood and/or the storm water. Moreover, the development of the coastal dike has to be made on the premises of plans for the river flood mitigation and/or the storm drainage improvement.

For this reason, the countermeasures against the storm surge are assumed as a part of the long-term project to be implemented subsequent to completion of the projects for the river flood mitigation and/or the storm drainage improvement, and the definite target completion year for them are not set in the Study.

6.5 Impact of Climate Change on Design Flood Level

6.5.1 Change of Recurrence Probability of Design Rainfall Intensity

The impact of climate changes on the design rainfall intensity for the structural flood mitigation plan was examined based on the results of the two (2) previous simulations on the climate changes for the Study Area (refer to Table 6.4). It is herein noted that these simulations are based on A1B Scenario, one of the greenhouse gas emissions scenario [i.e., Special Report on Emissions Scenarios (SRES)]. The SRES had been used since the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2001. However, the Representative Concentration Pathways (RCP) Scenario was newly applied instead of SRES since the Fifth Assuagement Report in 2013.

The SRES is the scenario to predict the future volume of greenhouse gas emission based on certain assumptions about the worldwide socio-economic trends. On the other hand, the RCP is the scenario on the policy for mitigation of the greenhouse gas emission and other radiative force on the premises

of the target degree of the future radiative force. Accordingly, the impacts of the climate changes based on the SRES are different from those of RCP.

This Study aims at estimating the degree of impact of the climate change on the design flood level (safety level) of the flood mitigation facilities but not discussing about the policy on mitigation of the greenhouse gas emissions. From this point of view, the A1B Scenario is judged to be appropriate for the evaluation, since it assumes the moderate greenhouse gas emissions standing between the extreme scenarios A1F1 (emphasizing the use of fossil energy) and A1T (emphasizing the use of non-fossil energy). Moreover, there is no available simulation result for climate change for the Study Area with the high grid resolution except those by the two (2) simulation models for A1B Scenario of SRES. For this reasons, the Study was made on the A1B Scenario although the scenario is not discussed in the updated IPCC.

Table 6.4 Features of Previous Simulation on Climate Change relevant to the Study Area

Simulation Mode/Research Institution	Regional Climate Model (RCM) by PAGASA	Atmospheric General Circulation Model (AGCM) by Meteorological Research Institute (MRI), Japan
Objective Area of Simulation	The Whole Country including Cavite Province	Pasig-Marikina River and Laguna Lake Basin including the Study Area
Grid Resolution	25km	20 km
Scenario on Greenhouse Gas Emissions	A1B Scenario	A1B Scenario
Years for Prediction of Rainfall Intensities	1985 (1971-2000)、2020 (2006-2035)、2050 (2036-2065)	1992 (1980-2004)、2027 (2015-2035), 2087 (2075-2099)

Source: JICA Study Team

According to the results of the above simulations for the climate changes, the design scale of 25years flood frequency applied to the flood mitigation facilities in 2015 would drop to 18years flood frequency in 2027 and further 11years flood frequency in 2050. The design scale of 50years flood frequency applied in 2015 would also drop to 35years flood frequency in 2027 and 18years flood frequency in 2050 as shown in Table 6.5. As for the storm water drainage, the design scale of 10years flood frequency applied in 2015 would drop to 1/8 years and 1/5.5 years in 2050, respectively.

Table 6.5 Predicted Decline of Future Design Flood Levels Influenced by Climate Change

Flood Mitigation Project	Rainfall for Setting of Design Flood	Design Flood Level in 2015		Future Flood Frequency of Design Flood	
		Intensity	Flood Frequency	2027	2050
River Flood Mitigation	2-day rainfall intensity	354 mm/2days	1/25 years	1/18 years	1/11 years
		383 mm/2days	1/50 years	1/35 years	1/18 years
Storm Water Drainage	1-hour rainfall intensity	82 mm/hr	1/10 years	1/8 years	1/5.5 years

Source: JICA Study Team

6.5.2 Plan for Adaptation to Climate Change by Structural Measures

The worldwide transit effects of climate change will gradually progress over centuries, while the precise prediction of such transit effects is hardly made due to unknown factors on the future volume of emission of greenhouse gas and the inadequate accuracy of the current simulation models for the future climate changes. For this reason, there is a risk to induce the excessive scale of flood

mitigation facilities to cope with the future decline of the design safety level of the facilities. On the other hand, when the flood mitigation facilities are designed ignoring the transit effects of climate change, the safety degree of the facilities against the flood would gradually decline leading to increment of risk of flood damage. In order to cope with these conflicts, the following schemes for adaptation to the climate changes are proposed.

(1) Minimizing of Flood Damage and Strengthening of Resilience of Flood Mitigation Facilities against Climate Changes

It is virtually difficult to avoid the extraordinary scale of floods, which exceeds the design flood level of the flood mitigation facilities, and such floods would occur more often as climate changes progress. In order to cope with such extraordinary scale of floods, the HWL for the river channel improvement, the diversion channel, the flood retarding basin and the flood retention ponds should be set not to largely exceed the hinterland level so as to minimize the risk of collapse of the dikes along the flood mitigation facilities. At the same time, it could prevent the large volume of flood overflow from flushing into the ground level at once.

(2) Stepwise Upgrading of Flood Mitigation Capacity according to Progress of Flood Risk Increased by Climate Changes

The flood mitigation measures proposed in the Study are broadly classified into two groups; namely, (a) increase of the channel flow capacity by the improvement of river/drainage channels; and (b) increase of the basin flood retention capacity by the flood retarding basins and the flood regulation ponds. Of these measures, those for increase of the basin flood retention capacity could be gradually increased through adding the new flood regulation facilities in response to the increment of flood discharges caused by the climate change. On the other hand, it is difficult to implement stepwise widening of the river/drainage channels and/or raising the river dikes in response to the climate changes due to the houses densely packed along the river/drainage channels. From these viewpoints, the measures for stepwise strengthening of the basin flood retention facilities are placed as the principals against the climate changes.

(3) Spreading of On-site Flood Regulation Pond at Downstream End of New Subdivision

The on-site flood regulation pond is proposed to be set up at the downstream end of every new subdivision and it is possible to gradually update the standardized storage capacity of the pond in accordance with increment of rainfall intensities inflicted by the climate changes. From this point of view, the on-site flood regulation pond could be used as one of adaptations to the climate changes.

(4) Spreading of On-site Rainfall Storage and/or infiltration Facilities

The on-site rainfall storage or infiltration facilities aim at storing or infiltrating the rainfall just in place where the rain falls. The facilities are, in general, installed at open spaces such as the area between neighboring buildings, the park, the sports ground and the car parking areas. Each

of the facilities has far smaller flood mitigation capacity than the large scale flood control structures such as the flood retarding basin and the off-site flood regulation pond. However, substantial flood mitigation effects by rainfall storage or infiltration facilities could be expected as shown in Table 6.6, when the facilities are step-wisely spread out through the integrated cooperation by the entire community. Accordingly, the facility has the potential to be adapted to the climate changes.

Table 6.6 Effects of On-site Rainfall Storage and Infiltration Facilities

Facility	Assumed Conditions	Effect on Flood Mitigation
Rainfall Infiltration Facility	- To assume the basin average infiltration capacity of 5 mm/hr*	- The concentration time of the peak flood discharge in the Study Area is estimated at 5 hours. Within the said 5 hours, 25 mm or 15% of the accumulated rainfall depth of the design flood of 50years flood frequency could be infiltrated through the rainfall infiltration facility. - The above ratio of infiltrated rainfall depth (i.e., 15% of the accumulated rainfall depth) is judged to be significant to climate change considering that the rainfall intensity in the Study Area will increase by 12% from 2015 to 2025 due to climate change as described above.
Rainfall Storage Facility	- To assume 30 cm as the allowable maximum storage depth for safety of the open space. - To assume that 3% of the premises of a new subdivision is used as the open space for the rainfall storage facility. - To assume that a flood regulation pond has been installed at the downstream end of the new subdivision.	- The rainfall storage facility could reduce 15% of the necessary storage volume of the flood regulation pond, which is designed to cope with the rainfall intensity as of 2015 in the Study Area. - The above retention capacity by the rainfall storage facility is almost equivalent to the incremental ratio of the rainfall intensity by the climate change from 2015 to 2050.

Note: : * Tentative measures for the preliminary design of the rainfall infiltration facility in Japan (refer to "Guideline on Development of Rainfall Infiltration facility (Draft) Ministry of Land and Transportation, April 2010")
Source: JICA Study Team

6.5.3 Plan for Adaptation to Climate Change by Non Structural Measures

It is difficult to cope with the climate changes solely by the structural flood mitigation measures. The non-structural flood mitigation measures would be indispensable for floods which exceed the design flood level of the structures. At the same time, it would also be important to preserve the basin flood retention capacity through control of the expansion of the urbanized area. The major non-structural measures against climate changes are as enumerated below:

(a) Strengthening of flood evacuation and flood fighting system (including development of flood hazard map and opening of information on the flood hazard area and eligible flood evacuation routes to the public);

(b) Enactment of ordinance for on-site flood regulation pond;

(c) Enactment of ordinance for Urban Growth Management;

(d) Strengthening of regulations against the illegal garbage dumping into the water ways, and

(e) Strengthening of administration of the river area.

7. FORMULATION OF STRUCTURAL FLOOD MITIGATION PLAN

7.1 Classification of Structura in Flood Mitigation Plans

As described in the foregoing section 6.1, the flood mitigation plans examined in the Study are classified into (a) plan for river flood mitigation, (b) plan for storm drainage improvement, and (c) plan for storm surge. The results of formulation for these plans are as described hereinafter:

7.2 Plan for River Flood Mitigation

7.2.1 Establishment of River Basin Boundary

In the Philippines, the following river and flood control areas are prescribed in Presidential Decree No. 1067 (PD No. 1067) of December 31, 1976, otherwise known as "the Water Code of the Philippines.

- River Area: The river area is defined within the following distances from the river bank: 3 m in urban areas, 20 m in agricultural areas and 40 m in forest areas.
- Flood Control Area: The flood control area is to be declared by the Secretary of DPWH in order to promote the best interest and the coordinated protection of floodplain lands. In declared flood control areas, rules and regulations could be promulgated to prohibit or control activities that may damage or cause deterioration of lakes and dikes, obstruct the flow of water, change the natural flow of river, increase flood losses or aggregate flood problems.

Both of the river and flood control areas are subject to public use for flood control and other purposes related to the function of rivers and easement in case of the house relocation required. Prior to formulation of the river flood mitigation plan, a study is firstly made to delineate the areas which should be essentially part of the river area and/or the flood control areas based on the topography/land uses around the river channels and the provisions of the law relevant to the river area and the flood control area. The delineation of river areas and flood control areas could make a contribution to the following items: (a) securing of land necessary for the flood discharge to safely flow down; (b) prohibition of resettlement in the flood risk area; (c) control of land use and/or land development in the river area which would hinder the safe flow of flood discharge; and (d) securing of space for construction of river structures such as revetment, dike, flood retarding basin, sluice gate, etc. The definite river area and flood control areas proposed in this Study are as described hereinafter.

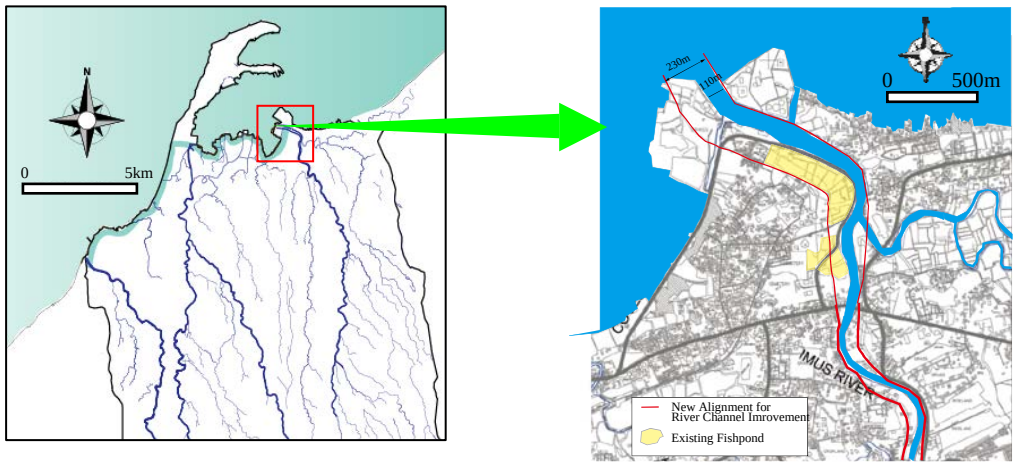
(1) Area Regarded as Part of River Area Judging from Topography/Land Use

Intensive land development in the Study Area has been made. As the land development made progress, parts of river channels were narrowed, the natural flood retarding areas such as the fishponds and the paddy fields were filled up and houses were built in the flood hazard area. As the result, the land which should be regarded as a part of river area is used as residential/commercial land, causing difficulties in safely discharging the flood flow and thus increasing the flood damage potential. In the Study, the areas which should be regarded as

river area and/or flood control area will be selected first. The results of selection of the areas are as described hereinafter.

(a) Fishponds along the Left Bank of Imus Downstream River Stretch

There exist the extensive fishponds along the left bank of Imus River from the river mouth to about 1,800 m upstream as shown in Figure 7.1. These fishponds had been functioning as the flood flow/retarding zones; however, they had been separated from the river by the road constructed just by the riverside. As the result, the river section along the fishponds became narrow, forming the bottleneck which led to the frequent channel overflow. Hence, the plan for Imus River Improvement is premised on the idea that the fishpond areas are put back to the river area, whereby the river channel could be widened from the present width of about 110 m to 230 m.

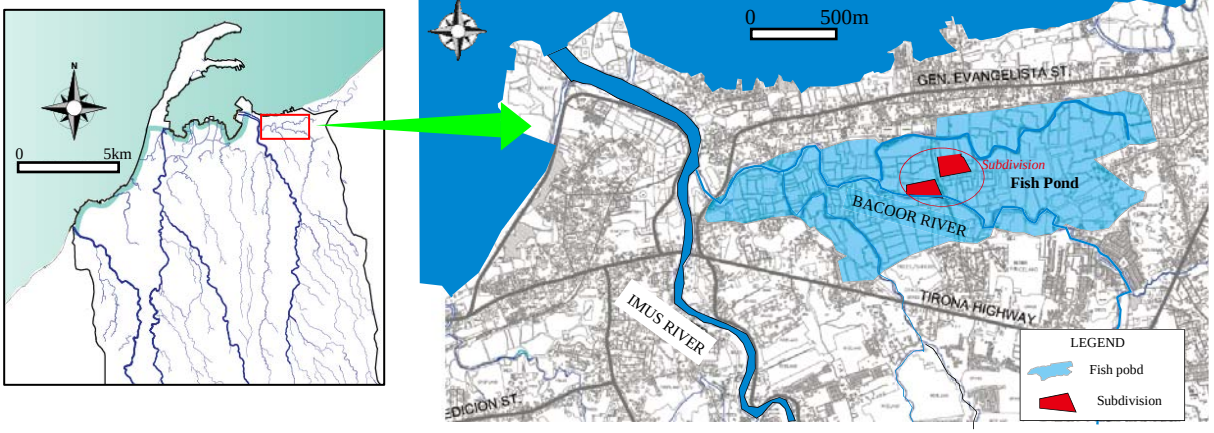


Source: JICA Study Team

Figure 7.1 Area along Left Bank of Imus Downstream River Stretch to be Turned into the River Area

(b) Fishponds along Bacoor Downstream River Stretch

Extensive fishponds of about 110 ha in total are located along both banks of the downstream stretch of Bacoor River from the confluence with Imus River up to 2,800 m upstream as shown in Figure 7.2. These fishponds are judged to have the flood retarding effect for not only Bacoor River but also Imus River. In spite of such flood retarding effects, a part of the fishponds is now being reclaimed for development of a housing complex. From these points of view, it is proposed that the fishponds should be preserved as the flood control area and any further land reclamation in the fishponds shall be prohibited and/or refrained.

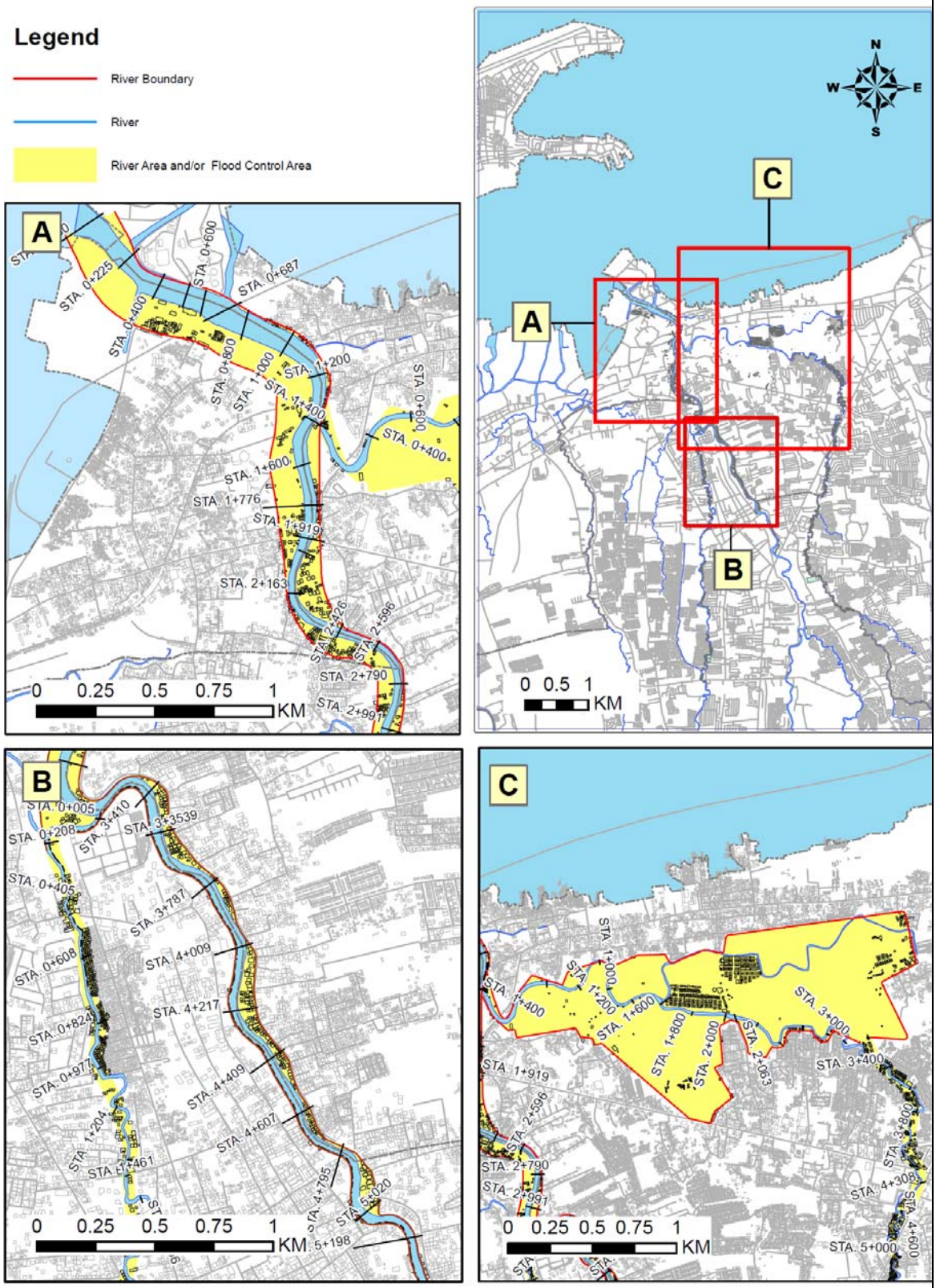


Source: JICA Study Team

Figure 7.2 Existing Fishpond along Bacoor River Downstream Stretch

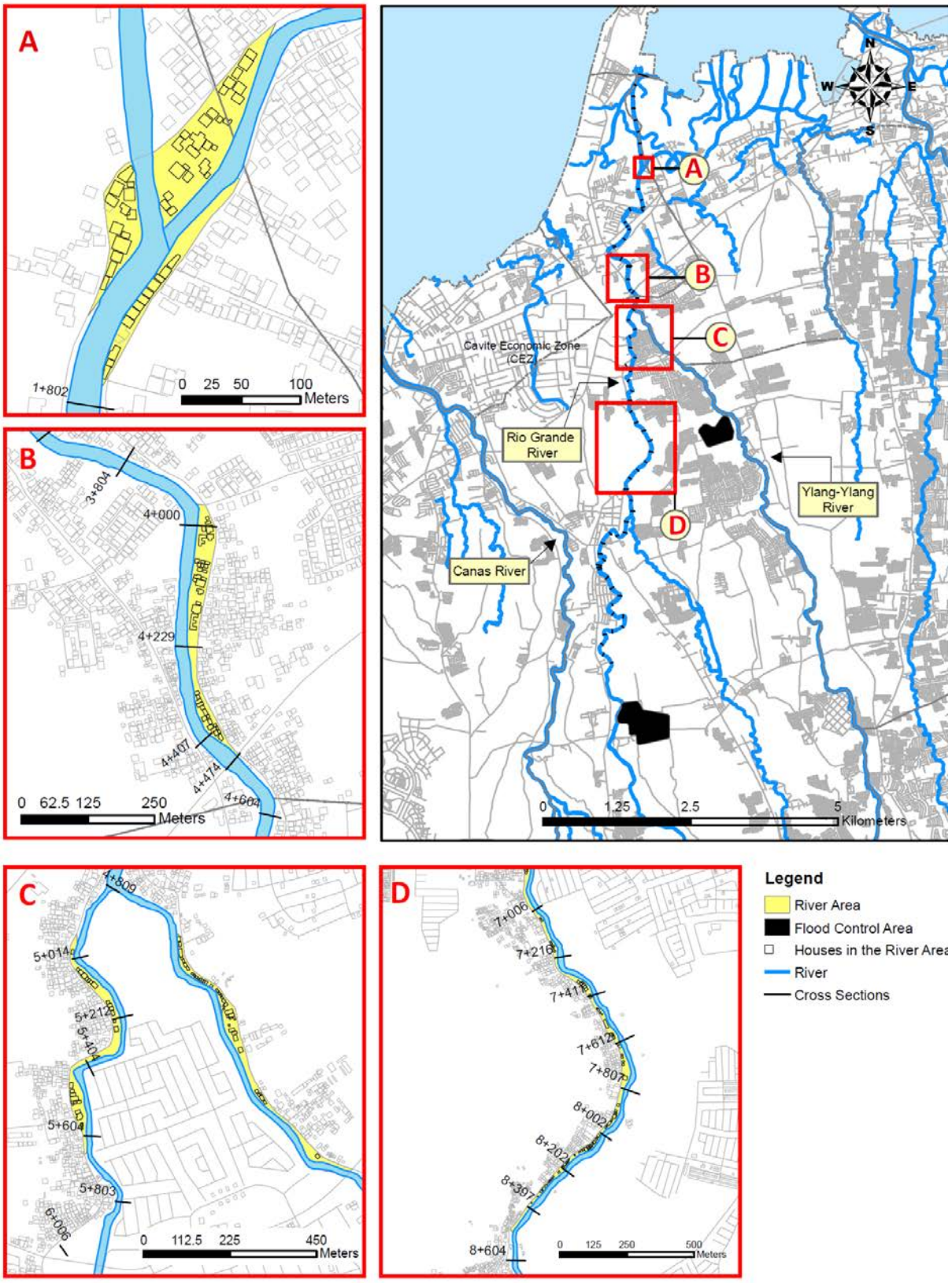
(c) Flood Hazard Area along River

There exist several flood hazard areas where the economic viability for any flood mitigation facility is hardly justifiable due to the particular topography and/or land use. These flood hazard areas should be designated as the river area or the flood control areas and non-structural measures are necessary, such as encouragement on moving of the residents from the areas and/or prohibition of resettlement into the areas. The location of these flood hazard areas are as shown in Figure 7.3 to Figure 7.5.



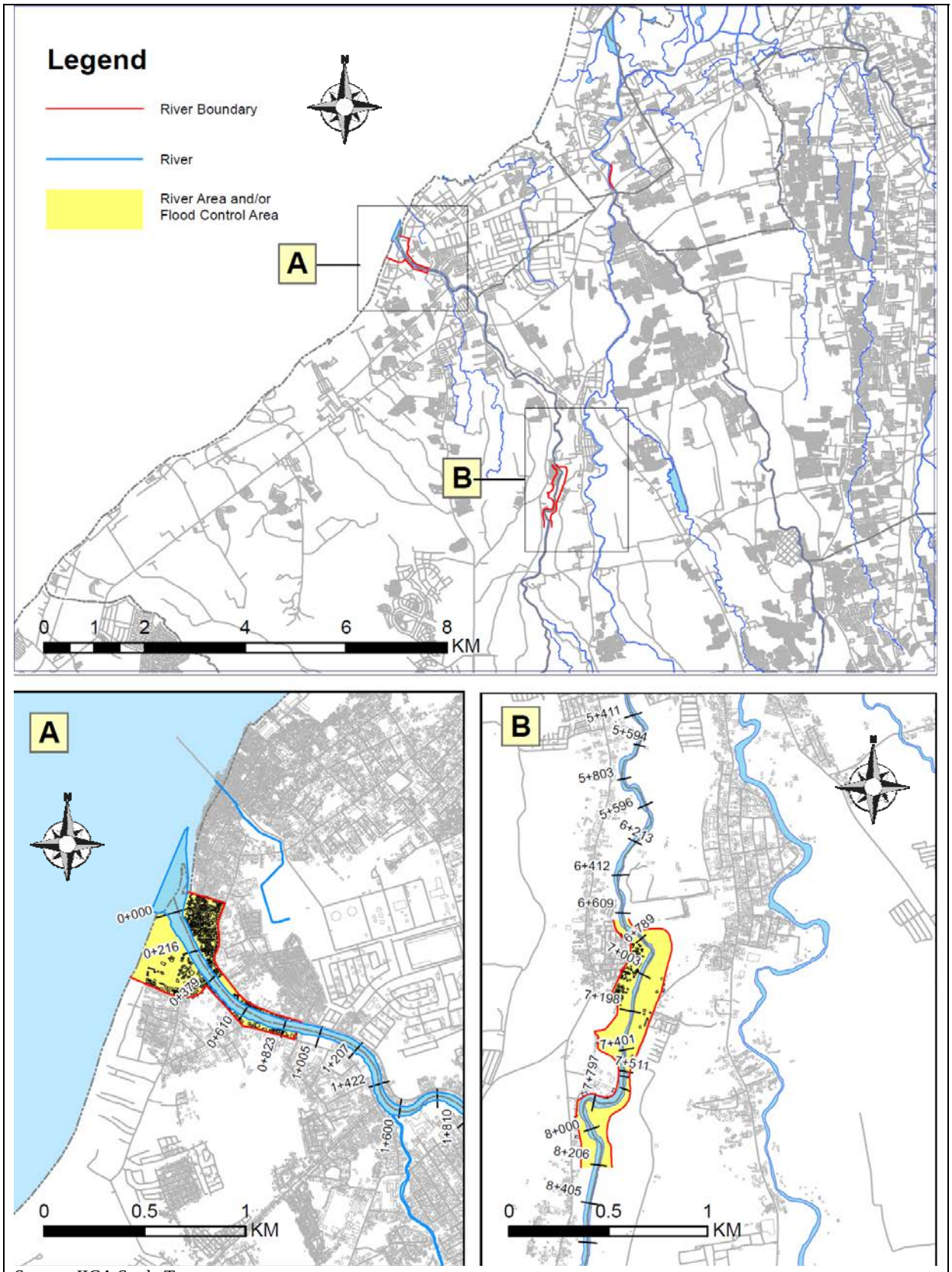
Source: JICA Study Team

Figure 7.3 Extent to be Designated as River Area along Imus River



Source: JICA Study Team

Figure 7.4 Extent to be Designated as River Area along Imus River

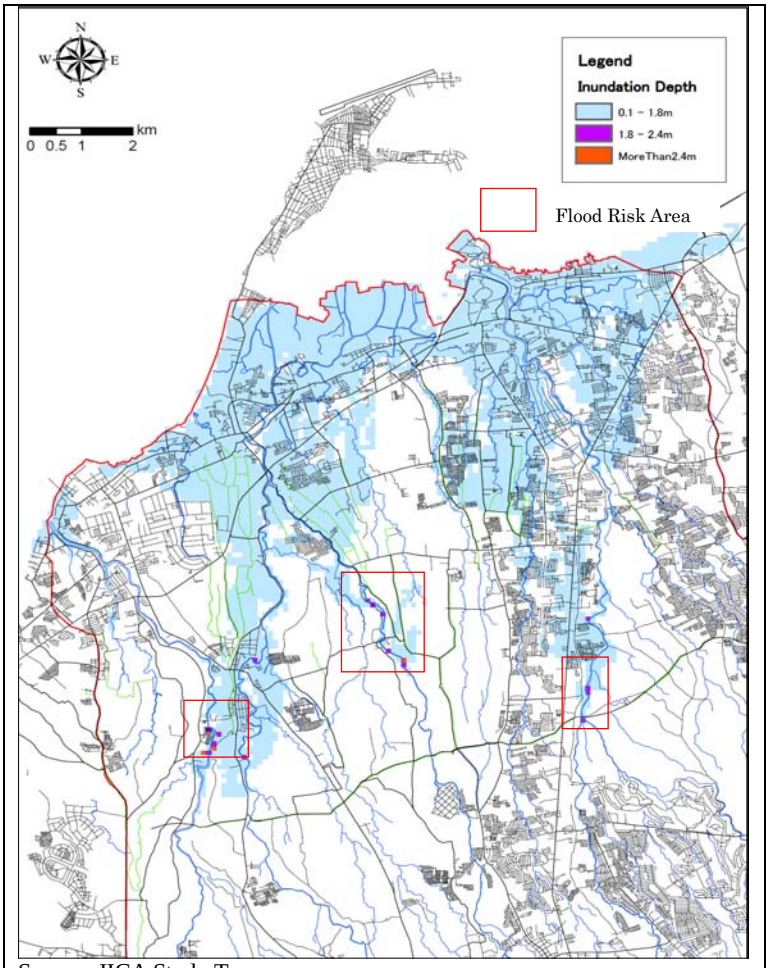


Source: JICA Study Team

Figure 7.5 Extent to be Designated as Flood Control Area along Canas River

(2) Flood Control Area to be Designated as Flood Control Area due to Potential Risk of Loss in Human Life by Flood

When there is a risk such that the flood causes the loss of human lives, the extent of such flood is proposed as the flood control area. The relation between the flood depth and the probability of loss in human life was analyzed by the US .Army Corps of Engineers Institute based on the actual damage caused by Hurricane "Katrina" in August 2005[4].



Source: JICA Study Team

Figure 7.6 Proposed Flood Control Area because of Risk of Loss of Human Life

According to the results of analysis, the mortalities of the residents of 65 years old and above is estimated at 0% in case of the flood water level below 1.8 m above ground level but they will increase to 12% for the flood water level of 1.8 m to 2.4 m and 92% for the flood water level of more than 2.4 m. In order to confirm the flood depth in the Study Area, the hydrological simulation was made on the recorded maximum flood caused by the Typhoon Milenyo in 2006 (the flood frequency of about 1/100 years). As the results, the three (3) flood hazard areas with the flood depth of more than 1.8 m. (i.e., more than the Compromise Zone) are confirmed as shown in Figure 7.6. These flood hazard areas are proposed as the flood control area in the Study.

7.2.2 Selection of Eligible River Flood Mitigation Measure

The alternative plans for river flood mitigation are composed of the various measures such as river channel improvement, the diversion channel, the flood retarding basin and the flood control dam. In

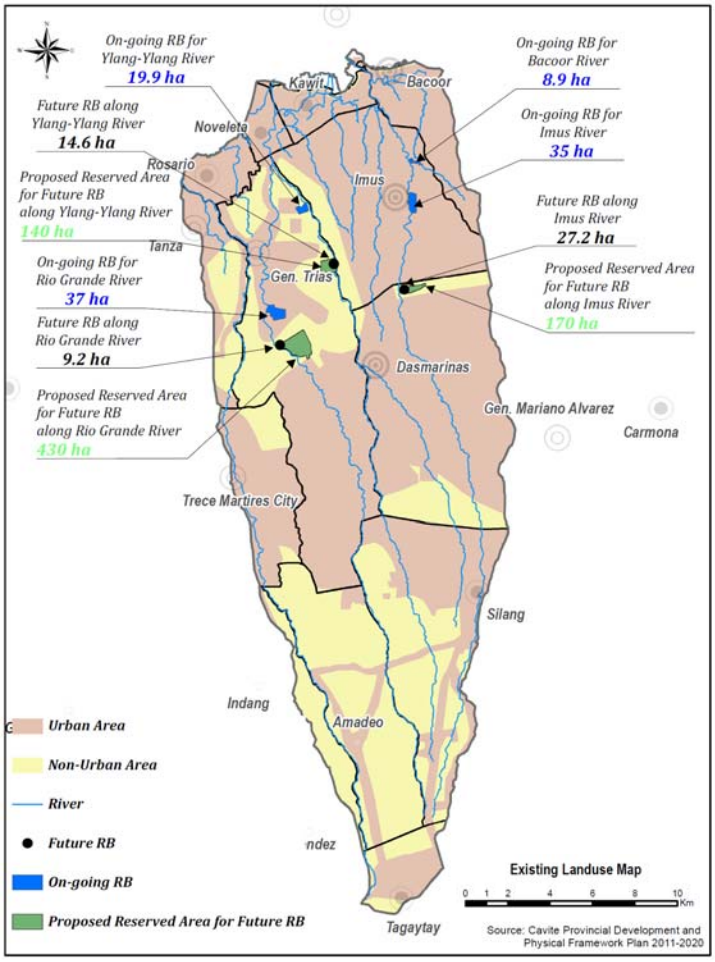
[4] Estimating Loss of Life from Hurricane-Related Flooding in the Greater New Orleans Area、 Loss-of-Life Modeling Report, Final Report, May 22, 2006, prepared by Gerald Stedge, Ph. D. and Mark Landry Maged Aboelata, Ph.D for U.S. Army Corps of Engineers Institute for Water Resources Alexandria

this Study, the eligible measures to be the elements of the alternative plans were firstly selected. The results of selection are as described hereinafeter.

(1) **Ongoing Flood Retarding Basins:** The ongoing projects for four (4) flood retarding basins in Imus and San Juan river basins are included as components of all alternatives in common to reduce the peak discharge of the downstream section.

(2) **River Channel Improvement:** The channel widening is adopted as the principal measure for the river channel improvement, and the HWL is set to be equal to or below the hinterland ground level except some special cases.

(3) **Diversion Channel:** Diversion Channel from the confluence of Rio Grande and Ylang-Ylang rivers to Manila Bay is selected as one of eligible measures to reduce the design flood discharge of the existing San Juan River Channel (the location of diversion channel is as shown in Figure 7.9).



Source: JICA Study Team

Figure 7.7 The Proposed Site for New Flood Retarding Basin

(4) **New Flood Retarding Basin:** The new flood retarding basins aim at stepwise upgrading of the design flood level of 1/25 years flood frequency in the first stage to 1/50 years in the second stage without change of the design discharges of 1/25 years flood frequency accomplished in the first stage[5]. The new flood retarding basins are assumed to locate in the non-urbanized areas designated in the land use zoning in 2020 proposed in the Study as well as the Initial Setting Growth Map prepared by the Provincial Government of Cavite (refer to Figure 7.7).

(5) **Flood Control Dams:** The Study Area is located at the slope formed by the eruption of Taal Volcano forming the V shape gorge. The flood control capacity given by such gorges is

[5] he definitions of the first and second stage are as shown in Table 6.1.

extremely small and there exits no suitable dam site in the Study Area. For this reason the flood control dam is excluded from the eligible measures for flood mitigation in the Study

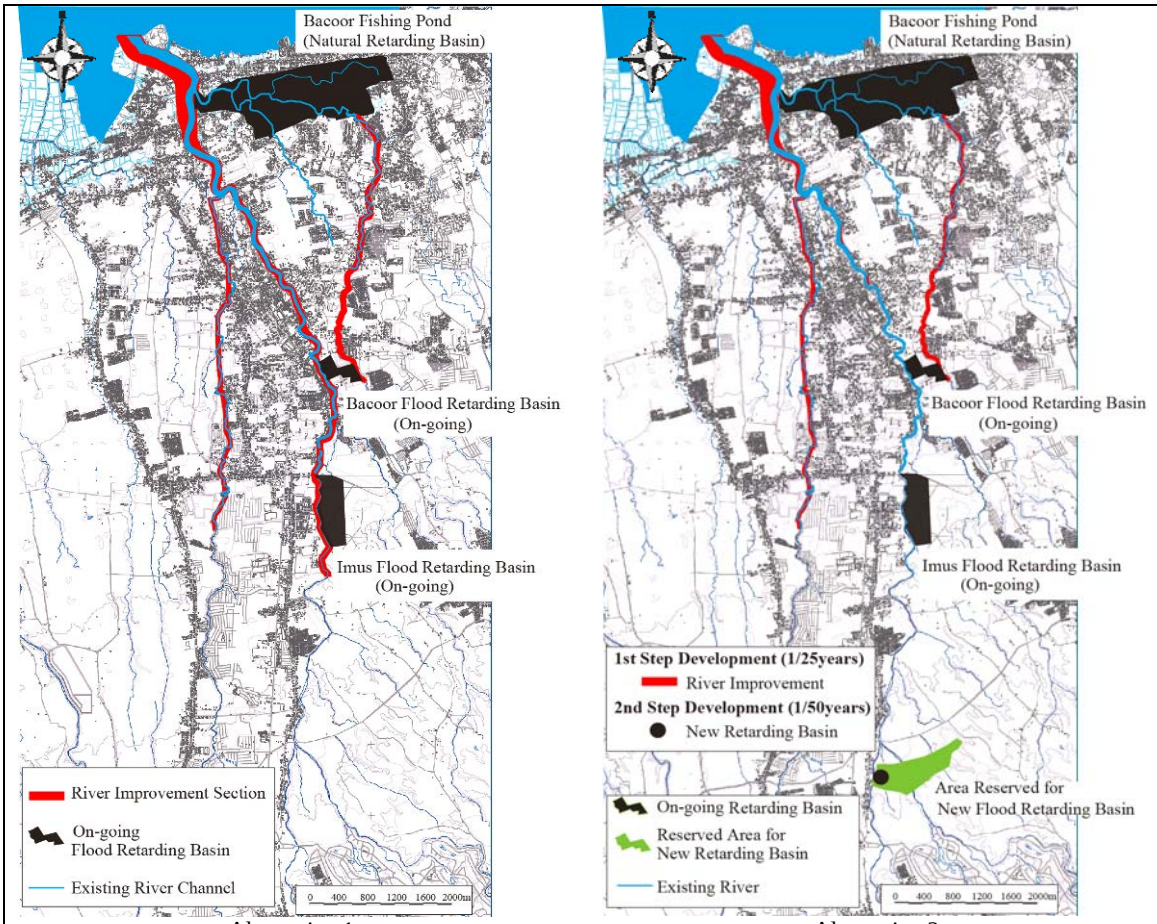
7.2.3 Selection of Alternative Flood Mitigation Plans

The alternative flood mitigation plans are subject to the design flood level of 1/50 years and those for Imus and San Juan River System are set taking various combinations of the aforesaid flood mitigation measures (refer to Table 7.1 and Figure 7.8 to Figure 7.9). It is herein noted that the Alternative 2 for Imus River System and Alternatives 2 and 3 for San Juan River System mentioned below contain the construction of new flood retarding basin as shown in Table 7.1 and they are oriented to stepwise development attaining the design flood level of 1/25 years at the first stage and 1/50 years at the second stage. As for the Canas River System, most of the river channels possess the channel flow capacity of more than 1/50 years flood frequency and, therefore, the economic viability of the structural flood mitigation measures for the design flood level of 1/50 years is hardly verified. For this reason, instead of structural flood mitigation measures, proposed is the "prevention of encroachment to the river area" as the non-structural measure against the design flood level of 1/50 years for the designated flood control area, which will encourage the evacuation of residents from the area and prohibit resettlement into the area (refer to Figure 7.5) .

Table 7.1 Alternative Flood Mitigation Plans for Imus and San Juan River Systems

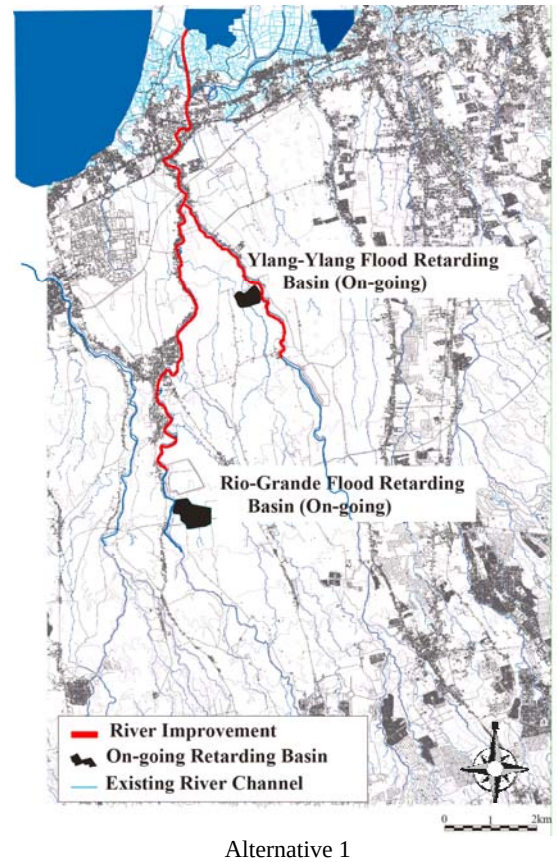
Flood Mitigation Measure	Imus River System		San Juan River System				Canas River System
	Alt. 1	Alt. 2	Alt. 1	Alt. 2	Alt. 3	Alt. 4	
River Channel Improvement	○	○ Short/Mid Term	○	○	○ Short/Mid Term	○ Short/Mid Term	X
Diversion Channel	X			○	X	○	X
New Flood Retarding Basin	X	○ Long Term	X	X	○ Long Term	○ Long Term	X

Note: The flood mitigation for the Canas River System is to be made solely by the non-structural measure.
○: Apply the measure, X: Not apply the measure
The Alt. 2 for Imus River System and Alts. 3 & 4 for San Juan River System are subject to stepwise development to boost the design flood level to 1/25 years and 1/50 years.
Source: JICA Study Team

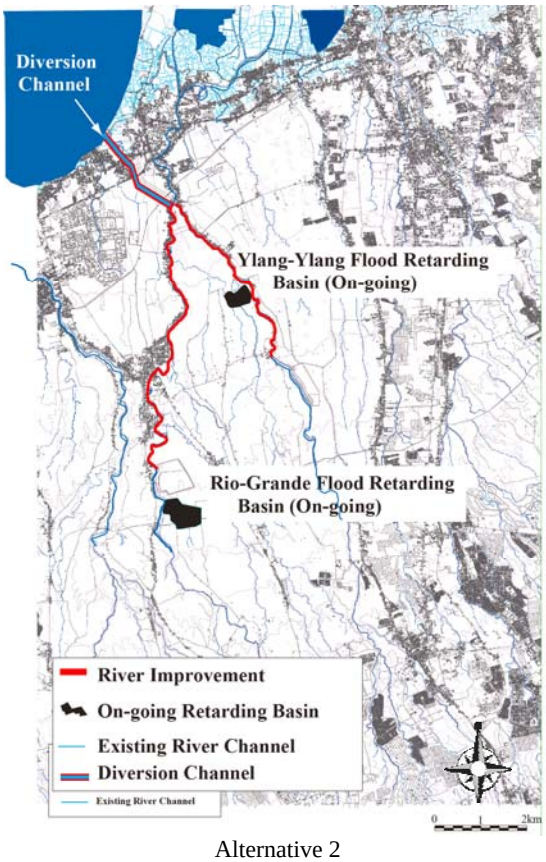


Source: JICA Study Team

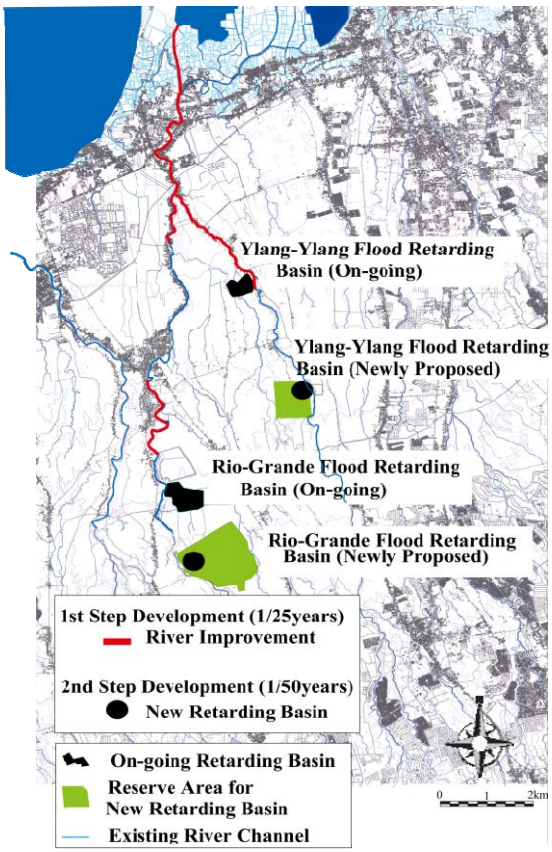
Figure 7.8 Alternative Flood Mitigation Plan for Imus River System



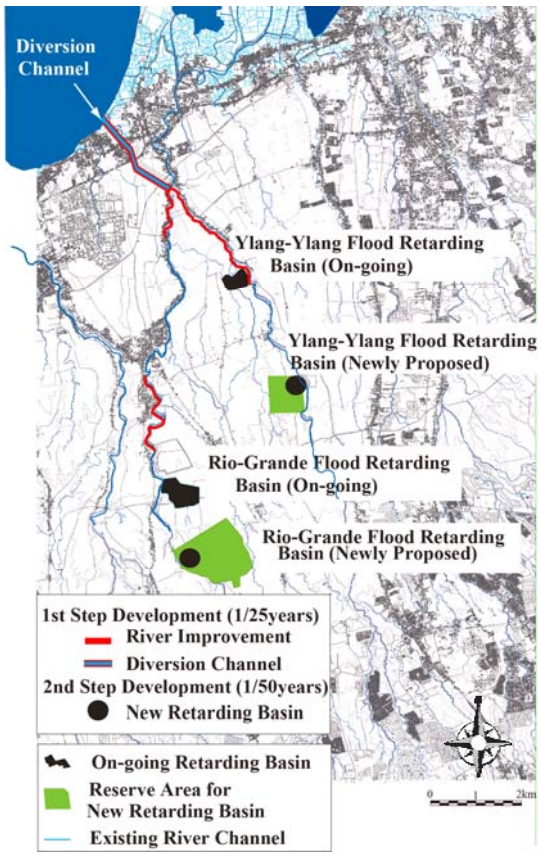
Alternative 1



Alternative 2



Alternative 3



Alternative 4

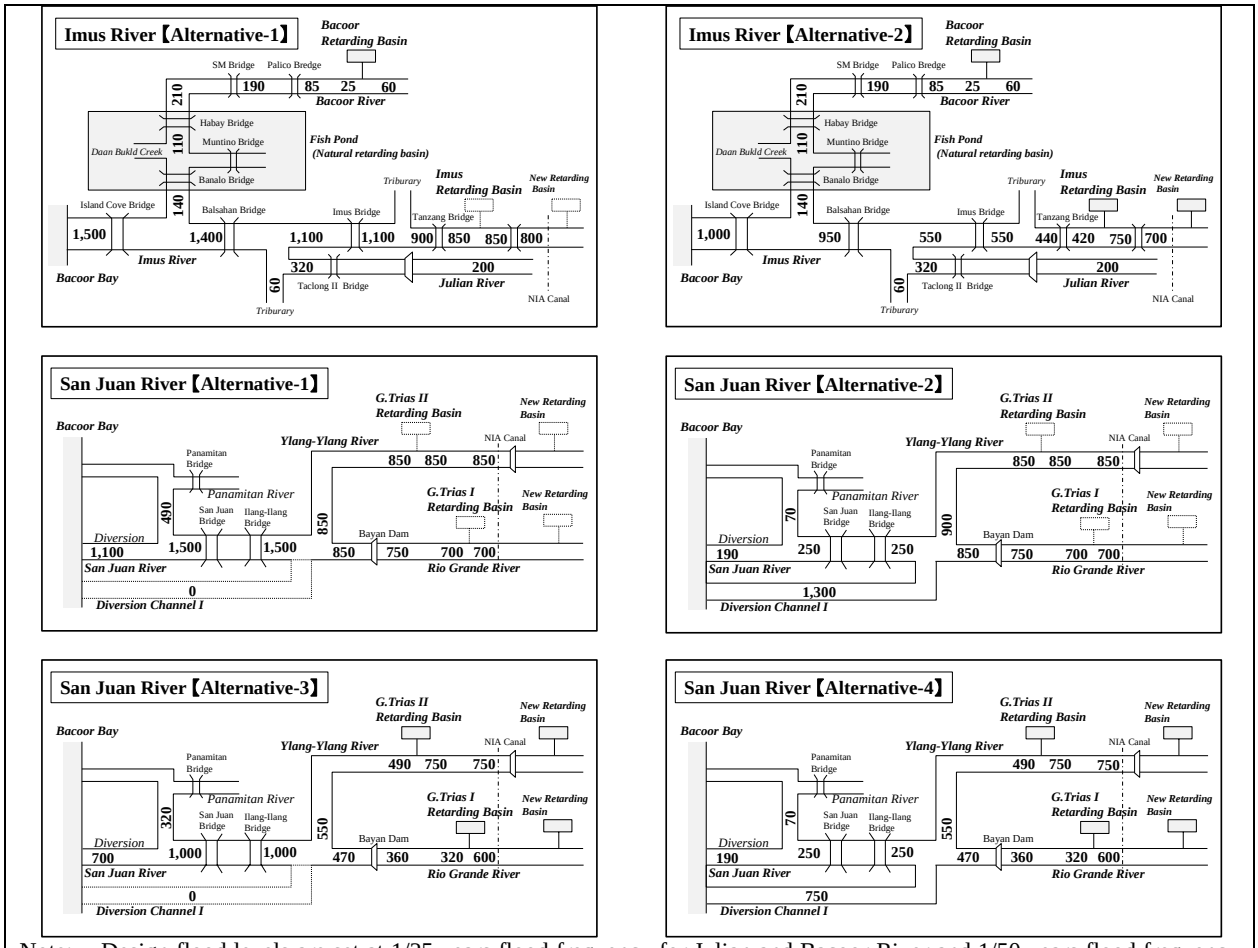
Source: JICA Study Team

Figure 7.9 Alternative Flood Mitigation Plans for San Juan River System

7.2.4 Basic Plan of Facilities for River Flood Mitigation

(1) Distribution of Design Flood Discharges

As described in the foregoing Subsection 6.2.1, the design flood level of 1/25 years flood frequency is set as the ultimate goal for Bacoor and Julian rivers that could comply with the guidelines of DPWH for small rivers. All objective rivers other than the said two (2) rivers have the catchment area of more than 40 km^2 and have to attain the design flood level of 1/50 years flood frequency. The stepwise program to boost the design flood levels to 1/25 years and 1/50 years flood frequency may be adopted for Alternative 2 for Imus River System and Alternatives 3 and 4 for San Juan River System. It is herein noted that as far as these alternatives are concerned, the distribution of design discharges of 1/50 years flood frequency in the lower reaches of the new flood retarding basin could be made equivalent to those of 1/25 years flood frequency because of the flood control effects by the new flood retarding basin as shown in Figure 7.10 below.



Note: Design flood levels are set at 1/25 years flood frequency for Julian and Bacoor River and 1/50 years flood frequency for all other rivers.
Source: JICA Study Team

Figure 7.10 Distribution of Design Flood Discharges for San Juan River System

(2) Basic Plan of Facilities for River Flood Mitigation

(a) Standard Cross Section for River Channel Improvement

The standard cross section is designed as the single section in the same way as the sections of the existing river channel. Referring to the existing channel slope angle, the face of slope of 1 to 0.5 and 1 to 2.0 are applied to most of the channel section. Especially, the slope of 1 to 0.5 only is applied in case of the very limited work space due to the dense houses. The Design High Water Level (HWL) is, in principle, set to be equal or below the hinterland ground level for the channel improvement sections except those along the area densely packed with houses and no adequate land for channel widening could be acquired.

(b) Longitudinal Plan for River Channel Improvement

The design high water level at the river mouth is set at the Mean High Spring Water of 0.8m above Mean Sea Level; and the freeboard above the HWL is set in accordance with the Design Guideline of DPWH as shown in Table 7.2.

Table 7.2 Design Flood Discharge and Freeboard

Design Discharge (m^3/s)	Freeboard (m)
200以下	0.6
200 ～500	0.8
500 ～2,000	1.0
2,000 ～5,000	1.2

Source: Manual on Design of Flood Control Structures, DPWH

The design riverbed level in the middle/upper reaches are set in accordance with the existing river bed, since the taff rock is exposed at the existing riverbed leading to small fluctuation of the existing riverbed. However, some sediment deposit tends to make progress and the periodical dredging may be required in the estuary.

(c) Alignment Plan for River Channel Improvement

The alignment for the river channel improvement will run along the existing river channel. However, some short-cut and realignment will be made in order to minimize the number of house relocations especially in the densely populated area.

(3) Basic Plan on Diversion Channel

(a) Standard Cross Section for Diversion Channel

The standard cross section is designed as the single section in the same way as the sections of the existing river channel. The face of slope of 1 to 3.0 is applied in accordance with the results of slope stability analysis. The HWL is, in principle, set to be equal or below the hinterland ground level at the upper part of the channel. However, the one at the lower part is higher than the hinterland ground level and embankment is required.

(b) Longitudinal Plan for Diversion Channel

Although the HWL is set to be equal or below the hinterland ground level at the upper part of the channel, the one at the lower part is higher than the hinterland ground level with the Mean High Spring Water of 0.8m above Mean Sea Level. The freeboard above the HWL is set in accordance with the Design Guideline of DPWH and the same as the one for the river channel.

Since some sediment deposit tends to make progress at the river mouth and the lower part of the river channel, the periodical dredging at the lower part of the diversion channel may be also required.

(c) Alignment Plan for Diversion Channel

The diversion channel crosses the cemetery area and/or densely populated area. The alignment for the diversion channel will run the area with less crossing houses, less crossing area of cemetery and less curvature.

(4) Plan for Flood Retarding Basin

As stated in the beginning of Chapter 4, the proposed alternative flood mitigation plan includes the four (4) ongoing flood retarding basins [two (2) for Imus River Basin and another two (2) for San Juan River Basin] and new flood retarding basins are further proposed at three (3) sites (Imus, Ylang-Ylang and Rio Grande rivers) as the potential measures. The exact location and structural dimensions of the flood retarding basins for the ongoing project have been set through the detailed designs. On the other hand, the definite site and the structural dimensions of the new flood retarding basins will be determined through the forthcoming detailed design. In this Study, the locations of the new flood retarding basins are preliminarily assumed based on the present land use states and future land use plan. The structural dimensions of the new flood retarding basins are also provisionally estimated based on the hydrological simulation. The salient features of the flood retarding basins set by the detailed design and preliminarily estimated in the Study are as shown in Table 7.3.

Table 7.3 Salient Features of Ongoing and Proposed New Flood Retarding Basins

Classification	Name of River	Storage Capacity (million m^3)	Extent of Project Site
Ongoing Flood Retarding Basin (Design Flood Level: 1/25 years flood frequency)	Bacoor	Not disclosed	
	Imus		
	Ylang-Ylang		
	Rio Grande		
New Flood Retarding Basin under long-term Plan (Design Flood Level:1/50 years flood frquency)	Imus		
	Ylang-Ylang		
	San Juan		

Source: FRIMP-CTI and JICA Study Team

7.2.5 Project Cost of Alternative Flood Mitigation Plan

The project cost of each of the alternative plans for flood mitigation of Imus and San Juan rivers is estimated as shown in Table 7.4

Table 7.4 Project Cost of Alternative Flood Mitigation Plans for Imus and San Juan Rivers

(Unit: million pesos)

Item	Imus River System		San Juan River System			
	Alt. 1	Alt. 2	Alt. 1	Alt. 2	Alt. 1	Alt. 2
Civil Works	Not disclosed					
Engineering Services						
Land Acquisition/Compensation						
Administration						
Physical Contingency						
Price Contingency						
VAT						
Total						

Source: JICA Study Team

7.2.6 Selection of Optimum Flood Mitigation Plan

(1) Optimum Flood Mitigation Plan for Imus River System

The evaluation sheet on the alternative flood mitigation plans for Imus River is shown in Table 7.5. Alt. 2 is selected as the optimum flood mitigation plan. The particular grounds for the selection of Alt. 2 are as stated below:

- Alt. 2 would require a smaller scale of river channel improvement and less project cost/number of house relocations than Alt. 1. At the same time, Alt. 2 could attain early flood mitigation effects than Alt. 1.
- In the case of Alt. 2, the new flood retarding basin is to be implemented after the completion of the first step flood mitigation project (i.e., the project for river channel improvement). For this reason, the flood control capacity of the new flood retarding basin could be more appropriately adjusted according to the increment of flood runoff discharge caused by the expansion of urban area and/or climate changes. In the case of Alt. 1, however, it is difficult to execute the stepwise construction of flood mitigation facilities and hence, flexible adjustment of the facilities according to the expansion of urban area and/or climate changes could hardly be made.

Table 7.5 Evaluation of Alternatives and Selection of Optimum Flood Mitigation Plan for Imus River Basin

Evaluation Items	Results of Evaluation	
	Alt. 1	Alt. 2
Reduction of Calamity Risk	- Alt. 1 could avoid the risk of flood damage by floods of 1/50 years frequency. - Alt. 1 could hardly adapt to the increment of flood risk brought about by the expansion of urban area and climate change.	- Alt. 2 could avoid the risk of flood damage by floods of 1/50 years frequency. - Alt 2 could adapt to climate change and/or expansion of the urban area.
Impact on Social Environment	- House relocation : houses - Land acquisition : ha.	- House relocation : houses - Land acquisition : ha.
Impact on Natural Environment	- The Project will have a minor effect to natural environment.	Same as on the left
Risk of Pollution	- The Project will cause noise and waste pollution as well as traffic congestion due to construction works in the urban area.	Same as on the left
Project Cost		
Economic Internal Rate of Return (EIRR)		
Restriction to Construction Work	- The river channel improvement has to be carried out within a limited space in the urban area.	Same as on the left
Recommended Optimum Plan and reason for recommendation	Not Recommended	**Recommended:** - Earlier flood mitigation effect - Less project cost, number of house relocations and land acquisition - Adaptable to climate change and expansion of urban area

Source: JICA Study Team

(2) Optimum Flood Mitigation Plan for San Juan River System

The evaluation sheet on the alternative flood mitigation plans for San Juan River is shown in Table 7.5. Alt. 4 is selected as the optimum flood mitigation plan. The particular grounds for the selection of Alt. 4 are as stated below:

- Alt. 4 would require least project cost and number of house relocation among the alternatives. At the same time, Alt. 4 could attain early flood mitigation effect through stepwise flood mitigation as compared with Alts. 1 and 2.
- In the case of Alt. 4, the new flood retarding basin is to be implemented after the completion of the first step flood mitigation project. For this reason, the flood control capacity of the new flood retarding basin could be more appropriately adjusted according to the increment of flood runoff discharge caused by the expansion of urban area and/or climate changes. On the other hand, in Alts. 1 and 2, it is difficult to execute the stepwise construction of flood mitigation facilities and hence, flexible adjustment of the facilities according to the expansion of urban area and/or the climate changes could hardly be made.

Table 7.6 Evaluation of Alternatives and Selection of Optimum Flood Mitigation Plan for San Juan River Basin

Evaluation Item	Results of Evaluation			
	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Reduction of Calamity Risk	- Alt. 1 & 2 could avoid the risk of flood damage by floods of 1/50 years flood frequency. - Alt. 1 & 2 could hardly adapt to climate changes and the expansion of urban area.		- Alt. 3 & 4 could get rid of the risk of flood damage by floods of 1/50 years flood frequency. - Alt. 3 & 4 could adapt to climate changes and/or the expansion of urban area.	
Impact on Social Environment	- House relocation: houses - Land acquisition: ha.	- House Relocation: houses - Land acquisition:: ha.	- House Relocation: houses - Land acquisition: ha.	- House Relocation: houses - Land acquisition: ha.
Impact on Natural Environment	- The Project will have a minor effect on the natural environment.			
Risk of Pollution	- The Project will cause noise and waste pollution as well as traffic congestion due to construction work in the urban area.			
Project Cost				
Economic Internal Rate of Return (EIRR)				
Restriction to Construction Work	- The river channel improvement has to be carried out within a limited space in the urban area.	- The river channel improvement has to be carried out within a limited space in the urban area. - The diversion channel has to cross the two major arterial roads.	The river channel improvement has to be carried out within a limited space in the urban area.	- The river channel improvement has to be carried out within a limited space in the urban area. - The diversion channel has to cross the two major arterial roads.
Recommended Optimum Plan and reason for recommendation	Not recommended	Not recommended	Not recommended	**Recommended** - Earlier flood mitigation effect. - Least project cost, number of house relocations and land acquisition. - Most adaptable to climate change and expansion of the urban area.

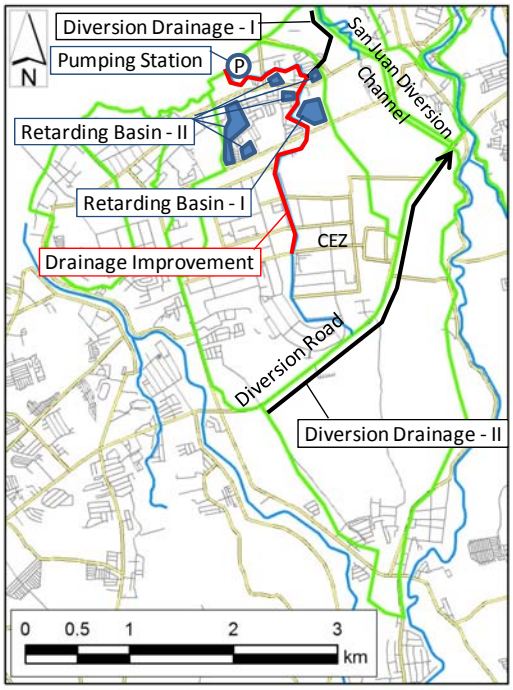
Source: JICA Study Team

7.3 Plan for Storm Water Drainage

7.3.1 Selection of Optimum Plan for Maalimango Creek Drainage Area

(1) Eligible Drainage Measures

The effective types of flood control measures for the Maalimango Creek as described hereinafter are selected considering the land use and topography (refer to Figure 7.11).



Source: JICA Study Team

Figure 7.11 Eligible Drainage Measures for Maalimango Creek Drainage Area

(a) Drainage Improvement

Drainage Improvement is the measure that enables the design discharge to flow through the channel with the introduction of channel widening, dredging, excavation, or construction of levee.

(b) Diversion Drainage I

Diversion Drainage I is the measure to divert the floodwater from Station 1+000 of Maalimango Creek to Bacoor Bay.

(c) Diversion Drainage II

Diversion Drainage II is the measure to divert the floodwater from the upstream of Maalimango Creek to the San Juan Diversion Channel on the premise of shift of the upstream of Maalimango Creek basin to its adjacent Bacao Drainage area in the east. Diversion Drainage II could reduce the scale of improvement of the lower Maalimango Creek below Diversion Road reducing the necessary land acquisition and house relocations. .It is herein noted that the Diversion Channels II is placed along the upstream side of Diversion Road in order to avoid the construction of the drainage pipe and/or box culvert across the road.

(d) Retarding Basin I

Retarding Basin I, which is placed at the existing agricultural area, aims at regulating the flood peak discharge of Diversion Discharge I.

(e) Retarding Basin II

Retarding Basin II, which is placed at the existing agricultural area in the lower reaches of Maalimango Creek, aims at regulating the flood peak discharge at the downstream of Maalimango Creek.

(f) Pumping Station

The Pumping Station aims at mechanically draining the flood at the river mouth of Maalimango Creek. In addition to the Pumping Station, the tidal gate is also necessary. The tide level applied for the design is MHWS of 0.8 m. above MSL.

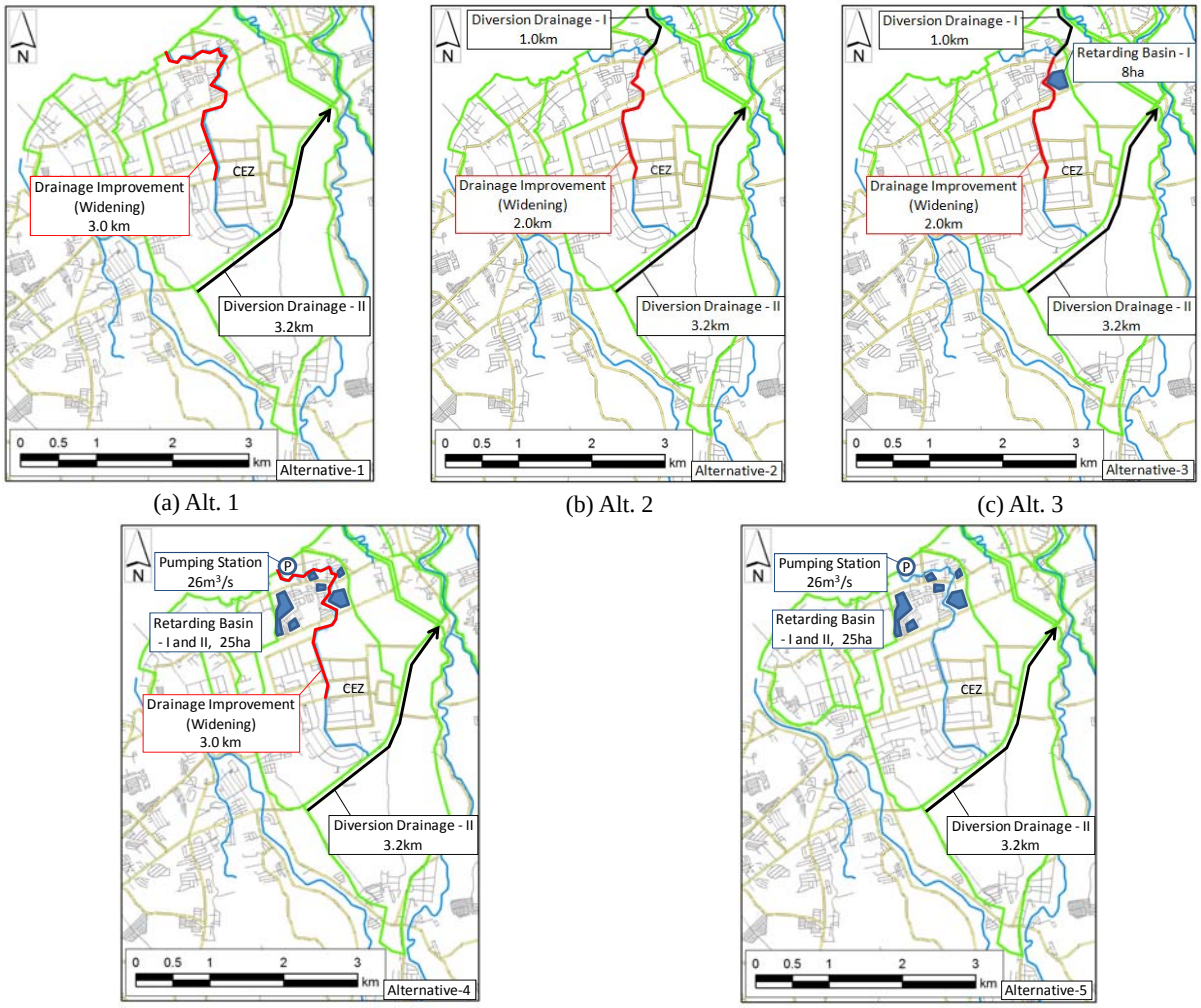
(2) Alternatives of Storm Water Drainage

The five alternatives shown in Table 7.7 are set through combination of several types of the aforesaid drainage measures (refer to Figure 7.12).

Table 7.7 Alternatives of Storm Water Drainage of Maalimango Creek

Type of Flood Control Measure	Gravity Drainage			Pumping Station	
	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Drainage Improvement	O	O	O	O	
Diversion Drainage I		O	O		
Diversion Drainage II	O	O	O	O	O
Retarding Basin I			O	O	O
Retarding Basin II				O	O
Pumping Station				O	O

Note: The selected type of flood control measure in each alternative is indicated as "O".



(a) Alt. 1 (b) Alt. 2 (c) Alt. 3

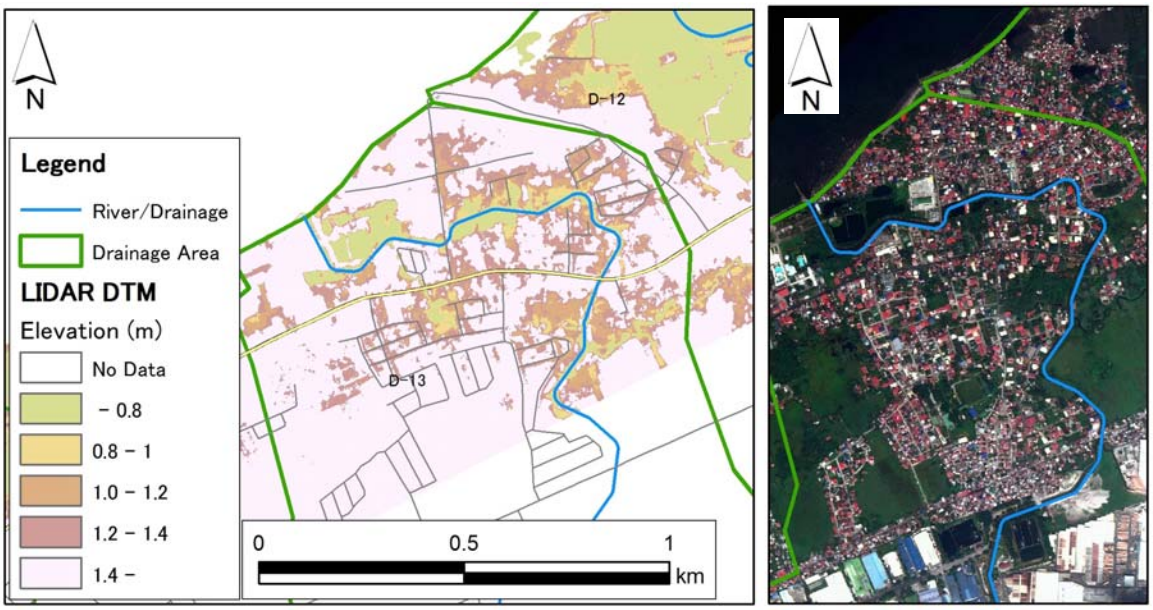
(d) Alt. 4 (e) Alt. 5

Source: JICA Study Team

Figure 7.12 Location Map of Alternatives of Storm Water Drainage of Maalimango Creek

(3) First Screening (Evaluation of Alt. 4 and Alt. 5 by Pump Drainage)

The ground level of the lowland area in the Maalimango Creek Drainage Area is estimated at about 1.0 m. above MSL according to the aerial survey by NAMRIA shown in Figure 7.13. Assuming that the allowable inundation depth is 0.2 m., the allowable water level of the inundation is set at 1.2 m. above MSL. On the other hand, the Mean High Water Spring (MHWS) is 0.8 m. above MSL, which is lower than the said allowable inundation water level. For this reason, gravity drainage is deemed to be available and hence, Alt. 4 and 5 which are subject to pump drainage are excluded from the candidates of the optimum plan.



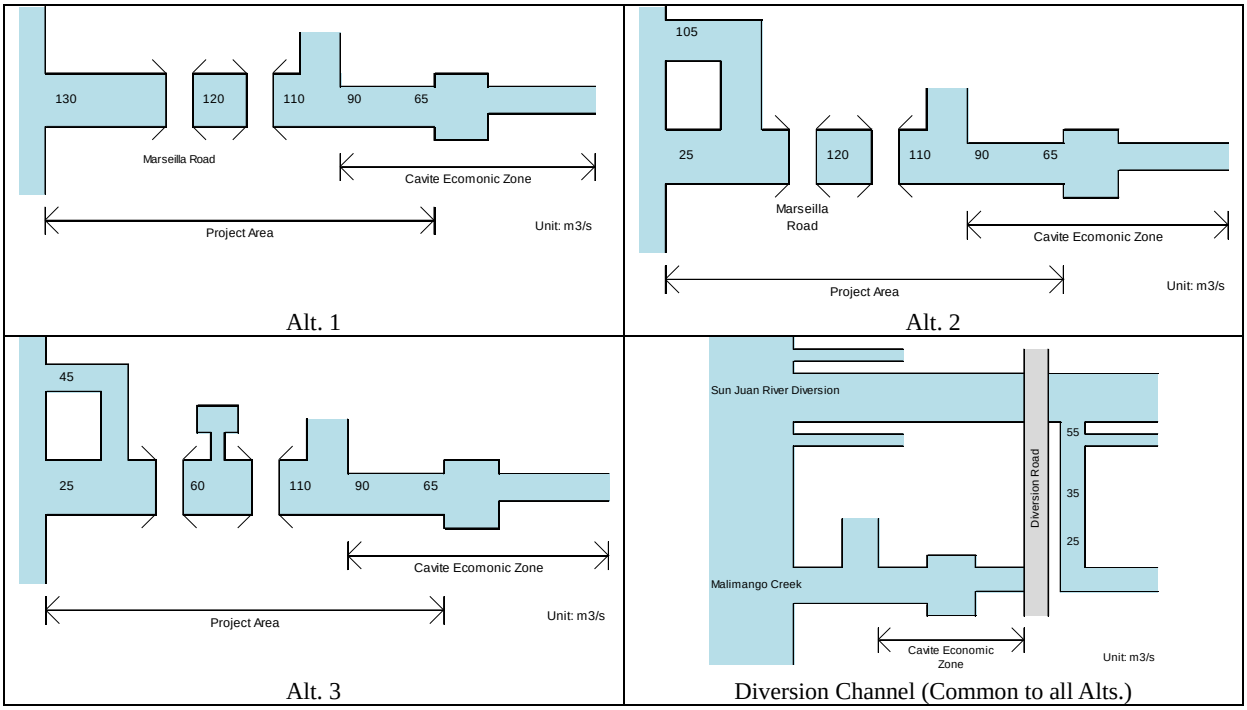
Source: JICA Study Team

Figure 7.13 Elevation Map and Satellite Image around River Mouth of Maalimango Creek

(4) Distribution of Design Flood Discharge of Each Alternative for Maalimango Creek Drainage Area

The design discharge distribution of each of the alternative drainage plans for the Maalimango Creek Drainage Area is as shown Figure 7.14. It is herein noted that the Alt. 3 and 4 by pump drainage are excluded from the objectives of the evaluation through the aforesaid first screening and therefore, the design discharge distribution is estimated only for the remaining Alt. 1, 2 and 3 by gravity drainage only.

The Alt. 1 has the design discharge of 130m^3/s at the existing downstream channel, while the Alt. 2 reduce the design discharge at the existing downstream channel to 25m^3/s diverting 105m3/s to the new diversion channel. The Alt. 3 also maintains the design discharge of 25m^3/s at the existing downstream channel, while it diverts the discharge of 45m^3/s after the discharge runoff from the upper reaches is regulated by the new flood regulation pond.



Note: The design discharge of Alt. 4 and 5 shown in Table 7.6 and Figure 7.12 are not estimated because both of the alternatives are excluded through the under-mentioned First Screening.

Source: JICA Study Team

Figure 7.14 Design Discharge for Each Alternative Drainage Plan for Maalimango Creek Drainage Area

(5) Project Cost of Alternative Storm Drainage Plan for Maalimango Creek Drainage Area

The project cost for each of Alt. 1, 2 and 3 by gravity drainage for the Maalimango Creek Drainage Area is as shown in Table 7.8.

Table 7.8 Project Cost for Each Alternative in Maalimango Creek Drainage Area

(Unit: million peso)

Item	Alternative 1	Alternative 2	Alternative 3
Civil Works	Not disclosed		
Engineering Services			
Land Acquisition and Compensation			
Administration			
Physical Contingency			
Price Contingency			
VAT			
Total			

Note: The design discharge of Alt. 4 and 5 shown in Table 7.6 and Figure 7.12 are not estimated because both of the alternatives are excluded through the under-mentioned First Screening.

Source: JICA Study Team

(6) Second Screening (Evaluation of Alternatives 1 to 3 for Gravity Drainage)

Alt. 2 is recommended to be the optimum drainage plan as shown in Table 7.9. It consists of the Drainage Improvement, Diversion Drainage I for diverting the floodwaters of Maalimango Creek to Bacoor Bay from Station 1+000, and Diversion Drainage II for diverting the floodwaters upstream of Maalimango Creek to San Juan Diversion Channel. The selection of Alt.

2 is attributed to the highest EIRR and the second least number of house relocation next to Alt. 3 together with the small difference between numbers of house relocations for Alt .2 and Alt. 3.

Table 7.9 Evaluation of Alternatives and Selection of Optimum Plan for Maalimango Creek

Item	Evaluation		
	Alternative 1	Alternative 2	Alternative 3
Reduction of Flood Risk	Reduction of flood risk below design scale (1/15 years flood frequency)	Same as Alternative 1	Same as Alternative 1
Impact on Social Environment	Resettlement: Land Acquisition:	Resettlement: Land Acquisition:	Resettlement: Land acquisition:
Impact on Natural Environment	Small impacts on fauna and flora by the project	Same as Alternative 1	Same as Alternative 1
Pollution Risk	Risk of noise in the construction sites close to residential areas, risk of waste generation, risk of traffic jam generation	Same as Alternative 1	Same as Alternative 1
Total Cost			
EIRR			
Constraint on Construction	Drainage improvement in the narrow construction yard close to residential areas	Same as Alternative 1	Same as Alternative 1
Optimum Plan	Not recommended	**Recommended** - The highest EIRR could be expected. - This Alt. causes the second least number of resettlement houses next to Alt. 3, but the difference of resettlement houses caused by this Alt and Alt.3 is few.	Not recommended

Source: JICA Study Team

7.3.2 Selection of Optimum Storm Water Drainage Plan for Panamitan Drainage Area

(1) Eligible Drainage Measures

The eligible types of flood control measures for the Panamitan River as described below are selected (refer to Figure 7.15).

(a) Drainage Improvement

The Drainage Improvement aims at channel widening, dredging, excavation, and/or construction of Panamitan River Channel so as to cope with the design flood discharge.

(b) New Drainage I

There is no drainage network in the upstream of the Diversion Road in the DR6 sub-basin. Hence, the New Drainage I is considered in order to collect the floodwaters from DR6.

(c) New Drainage II

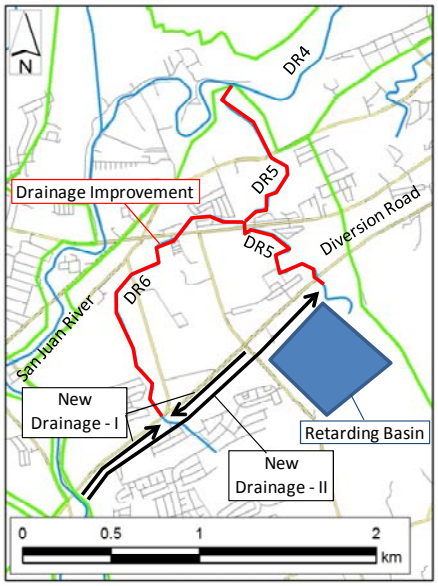
The New Drainage II aims at diverting the flood discharge from DR6 to DR5 so as to avoid the drainage improvement of DR6.

(d) Retarding Basin

The Retarding Basin, which is placed at the existing agricultural area, aims at regulating the flood peak discharge through its temporary storage of the floodwater.

(2) Alternative Plans of Storm Water Drainage

Three (3) alternative plans with various combinations of drainage measures are considered as shown in Table 7.10 and Figure 7.16.



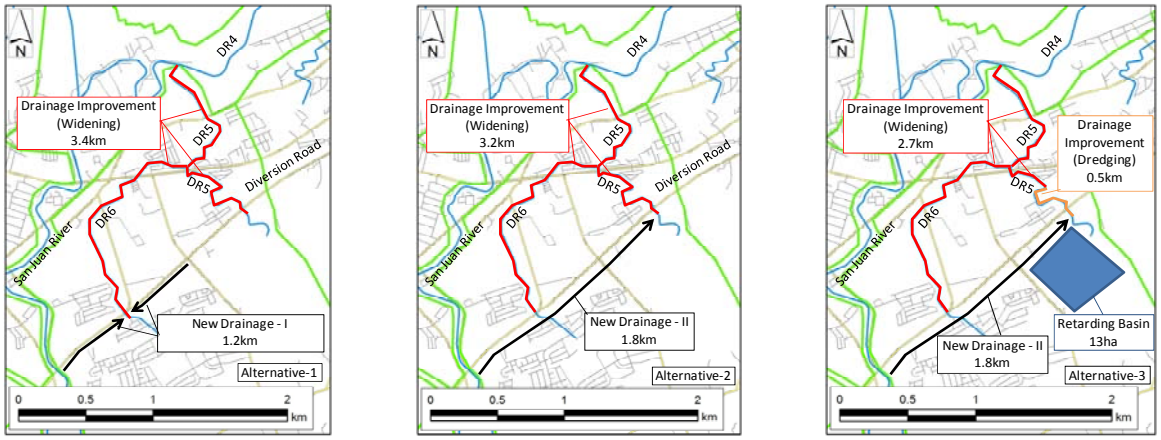
Source: JICA Study Team

Figure 7.15 Eligible Flood Mitigation Measures for Panamitan River Drainage Area

Table 7.10 Alternative Plans of Storm Water Drainage for Panamitan River Drainage Area

Types of Flood Control Measure	Gravity Drainage		
	Alt. 1	Alt. 2	Alt. 3
Drainage Improvement	O	O	O
New Drainage I	O		
New Drainage II		O	O
Retarding Basin			O

Note: The selected type of flood control measure in each alternative is indicated as "O".



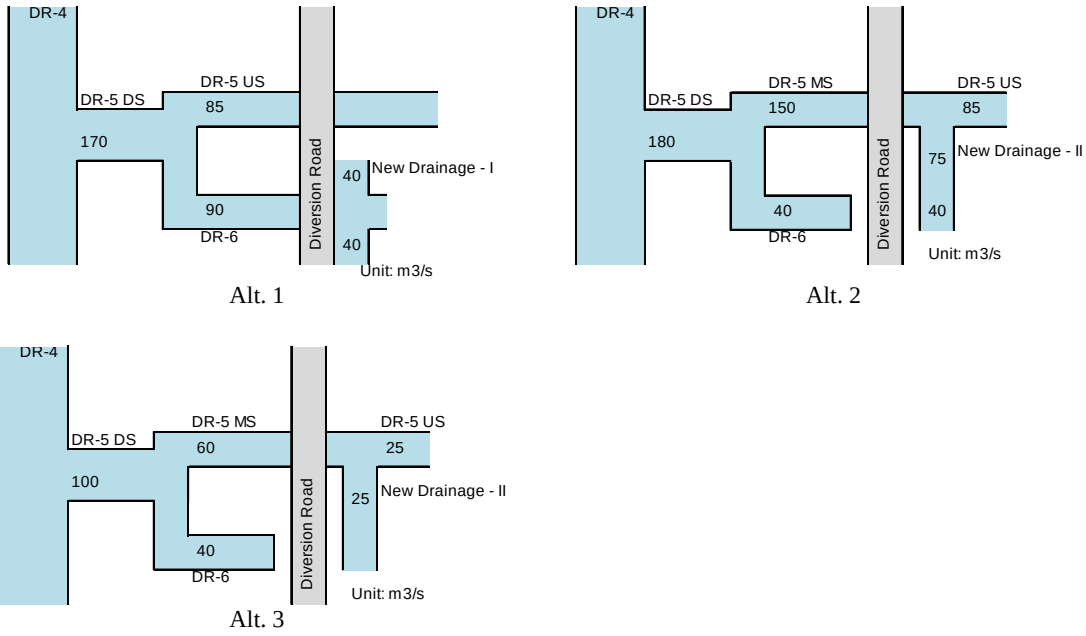
Alt. 1 Alt. 2 Alt. 3

Source: JICA Study Team

Figure 7.16 Location Map of Alternatives of Storm Water Drainage for Panamitan River Drainage Area

(3) Distribution of Design Flood Discharge of Each Alternative for Panamitan Drainage Area

The design discharge distribution for each of alternative drainage plan for the Panamitan Creek Drainage Area is as shown Figure 7.17. The Alt. 1 collects the runoff from the upstream of the Diversion Road through the New Drainage -I and finally discharges 170m^3/s into Manila Bay through the downstream drainage channel of DR-5DS. The Alts 2 collects the runoff from the upstream of the Diversion Road through the New Drainage-II and finally discharges 180m^3/s into Manila Bay through the downstream drainage channel of DR-5DS. The Alts 3 reduces the peak runoff discharge from the upstream of the Diversion Road through the flood regulation pond and finally releases 100m^3/s through the downstream drainage channel of DR-5DS



Source: JICA Study Team

Figure 7.17 Design Discharge of Each Alternative Drainage Plan for Panamitan River Drainage Area

(4) Project Cost of Alternative Storm Drainage Plan for Panamitan Drainage Area

The project cost of each alternative storm drainage plan for the Panamitan Drainage Area is as shown in Table 7.11.

Table 7.11 Project Cost of Each Alternative for Panamitan Drainage Area

(unit: million peso)

Item	Alt. 1	Alt. 2	Alt. 3
Civil Works	Not disclosed		
Engineering Services			
Land Acquisition and Compensation			
Administration			
Physical Contingency			
Price Contingency			
VAT			
Total			

Source: JICA Study Team

(5) Evaluation of Alternatives and Selection of Optimum Plan

Of the three (3) alternatives, Alt. 3 could be selected as the optimum plan due to least project cost, lesser number of house relocation and highest internal economic rate of return (EIRR). However, the EIRR of Alt. 3 is limited to 9.7%, which is lower than the minimum economically viable level of 15% required by NEDA. The ordinary residential houses and their assets are counted as the major potential flood damage in Panamitan River Drainage Area, while the aforesaid Maalimango Creek Drainage Area contains the factory buildings, assets, and products in the Cavite Economic Zone as the prominent potential flood damage items. Due to such difference of potential flood damage items, the Panamitan River Drainage Area has the less EIRR than the Maalimango Creek Drainage Area and the project implementation of the Panamitan River Drainage is hardly recommended and hence excluded from the objectives of the Feasibility Study.

Table 7.12 Evaluation of Alternatives and Selection of Optimum Plan for Panamitan River Drainage Area

Item	Evaluation		
	Alternative 1	Alternative 2	Alternative 3
Reduction of Flood Risk	Reduction of flood risk below design scale (1/15years flood frequency)	Same as Alternative 1	Same as Alternative 1
Impact on Social Environment	Resettlement: Land Acquisition:	Resettlement: Land Acquisition:	Resettlement: Land Acquisition:
Impact on Natural Environment	Small impacts on fauna and flora by the project	Same as Alternative 1	Same as Alternative 1
Pollution Risk	Risk of noise at construction sites close to residential areas, risk of waste generation, risk of traffic jam generation	Same as Alternative 1	Same as Alternative 1
Total Cost			
EIRR			
Constraint on Construction	Drainage improvement in the narrow construction yard close to residential areas	Same as Alternative 1	Same as Alternative 1
Optimum Plan	Not recommended	Not recommended	**Recommended** However, the project is not economically viable, thus, its project implementation is not recommended.

Source: JICA Study Team

7.3.3 Selection of Optimum Storm Water Drainage Plan for North-East Area of Kawit

(1) Eligible Drainage Measures

The eligible drainage measures for the North-East Area of Kawit as described below are selected (refer to Figure 7.18).

(a) Drainage Improvement

The drainage improvement aims at channel widening, dredging, excavation, and/or construction of levee for the existing drainage channels.

(b) New Drainage

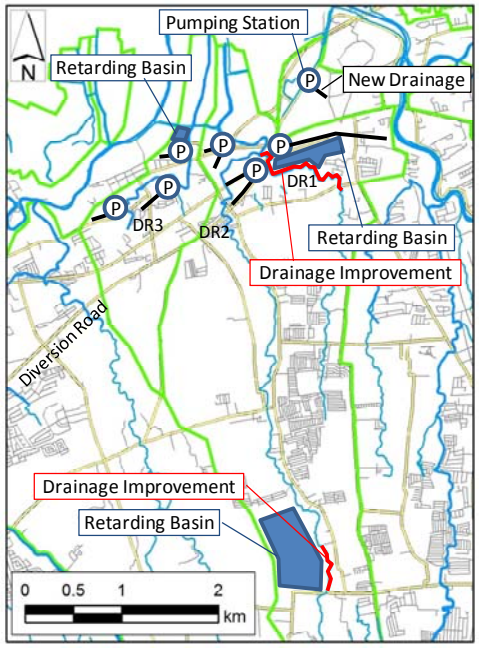
The new drainages are introduced to collect the floodwater where no drainage network is available.

(c) Retarding Basin

The Retarding Basin, which is placed at the existing agricultural area, aims at regulating the flood peak discharge through its temporary storage of floodwater.

(d) Pumping Station

The pumping station aims at mechanically draining the floodwater.



Source: JICA Study Team

Figure 7.18 Eligible Drainage Measures for North-East Area of Kawit

(2) Flood Control Measures in the River Mouths

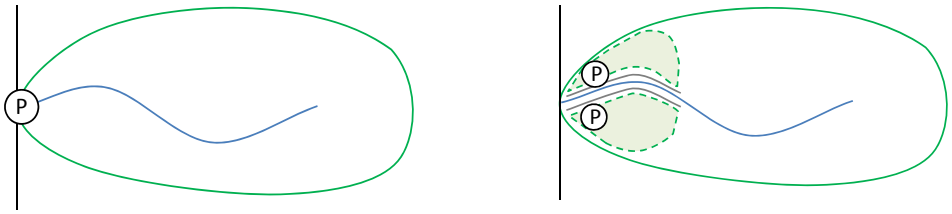
The difficulty of draining rainwater by gravity was estimated due to extremely low ground elevation. Hence, the pumping drainage system is required, and the following two (2) applicable measures are considered..

Measure 1: A river mouth is closed by a tidal gate, and the rainwater of a whole basin is drained by a pumping system (see Figure 7.19 a).

Measure 2: The downstream portion of an existing main drainage is improved by a levee system. Inland flooding areas are delineated by the levees, and pumping systems are installed in the inland flooding areas (see Figure 7.19 b).

The percentage of the lowland area in the whole basin is small. Hence, Measure 1 as a pumping system for whole basin in that a pumping station located in the river mouth drain out the floodwater including floods from upstream basin is cost-ineffective. In comparison,

Measure 2 as a small pumping system for the areas surrounded by levees is cost-effective. Therefore, Measure 2 was selected as the flood control measure in the river mouths.



(a) Pumping System for Whole Basin (b) Pumping System for Area Surrounded by Levee

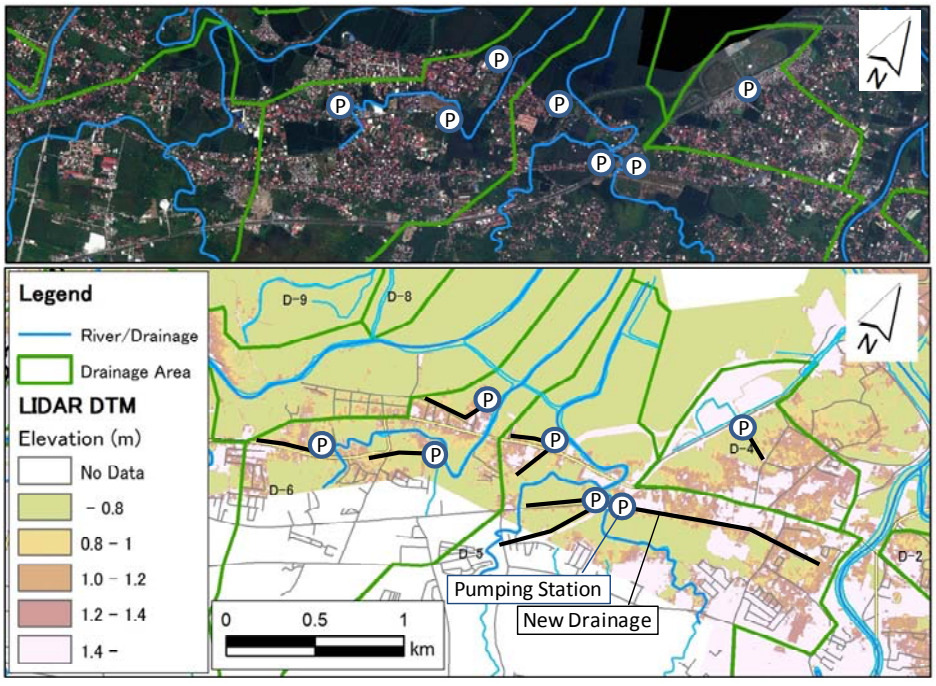
Figure 7.19 Conceptual Diagram of Target Area of Pumping System

(3) Improvements of Existing Main Drainages

The flow capacity of existing drainages is very low, and the capacity should be improved at a maximum. After maximizing the flow capacity of drainages, the agricultural areas should be diverted to the retarding basins to handle the excess floodwater beyond the drainage capacity.

(4) Flood Control Measures in Inland Flooding Area

The ground level around the river mouths is very low, and the levee system will be applied as a method of river improvement. Consequently, the inland flood will happen in the area surrounded by the levees, and pumping systems will be necessary. A pumping system consists of a pumping station, a tidal gate, drainages, and retarding ponds. The location of pumping stations was preliminary studied based on the elevation data as shown in Figure 7.20



Source: JICA Study Team

Figure 7.20 Location Map of Proposed Pumping Stations in North-East Area of Kawit (Conceptual Plan)

(5) Priority of Project Implementation

Judging from the topographic condition of the drainage area, most of the storm water is deemed to be generated from the upstream of the Diversion Road, while the flow capacities of the existing drainage channels are extremely small to accommodate the said storm water. To cope with this issue, the priority should be given to the improvement of existing drainage channels. The regulation pond is further recommended to cope with the excessive floodwater which would be hardly accommodated even by the improvement of the existing drainage channels.

Moreover, the levee system needs to be introduced to the above improvement of the existing drainage channels, since the ground level around the river mouth is very low. However, the storm water in the area surrounded by the levee would be hardly drained by gravity flow, requiring the drainage pump together with the drainage gate, construction of new drainage channel and regulation pond for pump drainage.

Taking the above process of drainage improvement, completion of the whole drainage system has to be far in the future. From this point of view, the preliminary design and cost estimation for the drainage facilities would need to be examined in the future Study based on the updated land use conditions at that time, and therefore, they are excluded from the objective of the Study.

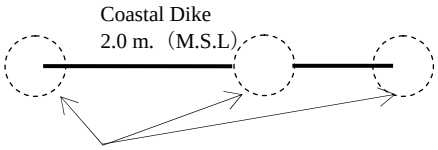
7.4 Plan for Countermaesures against Storm Surge

7.4.1 Design Height of Coastal Dike

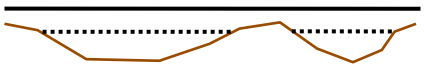
The design height of the coastal dike is proposed as EL. 2.0 m. above MSL taking account of the following Design High Tide Level (DHTL) and the freeboard.

(1) DHTL: As described in the foregoing Subsection 6.4.1, the DHTL is set at 1.4 m. above MSL.

(2) Freeboard of Coastal Dike: There is no definitive criterion or method to determine the height of freeboard for the coastal dike, and the height of freeboard is often set as less than 1 m. taking account of the continuity of the height of the existing coastal dike and/or the ground level along the coast. Since coastal dikes tend to extend over a long stretch, raising of the coastal dike would require a larger construction cost and a longer period. For this reason, the appropriate height of the dike has to be determined taking the ground levels of the coastal area into consideration. According to the LiDAR Data, the ground level along the coast of Cavite Province is almost in the range of 0 to 2 m. above MSL. Hence, the crown level of the dike is assumed at 2 m. taking consistency with the highest ground level of the coast and the freeboard at 0.6 m. (=2 m. above MSL – DHTL of 1.4 m. above MSL).



Since the high ground elevation along the coast is about 2 m. above MSL, the crown level of the dike is set at 2.0 m. (MSL).



Should the crown level be higher than 2 m. above MSL, the dike length has to be greatly extended leading to need of huge construction cost and deterioration of the social and natural environment.

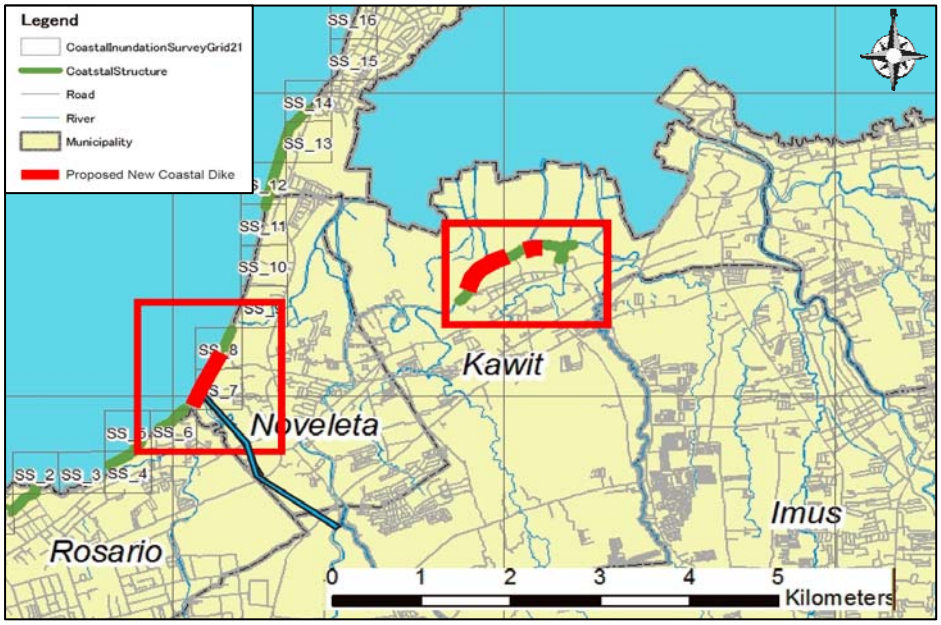
7.4.2 Priority Area for the Construction of Coastal Dike

The existing coastal dikes are discontinuously placed along the west coast of the Study Area as shown in Figure 7.21. According to the results of interview survey on the damage by storm surge, the coastal dike is insufficient to prevent Municipality of Noveleta from damage by the storm surge. Moreover, coastal dike together with drainage pump is particularly required for the northeastern part of Kawit Municipality because the ground levels in a substantial part are lower than the high tide level as stated above. For this reason, these two (2) areas are set as the priority areas for the construction of coastal dike (refer to Figure 7.22).

According to the results of interview survey, however, the damages by the storm surges in Municipality of Noveleta are judged to be insignificant as compared with the damages of the flood by river overflow and/or the storm rainfall. Moreover, construction of the coastal dike for the northeastern part of Kawit Municipality would be ranked as the super long-term project to be commenced after completion of the whole drainage channel improvement and installation of the numerous drainage pumps. For these reasons, the plan for countermeasures against the storm surge is limited to the layout plan for the priority area of the coastal dike, and the structural design and cost estimation for the construction of coastal dike is excluded from the objectives of this Study.

Source: JICA Study Team

Figure 7.21 Location Plan of Existing Coastal Dikes



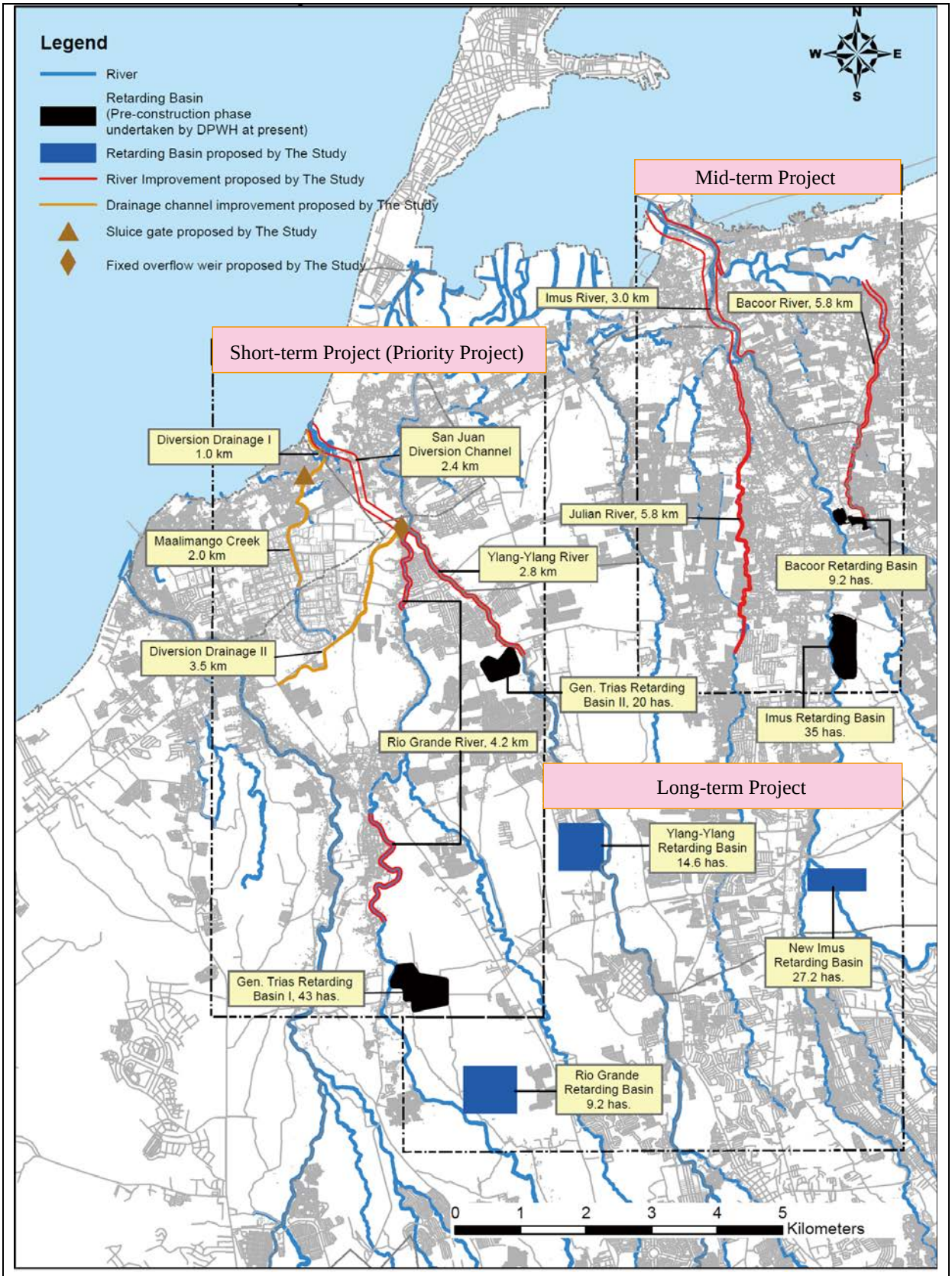
Source: JICA Study Team

Figure 7.22 Location Plan of Proposed Coastal Dike

7.5 Optimum Structural Plan for Flood Mitigation

As described in the foregoing subsections 7.1and 7.3, the projects for river flood mitigation and storm water drainage improvement are proposed adopting the design flood levels of 1/50 years flood frequency and 1/15 years flood frequency, respectively. Prior to implementation of these proposed projects, DPWH had commenced the Flood Risk management Project for Cagayan, Tagoloan and Imus River (FRIMP-CTI) undertaking the detailed design and the pre-construction works for two (2) flood retarding basins each for Imus and San Juan River Basin with the financial assistance by the international yen loan by JICA since 2014.

This Study aims at completing the design flood level of 1/25 years flood frequency for Imus and San Juan River Basin as the first step including the above ongoing project for construction of flood retarding basins under FRIMP-CTI into the overall plan. Then, the Study further proposes, as the second step, to raise the design flood level to 1/50 years flood frequency by construction of supplementary four (4) flood retarding basins. The layout and salient features of the flood mitigation facilities proposed in the Study area as shown in Figure 7.23 and Table 7.13 to Table 7.15



Source: JICA Study Team

Figure 7.23 Layout of Flood Mitigation Facilities Proposed in the Study

Table 7.13 Project for Construction of Flood Retarding Basins Proposed in the Master Plan Study

Project	Name of River Basin	Name of River	Design Flood Level (year)	Storage Capacity (10^6m^3)	Excavation Volume (10^6m^3)	Area of Project Site (ha)	Number of House Relocations (houses.)
On-going Project by DPWH	Imus 川	Imus	25	Not disclosed			
		Bacoor	25				
	San Juan 川	Rio-Grande	25				
		Ylang-Ylang	25				
	Subtotal						
Project Proposed in the Study	Imus	Imus	50				
	San Juan	Rio-Grande	50				
		Ylang-Ylang	50				
	Subtotal						
	Total						

Source: JICA Study Team

Table 7.14 Project for River Channel Improvement and Construction of Diversion Channel Proposed in the Master Plan Study

Name of River Basin	Name of River	Design Flood Level (year)	Works for Water Way			Works for Bridge		Area of Project Site (ha)	Number of House Relocations* (houses.)
			Length (km)	Width (m)	Exca-vation/ Dredging Volume (10^6m^3)	Number of Bridges (nos.)	Length (m)		
Imus	Imus	25	Not disclosed						
	Bacoor	25							
	Julian	25							
	Subtotal								
San Juan	Rio-Grande	25							
	Ylang-Ylang	25							
	Diversion Channel	25							
	Subtotal								
Total									

*: The number of house relocations is subject to revision in the subsequent Feasibility Study.
Source: JICA Study Team

Table 7.15 Project for Storm Water Drainage Improvement Proposed in the Master Plan Study

Name of Drainage Area	Classification of Projects	Deign Flood Level (year)	Works for Water Way			Works for Bridge		Area of Project Site (ha)	Number of House Relo-cations* (houses)
			Length (km)	Width (m)	Exca-vation/ Dredging Volume (10^6m^3)	Number of Bridges (nos.)	Length (m)		
Maalimango	Construction of New Drainage Channel	15	Not disclosed						
	Improvement of Existing Drain-age Channel	15							
	Construction of Diversion Chan-nel	15							
	Total								

*: The number of house relocations is subject to revision in the subsequent Feasibility Study.
Source: JICA Study Team

8. NON-STRUCTURAL FLOOD MITIGATION MEASURES

8.1 Proposed Non-Structural Flood Mitigation Measures

The following eleven 11 project in the six (6) categories of non-structural flood mitigation measures are proposed in the Study.

Table 8.1 Proposed Non-Structural Flood Mitigation Measures

Category		Name of Project	
1.	Expansion of Existing Flood Mitigation Committee (FMC)	(1)	Expansion of Existing Flood Mitigation Committee (FMC)
2.	Removal of Deposits in Waterways	(2)	Activities of Clean-up of Waterways
		(3)	Establishment of System for Solid Waste Management
3.	Management of River Area and Flood Control Area	(4)	Management of River Area and Flood Control Area
4.	Control of Excessive Land Development	(5)	Enactment of Ordinance for Urban Growth Management
		(6)	Enactment of Ordinance for On-site Flood Regulation Pond
5.	Strengthening of Functions for Flood Forecasting and Warning System	(7)	Establishment of Flood Monitoring System
		(8)	Establishment of Rules for Flood Warning and Evacuation
		(9)	Strengthening of Communication System for Flood Warning
		(10)	Strengthening of Institutional Setup for Flood Warning & Evacuation
6.	Information, Education and Communication (IEC)	(11)	IEC fpr the Project including the proposed structural and non-structural measures

Source: JICA Study Team

Outlines of the above five (6) categories of the non-structural measures are given below.

8.1.1 Expansion of Flood Mitigation Committee (FMC)

The FMS had been established under the FRIMP-CTI in September 2014 in order to undertake, in collaboration with Local Disaster Risk Reduction Management Office (LDRRMO), the administrative activities for Imus River Basin related to flood mitigation such as administration for the illegal land development, investigation of flood damages, and proposal of the appropriate flood disaster rehabilitation works.

Before completion of the project facilities, the FMC is headed by the official of DPWH as the chairperson and the Provincial Governor as the co-chair-person, and its members are the DPWH-First District Engineer, the heads of three (3) divisions of the Provincial Government (Engineering Division, Planning Division and Disaster Risk Reduction Office), and the officials of Imus City, Bacoor City and Kawit Municipality. On the other hand, the chairperson and co-chairperson will change: the Provincial governor will be the chairperson and the official of DPWH co-chair person, although the same members are kept.

The FMC is expected to make an important role for the appropriate administration and management for the proposed structural and non-structural measures in the Project. From this point of view, it is proposed to expand the jurisdiction of the existing FMC to San Juan River Basin adding the new members of nine (9) cities/municipalities which have the administration area in San Juan River Basin: the new members are the cities/municipalities of Rosario, Noveleta, Tanza, General Trias, Trece Martires, Silang, Amadeo, Indang, and Tagaytay.

8.1.2 Removal of Deposits in Waterway

Massive volumes of garbage and other drift materials clog the downstream of rivers and drainage channels. They have remarkably reduced the flow capacity of waterways, which is regarded as one of the major causes of flood in the Study Area. To cope with this problem, sustainable monitoring and strengthening of clean-up activities on the waterways are indispensable. To attain such activities, the following organizations for cleaning of the waterways are proposed:

(1) Actual Execution: The relevant city and municipality

(2) Technical Guidance: Provincial Government - Environment Natural Resource Office (PG-ENRO)

(3) Supervision and Coordination: Flood Mitigation Committee (FMC)

8.1.3 Management of River Area and Flood Control Area

In accordance with Presidential Decree No. 1067 of December 31, 1976, otherwise known as the Water Code of the Philippines, the river and flood control areas should be designated on the premise of easement of public use for flood control and other purposes as described in Subsection 7.1. Moreover, development and management of the database and asset management system of the rivers is proposed so as to attain the efficient management of the said rivers and the flood control areas (refer to Chapter 23).

8.1.4 Control of Excessive Land Development

(1) Enactment of Ordinance on Urban Growth Management

As described in Section 3.2, the expansion of urbanized area is rapidly progressing in the Study Area, leading to the serious reduction of basin flood retention capacity. To cope with this issue, the “Ordinance on Urban Growth Management (Draft)” was proposed in the JICA Study 2009, aiming to control the excessive expansion of urbanized area. The Provincial Governor of Cavite has organized a committee under the Provincial Assembly to update the Ordinance. Hence, it is recommended to finalize the Ordinance at the earliest opportunity and put it in force.

(2) Enactment of Ordinance on On-site Flood Regulation Pond

As described in Subsection 3.3.2, the development of residential subdivisions is intensively made in the Study Area, which is one of the reasons for the aforesaid rapid expansion of the urbanized area. To cope with this issue, the enactment of an ordinance regarding the On-site Flood Regulation Pond was proposed in the JICA Study 2009. The Ordinance aims at obligating the land developer to construct an on-site flood regulation pond at the downstream end of every new subdivision so as to offset the increment of flood runoff discharge as a result of subdivision development.

The Provincial Government of Cavite noted in the aforesaid "Ordinance on Urban Growth Management (Draft)" that the exhibit on the on-site flood regulation should be one of the documents for submission of the land developer to the Provincial Government. Then, the Draft of the Ordinance on the On-site Flood Regulation Pond submitted through the JICA Study was deliberated by the Committee of the Provincial Government. After completion of the JICA Study 2009, however, all of the members of the Committee were changed and the Committee stopped to deliberate the Ordinance.

As described above, the Provincial Assembly now undertakes the preparatory works for enactment of the Ordinance on Urban Growth Management intending to include the mandatory of construction of the on-site flood regulation pond by the land developer into the Ordinance. The mandatory is one of the essential factors to sustain the design flood level of the structural flood mitigation measures. Therefore, it is recommended to certainly accomplish the enactment of the Ordinance on the on-site flood regulation pond at the earliest opportunity.

8.1.5 Strengthening of Functions for Flood Forecasting and Warning System

(1) Establishment of Flood Monitoring System

The climate/hydrological monitoring network is now being developed including the five (5) water level gauging stations, five (5) rainfall gauging stations and one (1) database center in the Cavite Lowland Area under the GMMA READY Project implemented in line with the United Nations Development Programme (UNDP). The gauging stations and database center would be handed over to, and maintained by, the Provincial Government of Cavite upon completion of the Project. It is, therefore, necessary to examine how to utilize the gauged data for the flood forecasting and warning activities.

(2) Establishment of Rules for Flood Warning and Evacuation

The City/Municipal Disaster Risk Reduction Management Committee (CDRRMC/MDRRMC) presently undertakes the comprehensive evaluation of river water levels informed from each Barangay and the predicted rainfall volumes informed from PAGASA and instructs each barangay to evacuate, as required. However, members of the CDRRMC/MDRRMC are rotated or changed in every three (3) years, and the evaluation criteria for the issuance of flood warning may not be well administered by the new members. From this point of view, it is proposed to stipulate the rules for flood warning and evacuation including the standard flood water level for the issuance of flood evacuation.

(3) Strengthening of Communication for Flood Warning

After experience of the serious flood damage brought by the southwest monsoon in 2013, the LGUs in the Study Area has driven to strengthen the communication system for flood warning and evacuation through various programs such as establishment of the Disaster Risk Reduction

Management Office (DRRMO) as the flood information center and development of bidirectional wireless system.

Use of the mailing system of SMS by cellular phone is proposed for the early issuance of flood warning as well as the information on climate and water level. Since the diffusion of cellular phones had exceeded almost 100% of residents in the Philippines, the said mailing system would be effective as the measure to publicly disseminate flood information.

(4) Strengthening of Institutional Setup for Flood Warning and Evacuation

The functions and rules of the communication system for flood warning and evacuation should be enhanced among the existing or relevant agencies such as the Disaster Risk Reduction Management Committee (DRRMC), the Disaster Risk Reduction Management Office (DRRMO) and the Disaster Operation Center (DOC) of each municipality/city. Moreover, the roles and authorities of the relevant organizations, which could lead to the strengthening of functions, should be clearly demarcated.

In addition, the Flood Mitigation Committee (FMC) should be organized to consist of twelve (12) members dispatched from the municipalities/cities in the Study Area to enable the reliable supervision and recommendation for improvement of the flood warning and evacuation system (refer to Figure 8.1). At the same time, the Provincial Disaster Risk Reduction Management Committee (PDRRMC) should provide technical support to CDRRMO/MDRRMO as required.

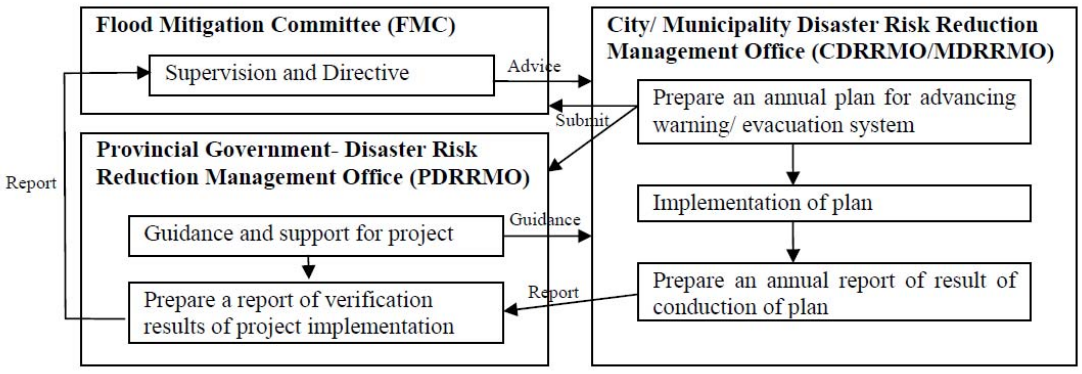


Figure 8.1 Management System for the Flood Warning/Evacuation System

8.1.6 Information Education and Communication (IEC)

The following activities should be carried out as a part of the IEC on the structural and non-structural measures proposed in the Project:

- IEC through web-site and/or leaflet for the structural and non-structural measures of the Project,
- Capacity building through opening of seminars and workshops, and
- Execution for the education on the disaster prevention in collaboration with PAGASA and OCD.

9. SELECTION OF PRIORITY PROJECTS

9.1 Selection Policy for Priority Projects

The priority projects have been selected from among the structural and non-structural plans from the viewpoint of reduction level of disaster risks, early flood mitigation effect, economic efficiency, and impacts on natural/social environment. The results of the selection of priority projects are described hereinafter.

9.2 River Flood Mitigation Project

9.2.1 Design Flood Level

As described above, the optimum flood mitigation plans selected for the Imus and the San Juan River System are subject to stepwise development adopting the design flood of 1/25 years in the first development stage and further to 1/50 years in the second development stage. This Study employs the project with the design flood level of 1/25 years in the first development stage as the priority project in order to attain early flood mitigation effects.

9.2.2 Objective River Basins of Priority Project

When the two river basins, Imus River Basin and San Juan River Basin, are altogether included in the scope of priority projects, it is virtually difficult to cope with the potential problems associated with project implementation such as heavy traffic jams and solid wastes accompanying the implementation of river works as well as huge project costs amounting to about 22.6 billion pesos. Enormous construction quantities are also required. For these reasons, the priority project shall be selected from the optimum projects of either the Imus River or the San Juan River.

The results of the comparative evaluation of flood mitigation works for the Imus River and the San Juan River are shown in Table 9.1 and summarized below:

(1) The flood mitigation project for San Juan River Basin has the higher EIRR than that for Imus River Basin. Accordingly, the priority from the viewpoint of the cost effect of the project could be given to the project for San Juan River Basin.

(2) River works in Imus River Basin will be mainly in the existing built-up area, so that the number of houses to be relocated will not change dramatically regardless of the project implementation schedule. However, the number of houses to be relocated in San Juan River Basin will increase more as implementation of the project is delayed, because of the ongoing intensive expansion of housing development.

Table 9.1 Comparison among Alternatives of the Imus River Works and the San Juan River Works

Evaluation Items	Imus River Works	San Juan River Works
Reduction of Disaster Risks	With the river works, 18,829 houses in 794 ha built-up area could get rid of the potential flood damage risk of 1/25 years flood frequency. The annual average reduction of flood damage is estimated at 4,039 million pesos/year.	With the river works, 7,032 houses in 556 ha built-up area excluding Cavite Economic Zone (CEZ) could get rid of the flood damage risk of 1/25 years flood frequency. As for CEZ, 66 ha located at the eastern part among the total 297 ha will get rid of the flood damage risk of 1/25 years flood frequency. The annual average reduction of flood damage is estimated at 3,224 million pesos/year in total.
Impacts on Social Environment	The river flood mitigation works will require relocation of houses and land acquisition of ha is required. River improvement section along the Imus River and its tributaries, the Bacoor River and the Julian River, locates in the existing built-up areas where houses already stand close together. Thus, the number of houses standing along the river improvement section will not increase dramatically and it can be said that the number of houses to relocate will not change dramatically by change of the commencement of implementation.	With the river works, resettlement of houses and land acquisition of ha are required. Housing development will likely increase in the planned construction site for the floodway and areas along river improvement section in the upstream of the Rio Grande River. Thus, it is expected that the number of houses to relocate will increase by delay of the commencement of implementation.
Investment Efficiency	It is expected that the annual average reduction of flood damage will amount to pesos/year and % EIRR as economic effects with the investment of billion pesos.	It is expected that the annual average reduction of flood damage will amount to pesos/year and % EIRR as economic effects with the investment of pesos.
Restriction on Construction	Since both river improvement works and retarding basin works have to be conducted in the areas densely packed with houses, countermeasures against the risks of pollution including noise, solid waste, traffic jam, etc., will be required.	- Since the river improvement works have to be conducted near residential areas, countermeasures against the risks of pollution including noise, solid waste, traffic jam, etc., will be required. - The floodway will cross two existing main roads. Accompanying this crossing, replacement works of existing roads and bridges and countermeasures against traffic jams will be required.

Source: JICA Study Team

9.3 Storm Water Drainage Plan

As described in the foregoing subsection 7.2, the storm water drainage plan has been examined for three areas; namely, Maalimango Creek Drainage Area, Panamitan River Drainage Area and the northeastern part of Kawit Municipality Drainage Area. Based on the examination, however, the drainage improvement project in the Panamitan Drainage Area is not expected to have economic viability so that it was excluded from the priority projects. As for the northeastern part of Kawit Municipality Drainage Area, it will take a long time to implement the countermeasures for storm drainage and hence excluded also from the priority projects.

On the other hand, the storm water drainage project for Maalimango Creek Drainage Area will solve the damage by chronic inundation in CEZ and is expected to show the economic efficiency of 17.3% EIRR. It can also solve the damage by chronic inundation of 1,086 houses in Rosario Municipality

whose population density is the highest in the survey area. For these reasons, the proposed storm drainage project for Maalimango Creek Drainage Area is included as one of the priority projects.

9.4 Location of Facilities Proposed for Priority Project

As described in Sections 6.2 and 6.3, the structural measures for the flood mitigation of San Juan River with the design scale of 1/25 years flood frequency and for the storm water drainage of Maalimango Creek Area with the design scale of 1/15 years flood frequency are proposed as priority projects. The composition of these priority projects are as listed in Table 9.2 below (refer to Tables 7.13 to 7.15 in detail) and their locations are as shown in Figure 9.1.

Table 9.2 Composition of Priority Projects

Priority Projects	Project Components	Quantities
Flood Mitigation of San Juan River	San Juan Floodway	Not disclosed
	Diversion Weir of Floodway	
	River Channel Improvement	
Storm Water Drainage Improvement for Maalimango Creek Area	Improvement of Existing Drainage Channel	
	Construction of New Diversion Channel I	
	Construction of New Diversion Channel II	

Source:: JICA Study Team

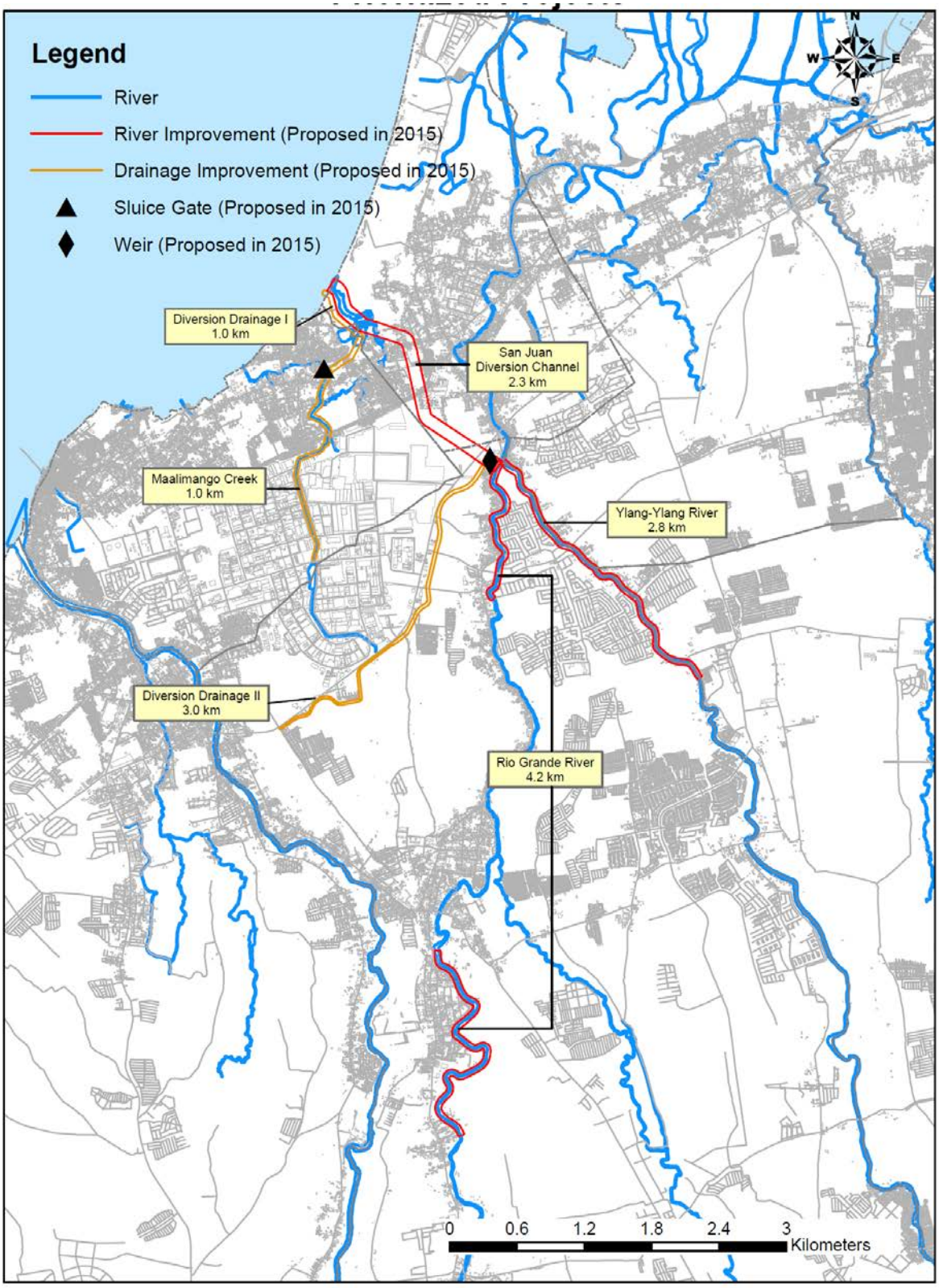


Figure 9.1 Location Map of Structures to Compose the Priority Projects

9.5 Non-Structural Measures

Of the eleven (11) projects shown in Table 8.1, the following eight (8) projects have been selected as the priority projects from the viewpoints of urgency, feasibility, and effectiveness (refer to Table 9.3).

- Expansion of Existing FMC (relevant to (1) in Table 8.1)
- Activities of Clean-up of Waterways (relevant to (2) in Table 8.1);
- Management of river area and flood control area (relevant to (4) in Table 8.1),
- Enactment of ordinance for on-site flood regulation pond (relevant to (6) in Table 8.1),
- Establishment of flood monitoring system (relevant to (7) in Table 8.1),
- Establishment of rules for flood warning and evacuation (relevant to (8) in Table 8.1),
- Strengthening of institutional setup for flood warning & evacuation (relevant to (10) in Table 8.1)
- Information, Education and Communication (relevant to (11) in Table 8.1)

Table 9.3 Urgency, Feasibility and Effectiveness of the Non-Structural Projects Selected as Priority Projects

Project	Urgency	Feasibility	Effectiveness
- Expansion of existing FMC	- The Project for San Juan River Basin is to be implemented in the near future urgently requiring expansion of FMC for administration of the Project.	- The FMC has been established for Imus River Basin, which is located adjacent to San Juan River Basin.	- The expanded FMC could make a great contribution to the effective administration and management of the proposed Project.
- Activities of Clean-up of Waterways	- Serious reduction of channel flow capacity due to clogging of channel by garbage	- Some of the LGUS are now involved in relevant activities.	- Increment of river channel flow capacity - Improvement of channel water quality
- Furtherance of Prevention of Encroachment to River Area by Using Database of Easement Management	- Risk of many dwellers in the flood risk area - Necessity of effective budgetary arrangement for management of river area	- Relevant legal setups are ready. - DPWH intends to database the river area.	- Reduction of serious disaster risk
- Enactment of Ordinance for Urban Growth Management	- Serious degradation of basin flood retention capacity - Increment of potential flood damage	- A part of LGUs are concerned with the enactment of ordinance	- Increment of basin flood retention capacity - Reduction of potential flood damage.
- Installation of Flood Forecasting and Flood Monitoring System - Functional Enhancement for Flood Warning/ Evacuation System - Establishment of Management System for Flood Warning/ Evacuation System	- Increment of risk of disaster by floods that exceed the design level.	- Relevant legal setups are ready. - LGUs currently implement the strengthening of flood warning and evacuation system including the education/campaign for public awareness.	- Reduction of risk of disaster by floods that exceed the design level.
- Information, Education and Communication (IEC)	- The Project for the San Juan River Basin is to be implemented in the near future urgently requesting the information on the Project for the residents..	- The necessary cost for the IEC could be shouldered even by the budget of the LGUs. - The DPWH and the Provincial Government have accumulated the knowledge on the IEC.	- The IEC could facilitate the understandings of the residents on the effectiveness and/or necessity of the Project.

Source: JICA Study Team

10. IMPLEMENTATION SCHEDULE OF WHOLE PROJECTS

10.1 Implementation Schedule of Structural Flood Mitigation Projects

A shown in Figure 10.1, the ongoing projects for the Imus and San Juan flood retarding basins are planned to be completed in 2019. In parallel with the ongoing projects, the river flood mitigation project for the San Juan River System and the rainwater drainage project for Maalimango Creek drainage area that have been selected as priority projects are planned to start in 2018 and be completed in 2024 in the first development stage. Then, the flood mitigation of 1/25 years flood frequency for the Imus River System will be commenced in 2021 and be completed in 2026.

Finally, the project of the new flood retarding basins for the Imus River System and the San Juan River System are planned to start in 2025 and completed in 2030 as the projects in the second development stage. Upon completion of the new flood retarding basins, the flood mitigation of 1/50 years flood level for the Imus River System and the San Juan River System will be achieved.

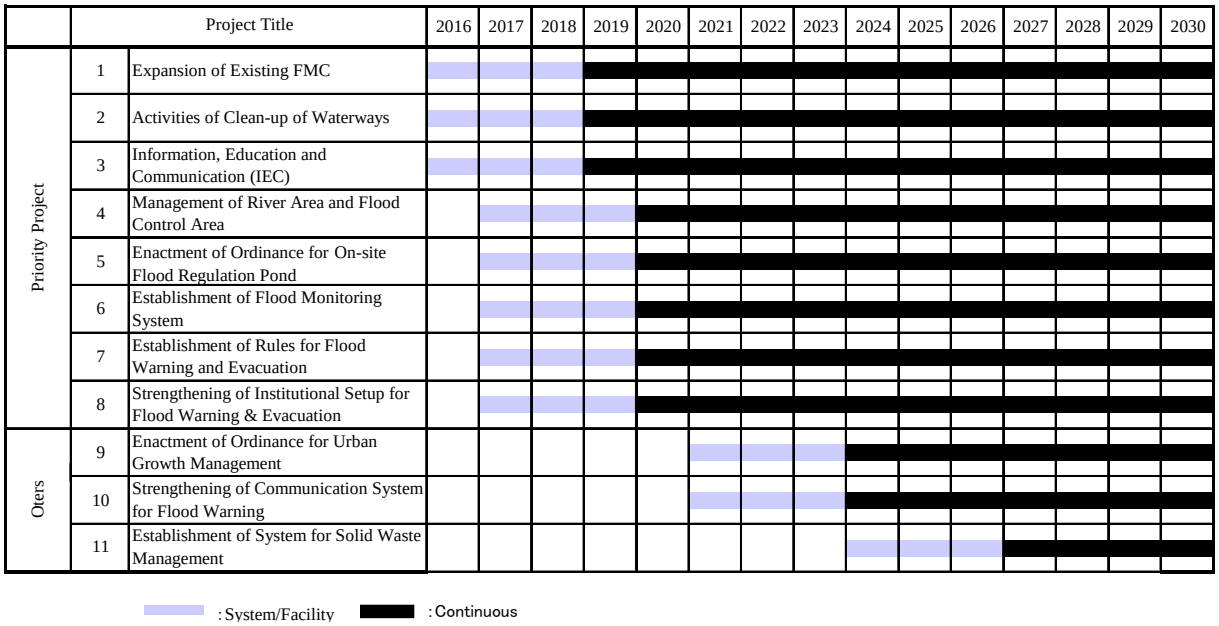
Not disclosed

Figure 10.1 Implementation Schedule for Structural Measures

10.2 Implementation Schedule of Non-Structural Flood Mitigation Projects

Of the proposed eleven (11) projects, the six (6) priority projects will initially complete their institutional setup in the period from 2017 to 2019 and then start actual operation as shown in Figure 10.2.

It should be noted herein that the river flood control along the flood risk area of Canas River shown in Figure 7.5 could be hardly attained through any structural measure without the prevention of encroachment to the river as described in Subsection 7.2.3. The flood risk area shown in foregoing Figure 7.5 should be legally designated as the critical river area, the existing houses and land use states in the area be listed up in the ledger and the necessary resettlement works be executed in the period from 2017 to 2019. The prevention of re-encroachment to the flood risk area would also be required through the river patrol from 2020 onward.



Source: JICA Study Team

Figure 10.2 Implementation Schedule of Non-Structural Measures

11. COST ESTIMATION

Project costs for each construction stage of the on-going projects including those under detailed design, the priority project, the mid-term project and the long-term project as described in Chapter 11 have been estimated as shown in Table 11.1 to Table 11.5[6].

Table 11.1 Project Cost of Ongoing Projects (with Project under Detailed Design)

(million Pesos)

Item	Imus and Bacoor Retarding Basins			Gen. Trias 1 and 2 Retarding Basins			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Civil Works	Not disclosed								
Engineering Services									
Land Acquisition and Compensation									
Administration									
Physical Contingency									
Price Contingency									
VAT									
Total									

Source: JICA Study Team

Table 11.2 Project Cost of Priority Projects

(million Pesos)

Item	San Juan River Basin			Maalimango Drainage Area			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Civil Works	Not disclosed								
Engineering Services									
Land Acquisition and Compensation									
Administration									
Physical Contingency									
Price Contingency									
VAT									
Total									

Source: JICA Study Team

[6] Definitions of the priority project, the middle-term project and the long-term project are as shown in Table 6.1.

Table 11.3 Project Cost of Mid-Term Projects

(million Pesos)

Item	Imus River			Bacoor River			Julian River			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Civil Works	Not disclosed											
Engineering Services												
Land Acquisition and Compensation												
Administration												
Physical Contingency												
Price Contingency												
VAT												
Total												

Source: JICA Study Team

Table 11.4 Project Cost of Long-Term Project

(million Pesos)

Item	New Imus Retarding Basin			New Rio Grande Retarding Basin			New Ylang-Ylang Retarding Basin			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Civil Works	Not disclosed											
Engineering Services												
Land Acquisition and Compensation												
Administration												
Physical Contingency												
Price Contingency												
VAT												
Total												

Source: JICA Study Team

Table 11.5 Total Project Cost

(million Pesos)

Item	Ongoing (w/ DD)			Priority Project			Middle-Term Project			Long-Term Project			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Civil Works	Not disclosed														
Engineering Services															
Land Acquisition and Compensation															
Administration															
Physical Contingency															
Price Contingency															
VAT															
Total															
Item															

Source: JICA Study Team

12. PROPOSED ORGANIZATIONAL SETUP OF PROJECT IMPLEMENTATION, OPERATION AND MAINTENANCE

12.1 Present Institutional Condition of Flood Management Sector

There are many stakeholders in the flood management sector. The stakeholders could be categorized into three (3) types; namely, Planning and Regulatory Departments, Implementing Agencies/Organizations, and Local Governments. The National Economic Development Agency (NEDA), the Department of Budget and Management (DBM) and the Department of Finance (DOF) are in charge of the planning and monitoring of the projects from the economic and financial aspects. They approve international loans and grants/subsidies for each project based on the national policy and prioritization of projects in whole sectors from economic and social aspects. These departments are in charge of supervision, as well as approval and arrangements for effective Japanese ODA loan projects from the national budgetary points of view.

There are organizations which actually plan, supervise, and implement structural and non-structural measures for flood management, such as the Department of Public Works and Highways (DPWH), and the Office of Civil Defense (OCD). These agencies plan projects and allocate the budget for each project based on the national policy and priority. The district offices and branches in local areas coordinate with the local government units and the residents in the construction and maintenance of infrastructures for flood management. The other national level agencies such as the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the Office of Civil Defense (OCD), and the Department of Interior and Local Governments (DILG) play important roles in undertaking non-structural flood mitigation measures. Specifically, PAGASA undertakes the task for issuing of flood warning, OCD works as the Secretariat of the National Disaster Risk Reduction and Management Council (NDRRMC) and DILG supports distributing of the information for flood evacuation to the residents. In order to implement an effective flood management project, these organizations, and their district offices need to implement their activities in harmony with the other organizations through good communication among them.

The local government units such as the Cavite Provincial Government and the targeted cities/municipalities as well as the barangays have important roles in flood management especially in non-structural measures such as enactment of ordinances for development planning, river cleaning, Information and Education Campaign (IEC) to raise awareness on flood mitigation, and dissemination of hazard warning. The LGU officials usually have direct contact with the residents as well as direct involvement in the pre-, during and after disaster phases.

DILG and DBM allocate 20% and 5% of the Internal Revenue Allotment (IRA), which is granted to LGUs by the central government to "Development Fund[7]" and "Local Disaster Risk Reduction Fund

[7] DILG allots at least 20% of IRA to development of infrastructures, which include but not limited to the flood risk management in accordance with the Joint Memorandum Circular（MC）2011-1, which was issued jointly by DILG and DBM.

(LDRRMF[8])." The Development Fund is used for development of infrastructures, which include those for disaster prevention, while the LDRRMF for urgent restoration of the disaster.

12.2 Financial System of Flood Management Sector

For the investment of flood management sector, the government budget is allocated through the following three main routes, the details of which are explained in the following section:

- The annual budget of DPWH for construction and O&M works of permanent structures/facilities to increase preparedness and rehabilitation against floods (PHP 52 billion allocated into the budget of 2015);
- The National Disaster Risk Reduction Management Fund (NDRRMF) managed by the National Disaster Risk Reduction and Management Council (NDRRMC) and the Quick Response Fund (QRF) for the preparation and response to disasters and for the rehabilitation of damaged structures (PHP 20 billion allocated into the budget of 2015); and
- The 20% Development Fund and the Local Disaster Risk Reduction Management Fund (LDRRMF) allocated to the LGUs for disaster preparedness and response (a total of PHP 1.6 billion allocated into the budget of 2015 for the provincial government and LGUs in the Study Area).

For implementation of the project in Cavite Province, the UPMO (Unified Flood Management Office) of DPWH takes the responsibility for managing the foreign-assisted project and the fund is provided from the ODA loan and the DPWH counterpart fund for the construction works and services. After the construction of facilities, the responsibility for O&M is handed over to the DEO (District Engineering Office) of DPWH in Cavite Province with expenditures provided from the DEO's own budget.

The NDRRMF and QRF, the second largest budget related to flood management, is spent in hazard affected areas for emergency use and rehabilitation purposes managed by NDRRMC and the line ministries. Thirdly, the LDRRMF of the local governments are mainly spent on several activities by the Flood Mitigation Committee (FMC) and the Disaster Risk Reduction and Management Office (DRRMO) which is in charge of managing non-structural measures for enhancing preparedness and response against flood risk.

12.3 Proposal of Institutional Framework for Project Implementation

The optimal institutional setup for project implementation from preparation phase to O&M phase is proposed in this chapter. Responsible organizations for structural and non-structural measures are explained separately.

12.3.1 Structural Measures

The organizations responsible for each phase of the structural measures are indicated in Table 12.1.

[8] DILG established the LDRRMF in accordance with Philippine Disaster Risk Reduction and Management Act, 2000 allocating 5% of IRA granted to LGUs as the LDRRMF, which could be used to cope with the natural and/or manmade disaster and restore the damages by the disaster

Table 12.1 Organizations Responsible for Structural Measures

Term	Competent Authorities and Contents of Activities
Before Construction	The DPWH-FCMC manages the details design and tendering works for construction. At the same time, it formulates and implements the Resettlement Action Plan (RAP) and monitors the actual resettlement works. The DPWH-FMC also chairs the FMC coordinating with the relevant LGUs. The DPWH-Bureau of Design undertakes evaluation on the results of tendering and verifies the estimated cost and implementing schedule of the project. In order to facilitate the tender works, the international consulting group prepares the tender documents coordinating with the relevant government agencies for execution of the tender works. DPWH-ESSD makes the technical advice for formulation, implementation, and monitoring of RAP.
During Construction	The DPWH-FCMC undertakes the management for construction supervision of the Project. The other relevant technical bureaus and the district engineering office of DPWH supports the construction supervision as required. The international consulting group undertakes the actual construction supervision of the Project.
After Construction (Period for Maintenance& Operation)	The ownership of the facilities constructed through the Project is to be transferred to the DPWH Cavite 1st District Engineering Office (DEO). The LGUs is responsible to monitor and remove the garbage dumped into the river and drainage channels in accordance with the MOA agreed among the members of FMC such as DPWH, Cavite Provincial Government, and LGUs. The cost for regular maintenance and the small scale repair of the project facilities is to be shouldered by the District Engineering Office and the LGUs. However, when the cost exceeds the budget of the District Engineering Office and the LGUs, it will be financed from the QRF, the annual budget of DPWH and/or the grant from the NDRRMF. The following are the major roles of the relevant entities during the non-flood and flood seasons. 1. Non-flood Season **DPWH Cavite 1st DEO:** (1) Regular inspection, maintenance and small repair of the flood mitigation facilities, (2) Removal of deposits at the bottle neck section of rivers and principal drainage channels, (3) Monitoring of encroachment into the river area and flood control areas, and (4) IEC for the residents on the proposed structural and non-structural flood mitigation measures. **Provincial Gov. and Cities/Municipalities** (1) Regular inspection and removal of the deposits in the waterways; (2) Monitoring of encroachment into the river area and flood control areas, and (3) IEC for the residents on the proposed structural and non-structural flood mitigation measures. **FMC** (1) Formulation of action plan for IEC to residents on the flood mitigation, (2) Monitoring and administration of the flood mitigation works by the LGUs, and (3) Coordination with LGUs for IEC on the flood mitigation weeks. 2. Flood Season **DPWH Cavite 1st DEO:** (1) Emergency inspection and repair of flood mitigation facilities as required during a flood;, (2) Monitoring of rainfall intensities and flood water level during a flood, (3) Support for the flood warning and evacuation carried out by LGUs (4) Inspection and repair of the flood mitigation facilities immediately after a flood. **Provincial Gov. and Cities/Municipalities** (1) Monitoring of rainfall intensities and flood water level during a flood, (2) Instruction and guidance for flood warning and evacuation during a flood, (3) Investigation of flood damages after flood, (4) Support of residents for disaster restoration. **FMC** (1) Coordination with DPWH and LGUs to conduct the instruction and guidance for the flood warning and evacuation.

Source: JICA Study Team

12.3.2 Non-structural Measures

The organizations responsible for the non-structural measures proposed in Chapter 8 are summarized in Table 12.2. Activities chosen for priority projects are as highlighted.

Table 12.2 Organizations Responsible for Non-Structural Measures

Category	Name of Projects	Responsible Organization							Details of Role-sharing
		FMC	DPWH-DEO	PAGASA	OCD	HLURB	Province	LGUs	
Removal of Deposits in Waterways	Establishment of Management System for the Clean-up Activities of Waterways	○					○		LGUs implement clean-up; PG-ENRO and FMC monitor the activities
	Establishment of Management System of IEC for the Cleanup of Waterways	○					○	○	LGUs implement IEC; PG-ENRO and FMC monitor the activities
	Establishment of Management System for Status of Solid Waste Management	○					○	○	LGUs prepare and implement SWMP; PG-ENRO and FMC monitor the activities
Management of River Area and Flood Control Area	Further Prevention of Encroachment to River Area by Using Database of Easement Management	○	○				○	○	DPWH establishes the river boundary. PG and LGUs enact the ordinances. LGUs conduct patrolling activities and inform FMC and stakeholders if encroachment is found.
Control of Excessive Land Development	Control of Excessive Land Development by Using Regulation Map of Land Development	○				○	○	○	LGUs prepare CLUP following the framework formulated by PG
	Enactment of Ordinance for Urban Growth Management	○				○	○	○	PG enacts the ordinance
Introduction of On-site Flood Regulation Pond	Enactment of Ordinance for On-site Flood Detention Facility	○					○		Ordinances should be enacted by PG. LGUs are to formulate a similar ordinances.
Flood Warning/ Evacuation System	Installation of Flood Forecasting to Enhance Flood Monitoring System			○	○		○		PAGASA, OCD (DND), DILG and Local Governments should cooperate and share forecast data.
	Functional Enhancement of Flood Warning/Evacuation System				○		○	○	Flood warning/evacuation system should function properly up to barangay level.
	Enhancement of IEC Activities for Flood Warning/Evacuation System	○		○			○	○	LGUs implement IEC; PDRRMO and FMC monitor the activities
	Establishment of Management System for Flood Warning/ Evacuation System	○		○	○		○	○	LGUs plan the C/MDRRMO activities. PDRRMO, FMC and OCD support the planning and implementation.

Source: JICA Study Team

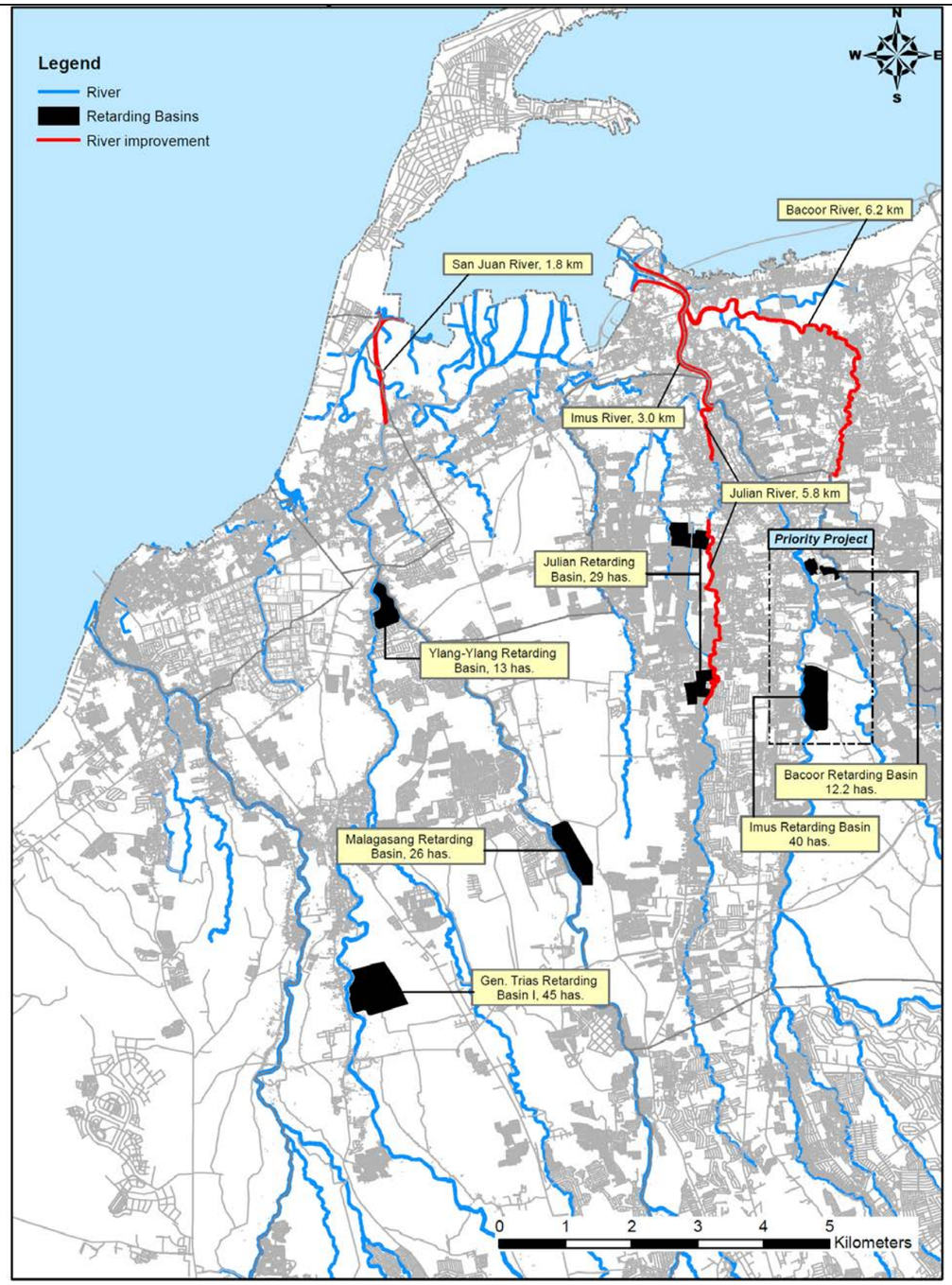
13. CHANGES IN THE STRUCTURAL FLOOD MITIGATION PLAN PROPOSED IN JICA STUDY 2009 AND THIS STUDY

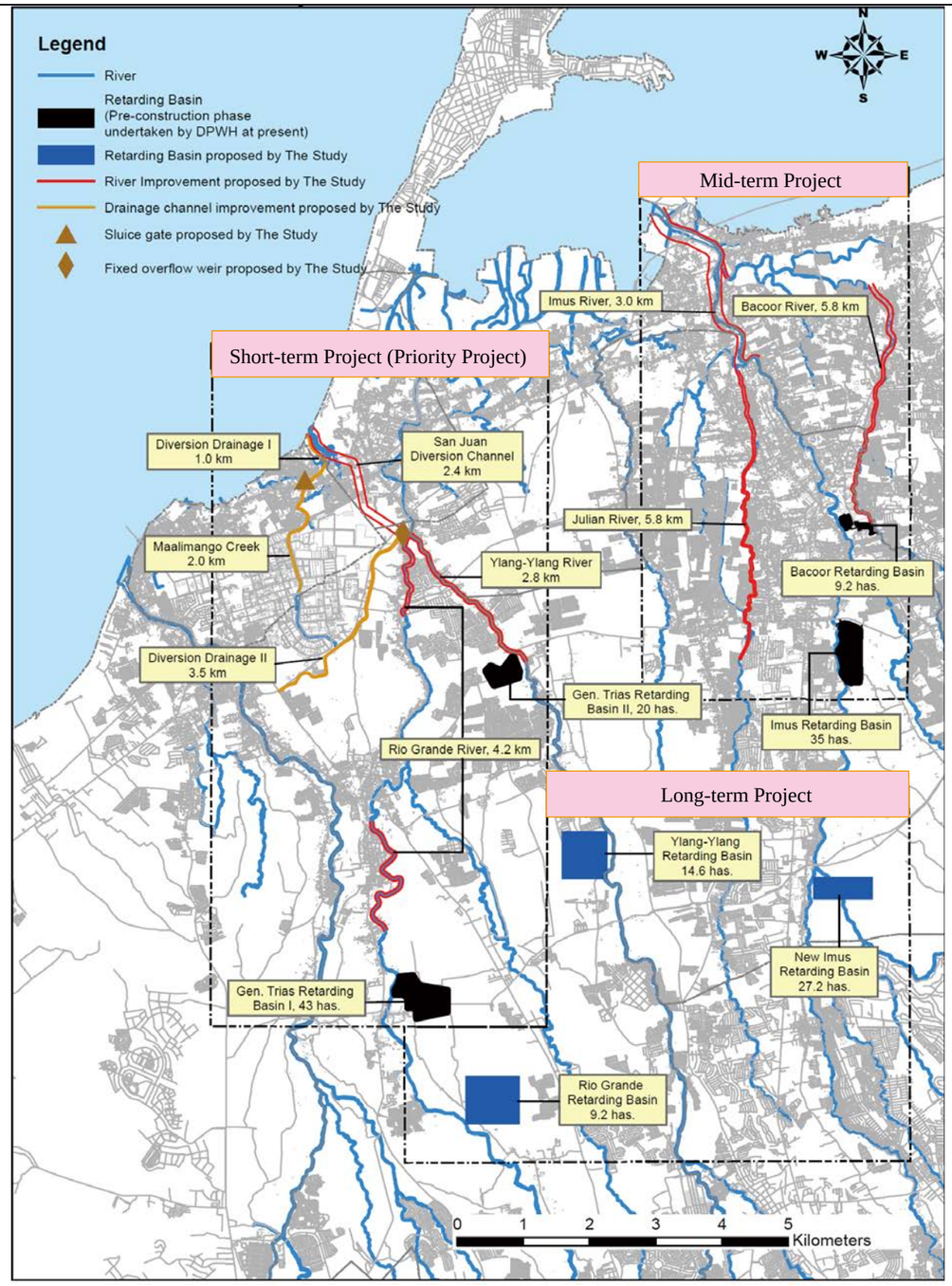
The comprehensive flood mitigation plan initially proposed in the JICA Study 2009 is composed of structural and non-structural measures. Thereafter, some modifications were made to the plan through the FRIMP-CTI project and this Study. The principal changes of the flood mitigation plans under these three (3) studies (i.e., JICA Study 2009, FRIMP-CTI and this Study) are as shown in Table 13.1. Location maps of the flood mitigation facilities proposed in the studies are further shown in Figure 13.1

Table 13.1 Changes in the Flood Mitigation Plan Proposed in the JICA Study 2009, FRIMP-CTI and the Study

<table>
<tr><th>Changes in the Plan</th><th>Reasons for the Change</th><th>Contents of Changes</th></tr>
<tr><td>Design Flood Level</td><td>Standard design flood levels were updated based on the Memorandum of the Secretary of DPWH in 2011</td><td>JICA Study 2009
- 1/10 years flood frequency for River Flood Control
- 1/2 years flood frequency for Drainage Improvement
FRIMP-CTI (2013 to present)
- 1/25 years flood frequency for Flood Retarding Basin
This Study (2015 to present)
- 1/50 years flood frequency for River Flood Control
- 1/15 years flood frequency for Drainage Improvement</td></tr>
<tr><td>Construction Site for Flood Mitigation Facilities</td><td>Some of the construction sites for flood retarding basin proposed in the JICA Study 2009 have been urbanized and could hardly be utilized as construction site.</td><td>JICA Study 2009
- Six (6) construction sites for flood retarding basin were proposed.
FRIMP-CTI:
The construction sites proposed in JICA Study 2009 were updated as below:
- Two (2) construction sites were secured with minor modification.
- Two (2) construction sites were shifted to other locations.
- Two (2) construction sites were abandoned.
The Study
- Four (4) construction sites being designed by FRIMP-CTI are assumed as prerequisite for flood mitigation of the entire Imus and San Juan river basins.
- Three (3) construction sites are newly proposed to attain the design flood level of 1/50 years frequency.</td></tr>
<tr><td>Design Rainfall Intensity</td><td>The recorded maximum and second maximum 2-day rainfall intensities were gauged in 2012 and 2013 at Sangley Point station which lies adjacent to the Study Area.</td><td>The design rainfall intensity for the flood mitigation plan in the JICA Study 2009 are updated in the FRIMP-CTI and the Study due to the recently gauged rainfall intensities, which led to the design structural scale in each of the studies.
Design 2-day Rainfall in Each of the Study
<table>
<tr><th>Frequency</th><th>JICA Study 2009</th><th>FRIMP-CTI</th><th>The Study</th></tr>
<tr><td>1/2 years</td><td>191 mm.</td><td>197 mm.</td><td>192 mm.</td></tr>
<tr><td>1/25 years</td><td>Not Available</td><td>333 mm.</td><td>360 mm.</td></tr>
<tr><td>1/50 years</td><td>360 mm.</td><td>356 mm.</td><td>403 mm.</td></tr>
</table></td></tr>
<tr><td>Priority Project</td><td>Serious floods occurred in and around San Juan River Basin including CEZ in 2013.</td><td>- The project of flood retarding basins in Imus River Basin was selected as the priority project under JICA Study 2009 and it is now being implemented under FRIMP-CTI.
- The serious flood damage in 2013 led to the project of flood retarding basins in San Juan River in 2015 by GOP Fund
- The flood mitigation plan for the entire San Juan River Basin is selected as the Priority Project in the Study.</td></tr>
</table>

Source: JICA Study Team





2009 JICA Study | **This Study**

Source: JICA Study Team

Figure 13.1 Layout Plans Proposed in the JICA Study 2009 and this Study

14. ENVIRONMENTAL AND SOCIAL CONSIDERATION: STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)

14.1 Outline of Project Components which Would Give Impacts on the Natural and Social Environment

The project components which would give impacts on the natural and social environment consist mainly of the construction of retarding basins and diversion channels and the river improvement (widening, dredging, excavation, and embankment).

14.2 Legal Framework on Environmental Impact Assessment in the Philippines

In the Philippines, all private or public projects or activities which are envisaged to potentially have a negative impact on the environment are subject to Environmental Impact Assessment (EIA) by the Philippine Environmental Impact Statement System (PEISS). According to Presidential Decree (PD) No. 2146 (1981), the EIA process covers projects which have been originally declared as Environmentally Critical Projects (ECPs) or projects in Environmentally Critical Areas (ECAs) presumed to have significant impacts on the quality of the environment. The EIA and Initial Environmental Examination (IEE) requirements for water management projects in the Philippines stipulated by the Department of Environment and Natural Resources through the Environmental Management Bureau (DENR-EMB) are presented in Table 14.1.

Table 14.1 EIA and IEE Requirements for Water Management Projects

Project Type	Covered in ECC			Covered/not covered in ECC	Not covered in ECC	Project Size Parameter
	Category A: ECP	Category B: Non-ECP		Category C	Category D	
	EIS	EIS	IEE checklist	EIS/IEE	PD (Part I)	
3.1 Dam, water supply, flood management project						
3.1.1 Dams (including those for irrigation, flood control, water source and hydropower projects) including run-of-river type	≧ 25 ha or ≧20 million m3	> 5 ha but < 25 ha or > 5 million m3 but < 20 million m3	≦ 5 ha or ≦ 5 million m3	A project intended to directly enhance the quality of the environment or directly address existing environmental problems. *Proponents are required to submit a project description to EMB to determine if the project needs an ECC, or conduction of EIS/IEE.	None	Reservoir in flooded/inundated area or/and water storage capacity
3.1.2 Irrigation projects (distribution system only)	None	≧ 1,000 ha (service area)	> 300 ha but < 1,000 ha		≦ 300 ha	Service area
3.1.3 Water supply projects (excluding dam)	None	With water source (e.g. infiltration gallery etc.) and water treatment facilities including desalination, reverse osmosis (RO)	Level III (distribution system only)		Level II/I (water supply station)	

Source: JICA Study Team, based on DENR-EMB Revised Guidelines for Coverage Screening and Standardized Requirements (2014)

14.3 Scoping and Results of Re-Evaluation

Prior to conducting surveys, impact assessment (scoping) was carried out on anticipated environmental and social impacts. The results of scoping were re-evaluated by field surveys based on the result, and Table 14.2 gives the list of outputs.

Table 14.2 Scoping and Results of Re-Evaluation

	No.	Likely Impacts	Rating in Scoping		Rating on Survey		Justification
			Pre-/ Const.	Operation	Pre-/ Const.	Operation	
Pollution	1	Air Pollution	B-	D	B-	N/A	There are two possible sources of air pollution from the prospective projects: disturbance of existing soil and rock matrix during construction and the heavy equipment that will be used to move these materials and other related vehicles. There are some expected impacts but these will not greatly affect the existing air quality in the area. Based on the type of project to be implemented, there will be no source of emission during the operation phase.
	2	Water Pollution	C-	D	B-	N/A	Most of the river systems are classified as Class C whose primary intention is for fishery and industrial water supply. The project will have direct impact on water quality, particularly, on levels of total suspended solids during construction period from runoff and erosion, and possibly from sewage generated by construction workers. With the current condition of the river, the project impact on water quality, although minimal and temporal, must be properly and adequately mitigated.
	3	Noise and Vibration	B-	D	B-	N/A	Since heavy equipment is likely to be used for the projects, the generated noise will be a significant impact on people, especially if the project site is within 50 m. of residential/commercial areas. The increase of noise level could be temporary, since there are no projected impacts once the project is in its operation phase.
	4	Soil Contamination	B-	D	B-	N/A	The potential source of soil contamination from heavy equipment and vehicles is limited and can be totally eliminated when maintenance is done offsite. Should dredging be required in areas downstream of industrial areas, the dredged materials, as required by law, must pass toxicity test prior to disposal.
	5	Waste	B-	D	B-	N/A	Given the informant interview in one of the potential impact sites, the project must further assess the impact of excavated or dredged materials to the surrounding areas. The project should be able to identify or designate potential disposal sites. Solid waste management and disposal of construction spoils must be emphasized in the environmental impact assessment.
	7	Offensive Odor	B-	D	B-	N/A	Offensive odor may be an issue when there will be dredging of heavily silted and polluted portions of the rivers. This issue is expected during construction period but will be localized and temporal. The issue of odor during the operation of retarding pond may be just perception and must be mitigated by an enhanced information campaign.
	8	Bottom Sediment	C-	D	B-	N/A	The impact on bottom sediment quality will be minimal considering the existing type of bottom sediment in the area. Additional river siltation may be experienced during construction but will be complemented when dredging is implemented as part of the river channel improvement.

	No.	Likely Impacts	Rating in Scoping		Rating on Survey		Justification
			Pre-/ Const.	Operation	Pre-/ Const.	Operation	
Natural Environment	10	Flora, Fauna and Biodiversity	B-	D	B-	N/A	Even though there are no rare and endangered species of animals and plants inland of the project area, the presence of mangroves in proposed project areas will have an impact on the project. These mangrove areas are considered protected both by national and local laws and ordinances. The activities of the project particularly dredging and river channel improvement will have impacts to these mangrove areas.
	11	Hydrological Situation	C-	A+	B-	A+	In general, some temporary re-channeling of river flow will be done during construction. Since the final alignment is not yet fixed, the impact rating is adjusted to B- to provide better mitigating measures for flow diversion during construction and validate whether the impact will be permanent.
	12	Topography and Geographical Features	B-	B-	B-	B-	The project will have an impact on the existing topography of the project-affected areas. This impact should be very minimal since the project will be limited to the Lowest Lowland Area and the Lowland Area.
	13	Soil Erosion	B-	D	B-	N/A	There is expected localized soil erosion when the river channels are widened. This impact will be minimal and localized. Land developments should not affect the sediment yield in the area since channel improvements should be far from land developments.
	14	Groundwater	B-	B-	B-	B-	Since the lowest lowland area of Cavite is less than 2 m. and the water level during high tide is about 0.8 m. or 2 m from the MSL, saltwater may intrude into groundwater tables of the lowest lowland municipalities of Cavite. This should be further verified in the detailed engineering stage so that proper hydraulic structures can be included to mitigate this concern.
	15	Coastal Zone (Mangroves)	B-	B-	B-	B-	The project, particularly the river improvement near San Juan River mouth and the diversion channel, will have potential negative impacts on the coastal zone environment ranging from potential siltation to destruction of existing mangroves. These areas must be studied further in the environmental impact assessment and detailed engineering stages.
Social Environment:	17	Involuntary Resettlement	A-	D	A-	N/A	While involuntary resettlement might be done for the implementation of the projects, Philippine legislation safeguards the rights of those affected by the possible relocation. A Resettlement Action Plan (RAP) will be required prior to the start of any construction activity.
	18	Local Economy such as Employment and Livelihood, etc.	B+/-	A+	B+/-	A+	The project will be conducted in densely populated areas along the riverbanks. The diversion channel will be built on a densely populated area in Noveleta. This entails massive relocation that may affect employment and livelihood in the area. The most affected source of livelihood will be businesses, particularly, small to medium enterprises.
	19	Land Use and Utilization of Local Resources	B-	B+	B-	B+	The project, particularly the proposed diversion channel, will run through several built-up areas including residential areas, a small part of a cemetery, a temporary dumpsite, commercial areas, and an area with mangroves and other vegetation. Massive impact on land use is anticipated.
	21	Existing Social Infrastructures and Services	B-	B+	B-	B+	Impacts on existing social structures and services are expected; particularly on roads, structures such as barangay halls and barangay health centers, and some bridges that connect both banks of the river.

	No.	Likely Impacts	Rating in Scoping		Rating on Survey		Justification
			Pre-/ Const.	Operation	Pre-/ Const.	Operation	
	23	Local Conflict of Interests	B-	D	B-	N/A	There are proposed project sites such as General Trias. As projected, these project sites will have a significant effect on mitigating flooding in the lowest lowland municipalities of Cavite, such as Noveleta, Kawit, and Rosario. Since land in General Trias might be acquired for the project, the Municipality of General Trias might see this as a conflict.
	24	Water Usage or Water Rights and Rights of Common	C-	D	B-	N/A	Impacts on sanitation will possibly be caused by workers. This can easily be mitigated by following proper environmental practices in construction sites.
	25	Hazards (Risk), Infectious Diseases such as HIV/AIDS	C-	D	B-	N/A	Expected to work as construction workers are able-bodied males aged 18-50 years. Moreover, these workers may be from other parts of the country. Based on the demographic data, most of those who have virus are aged 15-49, which is the same age as the prospect for construction workers.
	26	Cultural Heritage	C-	D	B-	N/A	There are a number of historical and cultural property sites listed, but these are far from the proposed construction sites. Although it may not be listed as historical site, a portion of the cemetery in Noveleta might be affected by the new diversion channel. This has to be validated during the detailed engineering, and proper mitigating measures must be done. Alignment may have to be changed to avoid the cemetery. The risk rating is adjusted to B- during construction phase.
	27	Landscape	C-	C-	B-	B-	Presence of heavy machinery and structures for flood mitigation may have impact to the aesthetics of the landscape in some areas of Cavite.
	28	The Poor, Indigenous and Ethnic People	C-	D	B-	N/A	According to statistics, a family of five needs about Php7,820 per month for their food and non-food expenses. The primary data shows that 0.98% of the 204 respondents have no income sources, while 43% earn less than Php5,000 per month. Furthermore, it is evident that there are no indigenous people residing in Cavite.
	29	Working Conditions/ Accidents	B-	D	D	N/A	Existing safeguards on workers' welfare in terms of occupational safety and health are present and very actively implemented in the Province of Cavite.
	30	Gender/ Children's Rights	C-	D	D	N/A	The project should not pose impacts on gender and children's rights in Cavite. This is proven by the sensitivity of the province regarding issues on gender and development, and the presence of DOJ and DPWH.

Rating:
A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent. C+/-: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.) D: No impact is expected. N/A: Not Applicable.
Source: JICA Study Team

14.4 Stakeholder Meetings

The First Stakeholder Meeting was held on July 7-8, 2015. The program and the major questions/responses in the meeting are as shown in Table 14.3 and Table 14.4, respectively, for the three river basins.

Table 14.3 Program of the First Stakeholder Meeting

Day 1 (7 July 2015)

Item	Content	Remarks
Date & Time	7 July 2015, 8:30-11:00	5 LGUs involved: Gen. Trias, Indang, Rosario, Tanza, Trece Martires (Canas River Basin)
Venue	La Isla Bonita de Salinas, Rosario, Cavite	
Participants	47 participants (women: 34%) including LGU/National Government. representatives, residents, etc.	
Agenda	1) Opening remarks 2) Project presentation (outline, objectives & method of IEE study, schedule) 3) Open forum/discussion/synthesis 4) Closing remarks	

Day 2 (8 July 2015)

Item	Content	Remark
Date & Time	8 July 2015, 8:30-11:00	4 LGUs involved: Bacoor, Imus, Kawit, Silang (Imus River Basin) 3 LGUs involved: Amadeo, Dasmariñas, Noveleta (San Juan River Basin)
Venue	ABC Hall, Bacoor City, Cavite	
Participants	30 participants (women: 23%) including LGU/National Government representatives, residents, etc.	
Agenda	1) Opening remarks 2) Project presentation (outline, objectives & method of IEE study, schedule) 3) Open forum/discussion/synthesis 4) Closing remarks	

Source: JICA Study Team

Table 14.4 Major Questions and Responses at the Stakeholder Meetings

Issues/Suggestions/Comments Raised by Stakeholders	Stakeholder Who Raised the Issue/Comment	Response of the Proponent
Rio Grande River was not mentioned as part of the project sites.	MENRO of Gen. Trias	• Since Rio Grande River is part of the San Juan RB, all main rivers in the area are included (JST) • DPWH has other projects in the area, including: 1) Supplemental study in Gen. Trias to fully address flood problem, and 2) Imus retarding basin project (for implementation in year 2016 (DPWH)
How long will the study take before being able to construct a retarding basin?	Brgy. Captain of Gen. Trias	• IEE: 4.5 months; FS: 16 months • Project sites will be chosen, and then an EIA will be done. This is the initial study. No ECC will be issued after this study. RAP is different (JST).
Can we not tie up with NHA with regard to the settlement?	Brgy. Captain of Gen. Trias	• Thank you for the suggestion. Laws will be followed with regard to relocation (JST).
Also consider formal settlers in dangerous areas.	MENRO of Gen. Trias	• There are policies to support project-affected people. Government will give proper compensation and uplift living standards. This is only the first meeting. There will be other meetings where PAPs will be involved (DPWH).
Has there been a successful project in the Philippines of this kind?	PGENRO of Cavite Provincial Government	• This project is the first in the Philippines. The existing water impounding system projects are quite similar but are not of the same scale as the retarding basins for this project (DPWH).
Will there be a measure to control water to be discharged from the retarding basin? The capacity of our river walls in Noveleta is currently not enough to contain river water inundation, which is expected to increase given the growing residential development activities in the	Resident of Noveleta	• There are no retarding basins to be constructed in Noveleta for this project. Measures and structures to be employed are mostly for the improvement of river channels. However, the proposed retarding basin under study in General Trias can potentially affect Noveleta (Cavite Governor's Office).

Issues/Suggestions/Comments Raised by Stakeholders	Stakeholder Who Raised the Issue/Comment	Response of the Proponent
upland areas.		
Is slope protection part of the proposed flood management project? What is the role of LGUs in the project?	CEO of Bacoor	• Slope improvement is one option for channel improvement. LGUs can help in selecting the most appropriate site for the flood control structures and in identifying barangays that may be affected by these structures (JST)
We need to first address informal settlement along the river channels in the Municipality of Noveleta. Consider the possibility of utilizing river water contained by the retarding basin versus just discharging. This may address water supply deficit during dry season.	PEO of Cavite Provincial Government	• Thank you for the suggestion (JST)

Source: JICA Study Team

14.5 Environmental Monitoring Plan

For the priority project which will be determined based on the Study, possible issues and items to be monitored during the construction phase and operation phase are listed in Table 14.5.

Table 14.5 Issues and Items for Environmental Monitoring Plan

No.	Issues	Items to be Monitored
Construction Phase		
1	Air Pollution	TSP (dust), SO2, NOx and CO
2	Water Pollution	pH, DO, oil & grease, BOD, Coliforms (fecal, total) and TSS
3	Noise	Noise level from heavy construction equipment (LAeq)
4	Soil Contamination	Condition of soil in the construction area (contamination)
5	Waste	Volume of wasted soil, trees/grass cut and disposed garbage
10	Flora, Fauna and Biodiversity	Situation of vegetation and animal behavior
11	Hydrological Situation	Flooding situation (frequency, flood level, interviewing)
12	Topography and Geographical Features	Slope stability
13	Soil Erosion	
14	Groundwater	Salinity of well water
15	Coastal Zone	Situations of mangrove and fishery
17	Involuntary Resettlement	Payment and implementation of social assistance (in accordance with RAP)
18	Local Economy such as Employment and Livelihood, etc.	
21	Existing Social Infrastructures and Services	
28	The Poor, Indigenous and Ethnic People	
23	Local Conflict of Interests	Number of complaints regarding the project
24	Water Usage or Water Rights and Rights of Common	
25	Hazards (Risk), Infectious Diseases such as HIV/AIDS	Number of infected patients
Operation Phase		
2	Water Pollution	pH, DO, oil & grease, BOD, Coliforms (fecal, total) and TSS
12	Topography and Geographical Features	Slope stability
14	Groundwater	Salinity of well water
15	Coastal Zone	Situations of mangrove and fishery

Source: JICA Study Team

15. IMPACT OF RESETTLEMENT AND THE RESETTLEMENT PLAN (POLICIES)

15.1 Impact of Resettlement due to River Flood Mitigation Measures

15.1.1 Involuntary Resettlement

The numbers of affected buildings, households and population were estimated, based on the satellite images, for each alternative flood mitigation plans for Imus and San Juan River Basin as shown in Table 15.1 and Table 15.2. The affected buildings, households, and population shown in the said Tables are herein defined as those to be forced to relocate due to river channel improvement, and/or construction of diversion channel and flood retarding basins in the Project, and they are subject to compensation by the Project. Even the building, households, and population, which ate located within the rive boundaries, are not subject to the compensation by the Project, if they are not forced to relocate by the Project, When they are required to resettle in line with the urban development, they could be subject to compensation by LGUs in accordance with Urban Development and Housing Act of 1992.

Table 15.1 Estimation of Impacts of Resettlement due to Alternative Plans in the Imus River

Affected Item	Alternative 1	Alternative 2
Building		
Household		
Population		

Note:* Same indicators were used for Alt. 1 and Alt. 2 since both of them include densely build-up residential areas along Imus River.
Source: JICA Study Team

Table 15.2 Estimation of Impacts of Resettlement due to Alternative Plans in the San Juan River

Affected Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Building				
Household				
Population				

Note:* Indicators used for Alt. 1 & Alt. 3 were also used for Alt. 2 & Alt. 4 because Alt. 3 and Alt. 4 also include densely build-up residential areas along the rivers of Alt. 1 and Alt. 2.
Source: JICA Study Team

15.1.2 Living Condition and Livelihood

(1) Imus River

The households have stayed in the sites over a long period of time. It is estimated that the average number of workers per household is 1.39 persons and the average household monthly income is Php 7,540. It is under Php 8,485 per household per month which was calculated from

the Per Capita Poverty Threshold in Region IV-A, 2012 (Per Capita Poverty Threshold). Since 41.0% of households earn below Php 5,000, while 39.7% of households earn between Php 5,000 to Php 10,000, it is assumed that about 60 to 70 percent of households remain below or on the poverty line. On the other hand, most households reside in concrete, semi-concrete or wooden buildings with basic infrastructure such as electricity, and few informal settlements are found. Educational levels of household heads are mostly the same as the provincial level, although some vulnerable households are found as about 15% of household heads are widows, elderly or disabled.

(2) San Juan River

The households have stayed in the sites over a long period of time. The average number of workers per household and the average household monthly income of the Alt.1 & 3 and Alt. 2 & 4 are estimated at 1.57 and 1.55 persons, and of Php 8,761 and 8,347, respectively. These are over Php 7,847 and 7,560 per household per month which were calculated from the Per Capita Poverty Threshold in Region IV-A, 2012. Since about 70% of households earn below Php 10,000 for the alternatives, it is assumed that about 50 to 60 percent of households remain below or on the poverty line. On the other hand, most households reside in concrete, semi-concrete or wooden buildings with basic infrastructure such as electricity although about 10% of buildings are made of salvaged materials in Alt. 2 & 4, and few informal settlement are found except about 10% in Alt. 1 & 3. Educational levels of household heads are mostly the same as the provincial level, although some vulnerable households are found as about 10 to 15% of household heads are widows, elderly or disabled.

15.1.3 Other Major Impacts on Social Environment

(1) Imus River:

Since other structures and facilities such as economic/industrial facilities (market building, factory, office building), public buildings (school and local government), and religious facilities (church and cemetery) are located on the Bacoor, Julian and Imus rivers, they can also be affected on those lands and relocations as shown in Table 15.3.

Table 15.3 Expected Impacts on Other Structures/Facilities by Alternatives in Imus River

Location	Alternative 1	Alternative 2
Bacoor River	- The alternative can affect a church, a sports facility, a hotel, a number of schools and commercial facilities, a slaughterhouse, a lumber warehouse. - In addition, a part of the Emilio Aguinaldo Road would be changed in alignment.	- Same as Alternative 1
Julian River	- The alternative can affect a cemetery, a school and an amusement facility in the mid-to-downstream	- Same as Alternative 1
Imus River	The alternative can affect: - a cemetery and a church located in the downstream can be affected - a cemetery, a number of schools/churches/local governments/business offices, a shopping mall, a beverage factory, a slaughterhouse and a clothing factory in the mid-to-upstream.	- The alternative can affect a cemetery and a church located in the downstream.

Source: JICA Study Team

(2) San Juan River

As Table 15.4 shows, although no large-scale commercial buildings and factories are located as in the Imus alternatives, the Alt. 1 & 3 can affect public buildings (school and local government), and religious facilities (mosque, church and cemetery). The Alt. 2 may also have similar impacts as Alt. 1 & 3 on Rio Grande River, and the Alt. 4 has the least impacts. However, since the Alt. 2 & 4 include the construction of diversion channel, their alignment can affect a private school (elementary & high schools), a cemetery and a resettlement site for poor families, and pass across two (2) arterial roads and a regional road.

Table 15.4 Expected Impacts of Alternatives for San Juan River on Other Structures/Facilities

Location	Alternative 1	Alternative 2	Alternative 3	Alternative 4
San Juan River	- The alternative can affect a mosque, a number of schools/markets/local governments, a construction company, and a health center in the mid-to-upstream.	- None	- Same as Alternative 1	- None
Rio Grande River	- The alternative can affect a number of churches/cemeteries/health centers, and a school in the mid-to-upstream.	- As same as Alternative 1	- Same as Alternative 1	- None
Diversion Channel	- None	- The alternative can affect a private school (elementary & high school), a cemetery and a resettlement site for poor families. - The alignment passes across 2 arterial roads and a regional road.	- None	- Same as Alternative 2

Source: JICA Study Team

15.2 Land Acquisition and Resettlement Plan (Policies)

15.2.1 Objective Project Components for Estimation of Land Acquisition and Resettlement

The following are the objectives components of the priority project for estimation of land acquisition and resettlements:

- Project for River Flood Mitigation: (a) San Juan Diversion Channel connecting the confluence of the Ylang-Ylang and Rio Grande rivers to Manila Bay at the scale of 110 m in width with 2.2 km in length, and (b) the river improvements of the Rio Grande River and the Ylang-Ylang River.
- Project for Storm Water Drainage: (a) Widening of existing drainage channel of 2 km in length, (b) deepening of existing drainage channel of 1 km in length by dredging and 8c) construction of Maalimango Diversion Drainage I of 1km in length and II of 3.2 km in length.

15.2.2 Legal Framework

The legal foundation for resettlement policies in the Philippines is the Philippine Constitution (1987). The key policy frameworks are based on the DPWH's "Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples Policy [LARRIPP) (2007)]". Other environmental and social safeguards of the financing institutions are also applicable especially the ADB/World Bank Resettlement Policies and JICA Guidelines. Particularly, the LARRIPP stipulates policies on eligibility, compensation and

other entitlements, indigenous peoples who will be affected by the project, public participation/ consultation, grievance procedures, institutional arrangements, monitoring and evaluation as policy frameworks of the land acquisition and resettlement for DPWH projects.

15.2.3 Scope of Land Acquisition and Resettlement

The land acquisition and resettlement affected by the priority project of river flood mitigation measures is preliminarily estimated to be buildings, households and persons with about 65 hectares of land for land acquisition. The site of San Juan Diversion Channel has the largest impact on buildings, households and persons for about hectares of land (indicators of average households living in a building, and average household members were calculated at 3.8 persons). For the rainwater drainage facilities including Maalimango Drainage, buildings were counted, and the affected number of households and persons were estimated to be households and persons, respectively, with about hectares of land (indicators of an average households living in a building, and average household members were calculated at 5.5 persons).

The households have stayed at the sites for a long period of time. The average number of workers per household and the average household monthly incomes around San Juan Diversion Channel and Maalimango Drainage are estimated at 1.39 and 1.67 persons, and Php 7,045 and Php 14,361, respectively. These are over Php 6,061 and Php 8,773 per household per month which were calculated from the Per Capita Poverty Threshold in Region IV-A, 2012. However, since about 60% of households around San Juan Diversion Channel and about 50% on Maalimango Drainage earn below Php 5,000, it is assumed that about 50 to 60 percent of households remain below or on the poverty line. On the other hand, most households reside in concrete, semi-concrete or wooden buildings with basic infrastructure such as electricity although about 20% of buildings are made of salvaged materials and about 50% informal settlements are found on Maalimango Drainage. Educational levels of household heads are mostly the same as the provincial level, although some vulnerable households are found because about 20% of household heads are widows, elderly or disabled.

15.2.4 Measures of Compensation and Support

The people residing, running business, cultivating land or using other resources within the Project Area as of the census survey date will be eligible for compensation and/or support from other rehabilitation programs regardless of their tenure status. They include lessons who cannot verify their legal rights and claims for land occupied, traders, workers, and employees. However, professional squatters and members of squatting syndicates who exploit the compensation and aim for profit, and people who have previously received support are not eligible for any compensation and assistance.

(1) Entitlement:

Compensation and entitlement are defined according to the degree of impact by type of loss as 100% replacement cost for an asset, and defined as the amount necessary to replace the structure or improvement based on the current market prices for materials, equipment, labor, contractor's profit, overhead, and all other attendant costs. The compensation is mainly for land/structure, crops/trees/perennials, other built structures, leased agricultural land, business loss, and assistance to PAPs who do not own the land (e.g., tenants, renters of house structures) for relocation and reconstruction of their dwellings; rental subsidy equivalent to the average monthly rental for similar structure; rehabilitation assistance (skills training if the present livelihood is no longer viable and the PAP will have to engage in new income-earning opportunity) and transportation allowance.

(2) Consideration of Vulnerable Groups:

The project will pay special attention on the poor and landless residents, elderly, women and children, particularly for households below the poverty line, with disabled people, and with women/elderly household heads. They are given priority for the supports with vocational training, financing and food aid. In addition, in consideration of women, the Resettlement Action Plan (RAP) will propose to consider those who are responsible for the part of the livelihoods of families, or de facto household heads that mainly support family and livelihood, and eligible persons for compensation.

(3) Livelihood Rehabilitation:

There are: i) livelihood and employment development that Cavite Provincial Cooperative, Livelihood and Entrepreneurial Development Office (PCLEDO) conducts the Techno-Livelihood Caravan for poor communities for cooperatives, livelihood and entrepreneurial developments particularly by producing household-based products, which includes improvement of women's health/welfare, development of livelihoods and entrepreneurship to promote self-employment and home-based activities for the job opportunities; ii) skill development that the Technical Education and Skills Development Authority (TESDA) conducts community-based skill trainings; iii) financing opportunities that the Department of Social Welfare and Development (DSWD) finances the organization of community-based associations for entrepreneurial development with the Self-employment Assistance-Kaunlaran (SEA-K) Program; iv) cooperative development that the PCLEDO supports to establish and operate the cooperatives in order to provide more opportunities and capital for livelihood development through coordination with LGUs, DTI and partner NGOs; and v) livelihood development programs by NHA.

(4) Social Rehabilitation

There are: i) extension of the social services to meet the increased population by LGU and Barangay; and ii) comprehensive community formation programs with the support of NGOs.

(5) Development of Resettlement Sites

Especially for low-income PAFs, provision of resettlement site will be one of appropriate compensation measures. The resettlement site provided should include socialized housing structures with basic infrastructures such as roads, drainage, water supply, and power lines. It may also include public schools, public markets, chapels, health care centers, and solid waste management.

(6) Improvement of Existing Resettlement Sites

The NHA, the PHDMO, the private developers, and the NGOs have constructed resettlement sites in Cavite Province. The NHA and the PHDMO with private developers have developed large-scale sites, and they may have lots to accommodate the relocated people for the Projects. However, it is concerned that those locations are in different cities or municipalities, and they are 10 km to 15 km in direct distance away from the Project Site.

(7) Resettlement Housing Development

In order to undertake resettlement housing development, the DPWH will propose the programs for the relocated people in coordination with respective LGUs, NHA, housing finance agencies, NGOs, peoples organizations and private developers. For the poor, there are opportunities of resettlement site and community developments by facilitating the voluntary self-help efforts with Gawad Kalinga (GK) or Habitat for Humanity Philippines (HFHP). The Community Mortgage Program (CMP) managed by the Social Housing Finance Corporation (SHFC) is also an optional financial support for the poor to own the lots and houses. On the other hand, for low-income households, the NHA has developed several resettlement sites with private developers in Cavite. The PHDMO and a private developer are also developing low-cost housings where the Home Development Mutual Fund (HDMF) popularly known as PAGIBIG Fund with favorable conditions for the members applied in Pasong Kawayan II, General Trias City.

(8) Operation and Maintenance of Resettlement Sites:

In the existing resettlement sites, since there are relocated people who repeat to form informal settlements after they benefitted from selling their resettlement units, the NHA has cooperated with LGUs to make a master list with the biometrics data to validate and identify the returnees who are not eligible for the resettlement program again. Besides, the NHA has entrusted the resettlement site development to private developers, and recovers the development costs by loan repayment from the relocated people. However, delay of the repayment has become a problem

although the relocated peoples sign a simple memorandum of agreement on the loan with the NHA. Thus, ability and understandings to pay should be improved through the livelihood recovery programs, preparation of transportation for commuting, or the planned savings program. LGUs including the barangays are often responsible for the maintenance and management of the resettlement sites, which is generally incorporated in a memorandum of agreement (MOA). In case it is insufficient, LGUs should be prompted to provide appropriate social services through the monitoring and evaluation.

15.2.5 Implementation Framework

(1) Grievance Redress Mechanism

The PAPs' right to appeal grievances and that the grievances are solved is guaranteed through grievance redress procedures and mechanisms, particularly for legitimate complaints and conflicts over compensation and entitlements. If grievances related to any aspect of the project arise, these will be handled through negotiations aimed at achieving consensus. Meanwhile, the PAPs shall be exempted from all administrative and legal fees incurred pursuant to the grievance redress procedures.

(2) Institutional Framework

The implementation of RAP activities is led by the DPWH involving various government offices, LGUs, PAFs and/or other organizations representing PAFs. The leading organization is composed of i) Project Management Office (PMO) which has overall responsibility for implementing the Project, ii) District Engineering Office (DEO) of the DPWH which is the major implementer of the RAP activities, and iii) Regional Offices (RO) of the DPWH which acts as the liaison between the Environmental and Social Safeguards Division (ESSD) and the DEO. In addition, the supporting organization is composed of i) ESSD which provides technical guidance and support in the implementation of the RAP activities; ii) the Resettlement Implementation Committee (RIC) which is mainly composed of representatives from the RO and DEO, the City/Municipality LGUs, affected barangays and PAFs/PAPs, and functions to the monitoring of the RAP implementation, the payment of compensation, the grievance redress, prevention of encroachment into the project site or ROW; and iii) the Local Inter-Agency Committee (LIAC) which will be established involving relevant LGUs, Peoples Organizations (PO) and NGOs for their coordination.

(3) Implementation Process

Implementation procedure of land acquisition and resettlement mainly consists of the RAP planning and its implementation. The RAP for involuntary resettlement associated with the implementation of the proposed priority project will be studied and drafted at the F/S phase, and be finalized in the detailed design (D/D) phase. The RAP implementation includes parcellary survey with mapping, census survey/structure tagging (C/T), inventory of PAPs' assets, master

list of eligible PAPs and entitlement, evaluation of PAP's assets for compensation with review and finalization of the RAP draft based on these data, negotiations, consensus building, payment, relocation, structure removal, and supports after relocation. In addition, public consultations, grievance redress, monitoring and evaluation are conducted throughout the entire process of RAP activities.

(4) Cost and Finance

Necessary costs of the RAP implementation will be estimated in the draft RAP. The cost estimation includes the costs for compensation, relocation, rebuilding livelihoods and administration. The DPWH will prepare and provide the budget for all costs.

(5) Monitoring

Monitoring will be conducted to evaluate whether the resettlement activities are implemented as planned in the RAP. The Environmental and Social Safeguards Division (ESSD) of the DPWH shall conduct the supervision and in-house monitoring of the RAP implementation as the Internal Monitoring Agent (IMA). Besides, an External Monitoring Agent (EMA) will be commissioned by the DPWH-PMO to undertake independent external monitoring and evaluation. The EMA will be either a qualified individual or a consultancy firm with qualified and experienced staff.

PART II: FEASIBILITY STUDY

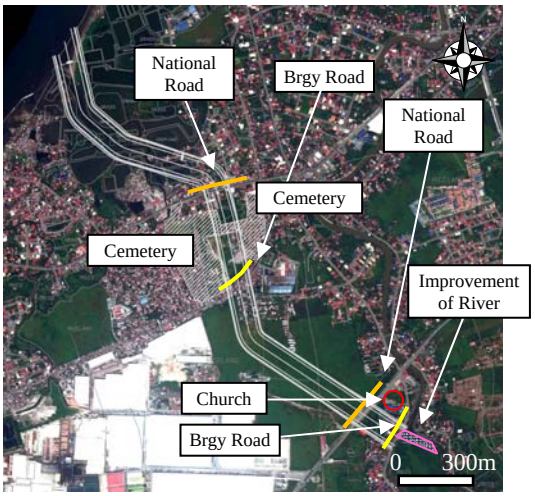
16. STRUCTURAL DESIGN AND COST ESTIMATION OF PRIORITY PROJECT

16.1 Structural Design

16.1.1 Layout Plan

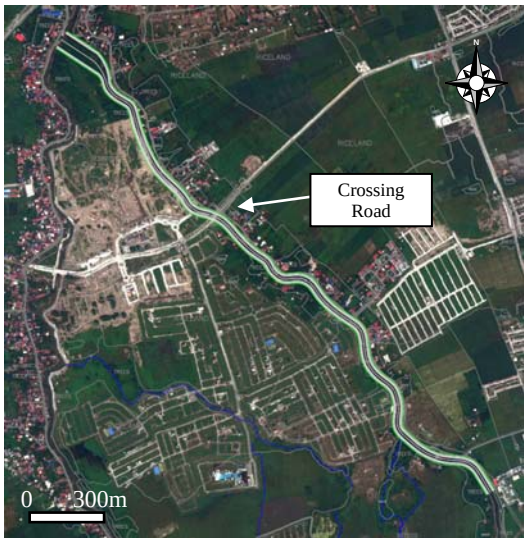
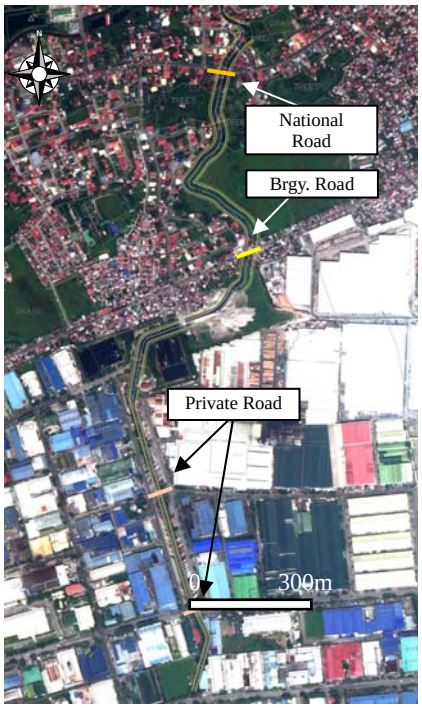
Features on the layout plans of river and drainage structures in the prioritized project have been reviewed and new layout plans were proposed. Those features are summarized in Table 16.1 to Table 16.3.

Table 16.1 New Layout for San Juan Diversion Channel and Rio Grande River

Item	New Layout, San Juan Diversion Channel	New Layout, Rio Grande River
Layout		 Downstream  Upstream
Features	・ Length: km. ・ Waterway Width: m. ・ No relocation of church ・ Additional Ylang-Ylang River Improvement ・ Crossing Road: 2 National Road, 2 Barangay Road ・ Since existing bridge along national road is away from the diversion channel, the elevation of the new bridge on the diversion channel is lowest and its length is shortest. ・ Easy to make detours for bridge construction ・ Diversion channel crosses Marseilla St. at orthogonal angle so that the length of bridge is shortened. ・ Crossing Cemetery ・ On Existing Creek (downstream)	・ Length km. ・ Waterway Width: ・ Crossing Road: 1 road owned by a house developer ・ Widening the channel mainly on the right side of Ylang-Ylang River since some buildings can be seen on the left side

Source: JICA Study Team

Table 16.2 New Layout for Ylang-Ylang River and Maalimango Creek

Item	Ylang-Ylang River New Layout	Maalimango Drainage Channel New Layout
Layout		
Features	・ Length: km ・ Waterway Width: ・ Crossing Road: 1 Rural Road (owned by a local developer) ・ Widening the channel mainly on the left side of Ylang-Ylang River since some buildings can be seen on the right side	・ Length: km. ・ Waterway Width: ・ Crossing Road: 1 National Road, 1 Barangay Road, 2 Private Road ・ Widening the channel on the other direction of the crowded area. ・ Avoiding the interference to the steel tower close to the national road

Source: JICA Study Team

Table 16.3 New Layout for Maalimango Diversion-I and II

Item	Maalimango Diversion-I New Layout	Maalimango Diversion-II New Layout
Layout		
Features	・ Length: km. ・ Waterway Width: m. ・ Diverting water from 1+000 of Maalimango Creek ・ Downstream runs along San Juan Diversion Channel ・ Crossing Road: 1 Rural Road ・ Improving MP layout avoiding penetration at upstream crowded area	・ Length: km. ・ Waterway Width: m. ・ Along EPZA diversion road, circumventing residential structures and commercial facilities ・ Crossing Road: 4 large roads, 1 maintenance road ・ Constructing bridges in approx. m. interval for the access to the southeast plain field

Source: JICA Study Team

16.1.2 Preliminary Design of River Flood Mitigation Structure and Drainage Structure

The standard cross sections of San Juan Diversion Channel are preliminarily designed based on the results of the Master Plan Study and the construction conditions. A weir at the entrance of the San Juan Diversion Channel and a sluice gate on Maalimango creek for the diversion are also proposed.

(1) Design Standard

Annex-T 7.4.1 in Volume 2, Master Plan Study shows the design standards applicable to the proposed flood mitigation structures. Such design standards in the Philippines are mostly equivalent to the ones in Japan. Hence, the Philippines' national standards were principally applied, while the Japanese standards were utilized as supplements.

(2) Slope Protection

The natural rocks have to be brought about 40 to 50km away from the project site and therefore, they are hardly used as the materials for slope protection. For this reason, the concrete block with or without backfilling concrete are applied as the slope protection for river improvement and drainage improvement as shown in Table 16.4.

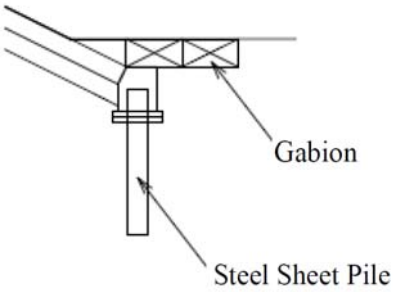
Table 16.4 Slope Protection

Slope	Velocity (m/s)	Structure
1:0.5	1.0 ～ 4.0	Concrete Block Protection with Backfilling Concrete
1:2.0, 1:3.0	1.3 ～ 5.3	Concrete Block Protection without Backfilling Concrete

Source: JICA Study Team

(3) Foot Protection

The foot protection with gabions is proposed for the upstream river improvement section of more than 6km from the river mouth. The steel sheet piles of 2m in depth in addition to the gabions are further proposed for the downstream river improvement section of less than 6km from the river mouth taking the present damages on the existing slope protection works into account (refer to Figure 16.1).



Source: JICA Study Team

Figure 16.1 Foot Protection at Lower Reach (River Mouth to 6km)

The depth of the sheet pile for San Juan Diversion Channel in particular was principally determined through slope stability analysis. However, the lower section of San Juan Diversion Channel of about 600m from the river mouth in particular lies on the wet zone, where difficulties in driving the sheet piles into the bottom of the channel section are foreseeable. From this viewpoint, combination of geotextile tube and riprap is proposed as the foot and slope protection for the said lower section.

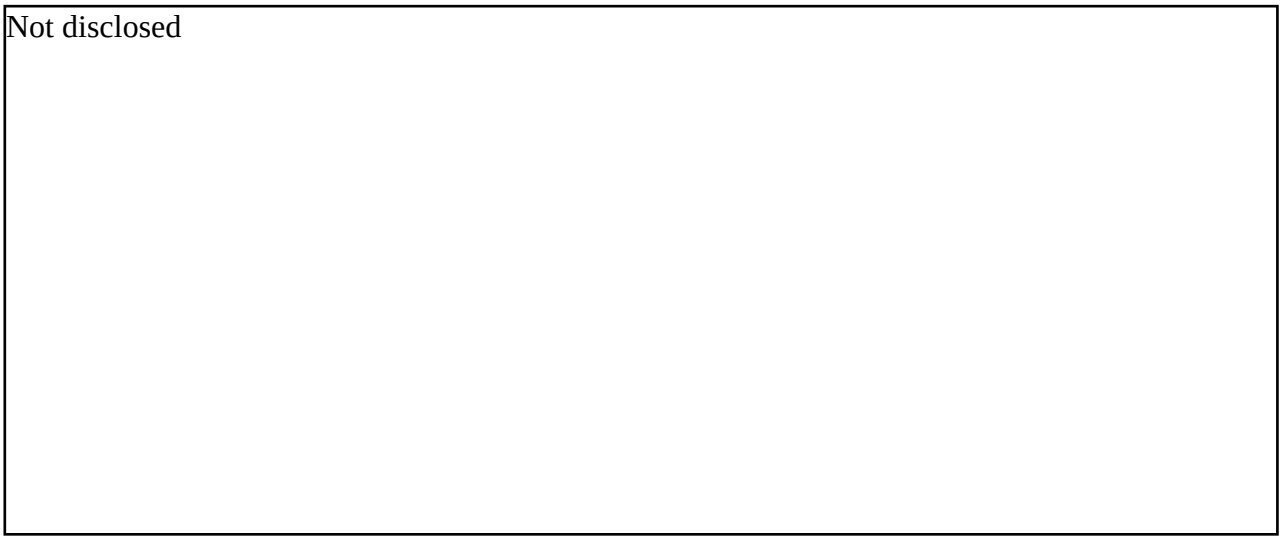
As for drainage improvement of Maalimango Creek, the necessary depths of sheet pile with gabions are estimated at 4.5m for Diversion Channel 1 and 3m for Diversion Channel II based on the slope stability analyses.

(4) Maintenance Road

The concrete road, which is generally applied in the Philippines, is proposed as the maintenance road for both of the banks of diversion channels.

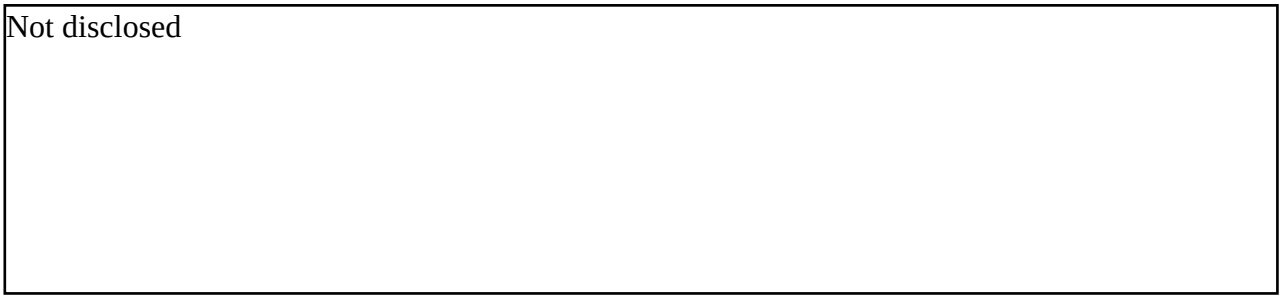
(5) Standard Cross Section

Standard cross sections for rivers and drainages are presented from Figure 16.2 to Figure 16.7.



Source: JICA Study Team

Figure 16.2 Standard Cross Section of San Juan Diversion Channel



Source: JICA Study Team

Figure 16.3 Standard Cross Section of Rio Grande River

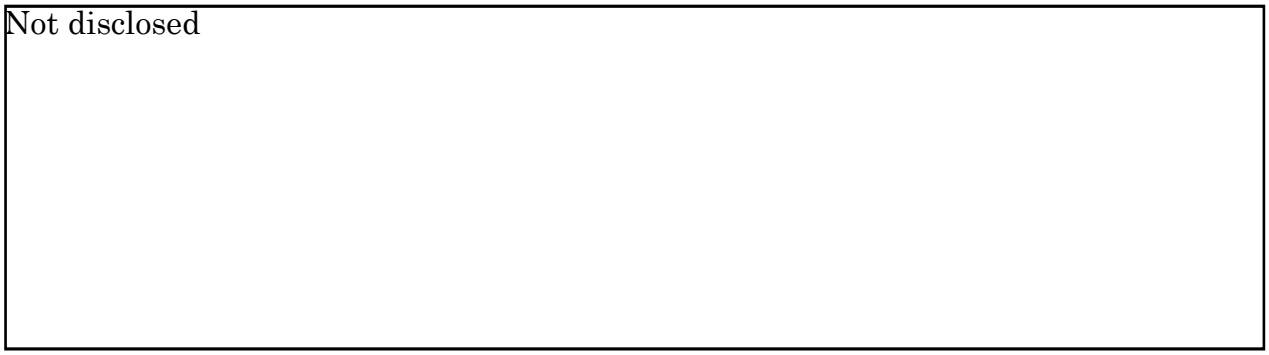
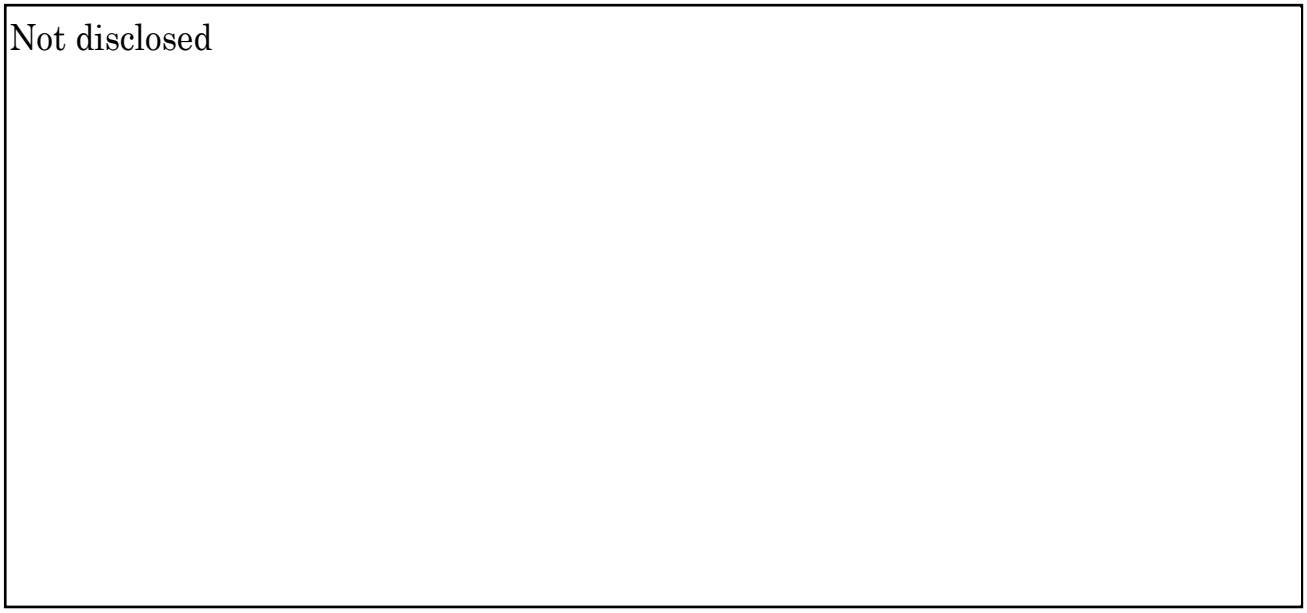


Figure 16.4 Standard Cross Section of Ylang-Ylang River



Source: JICA Study Team

Figure 16.5 Standard Cross Section of Maalimango Creek

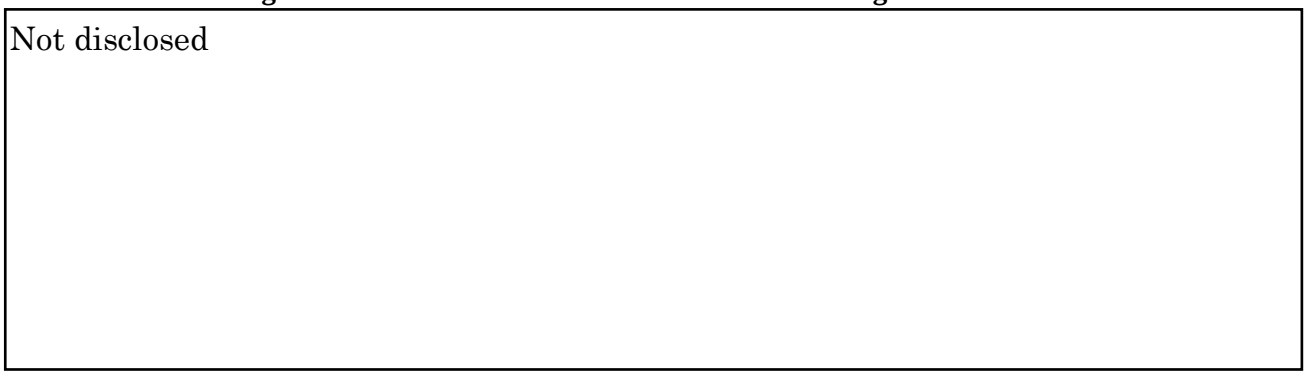


Figure 16.6 Standard Cross Section of Maalimango Drainage Diversion I

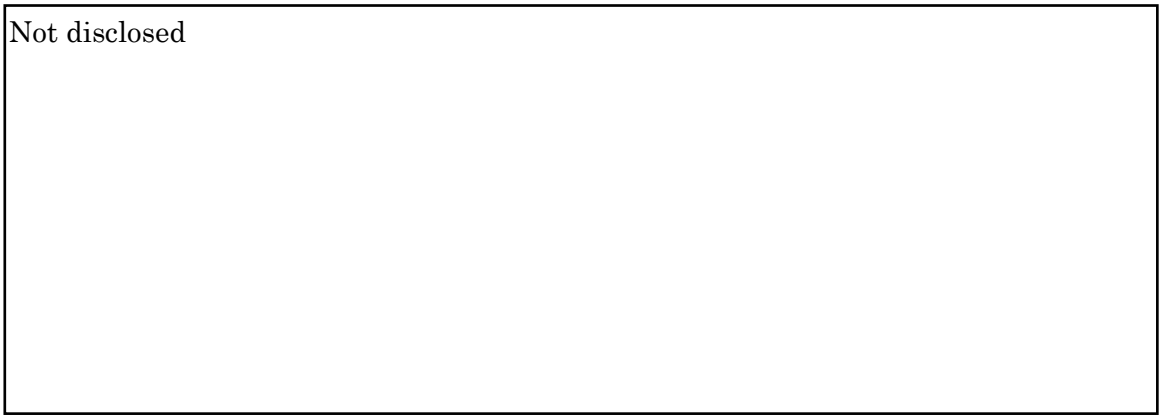


Figure 16.7 Standard Cross Section of Maalimango Drainage Diversion II

(6) Resettlement Site Development

Due to the construction of San Juan Diversion Channel, the relocation site development is required. It includes the reclamation of the land and installation of the infrastructures, such as drainage, electricity,

sewerage, drinking water, fence and so on. The fixing the location and design of the resettlement site development will be conducted during the detailed design stage.

(7) Fixed Weir at San Juan Diversion Channel

A fixed weir is designed at the entrance of the San Juan Diversion Channel for the smooth design diversion. Specifications and the schematic drawing of the weir are shown in Table 16.5 and Figure 16.8, respectively.

Table 16.5 Specification of Weir

Structure	Dimensions
Weir Body	W: m., Weir height: m. Elevation at crown of weir: m. Type: Concrete Fixed Weir (w/ Harold curve)
Energy Dissipation Structure	W: m., L: m., Thickness: m. Type: Reinforced Concrete connected with Weir Body
Riverbed Protection	Channel Bed Protection A; W: m., L: m. Type: Reinforced Concrete Channel Bed Protection B; W: m., L: m. Type: Concrete Block (0.3 m. x 0.5 m. x 0.5 m.)

Source: JICA Study Team

Not disclosed

Source: JICA Study Team

Figure 16.8 Fixed Weir Structure

(8) Sluice Gate on Maalimango Creek

A sluice gate on Maalimango Creek is proposed in order to close the main stream and divert all of the flow into the Diversion Drainage I during the wet season. The specifications and the schematic drawing of the sluice gate are shown in Table 16.6 and Figure 16.9.

Table 16.6 Specification of Sluice Gate at Maalimango Creek

Structure	Specification
Gate	
Side Wall	

Source: JICA Study Team

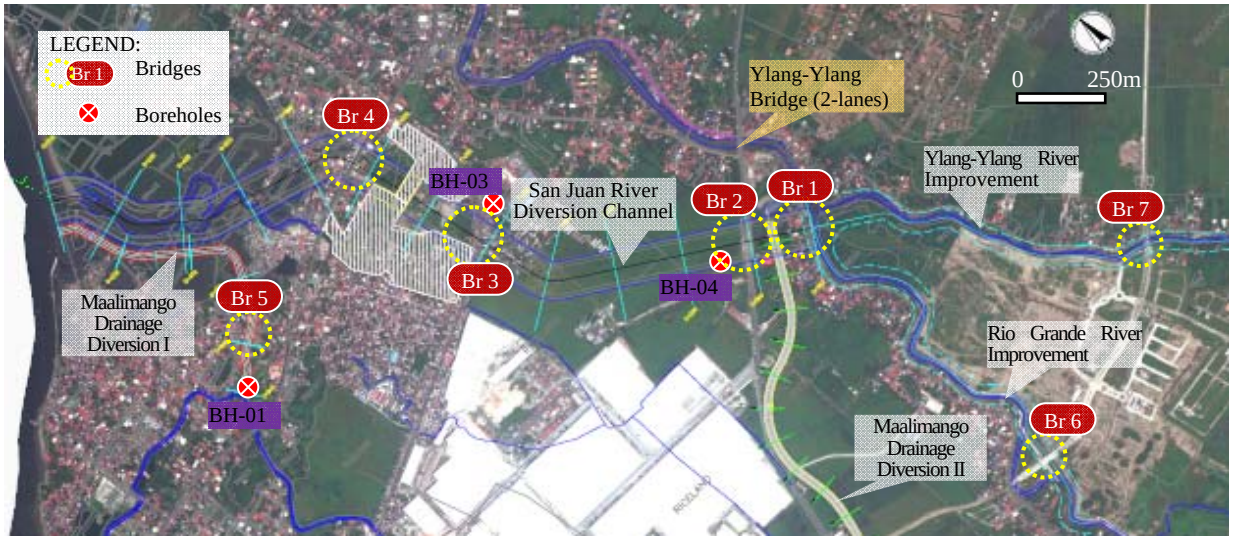
Not disclosed

Source: JICA Study Team

Figure 16.9 Sluice Gate at Maalimango Creek

16.1.3 Bridge and Approach Road

The construction of the San Juan Diversion Channel and the Maalimango Creek Drainage Diversion I and the widening of Rio Grande and Ylang-Ylang Rivers necessitates construction of five (5) new bridges traversed by the diversion works and replacement of two (2) existing bridges affected by the river improvement. Figure 16.10 and Figure 16.11 show the locations and features of the proposed bridges.



Source: JICA Study Team

Figure 16.10 Location of Reconstructed Bridges

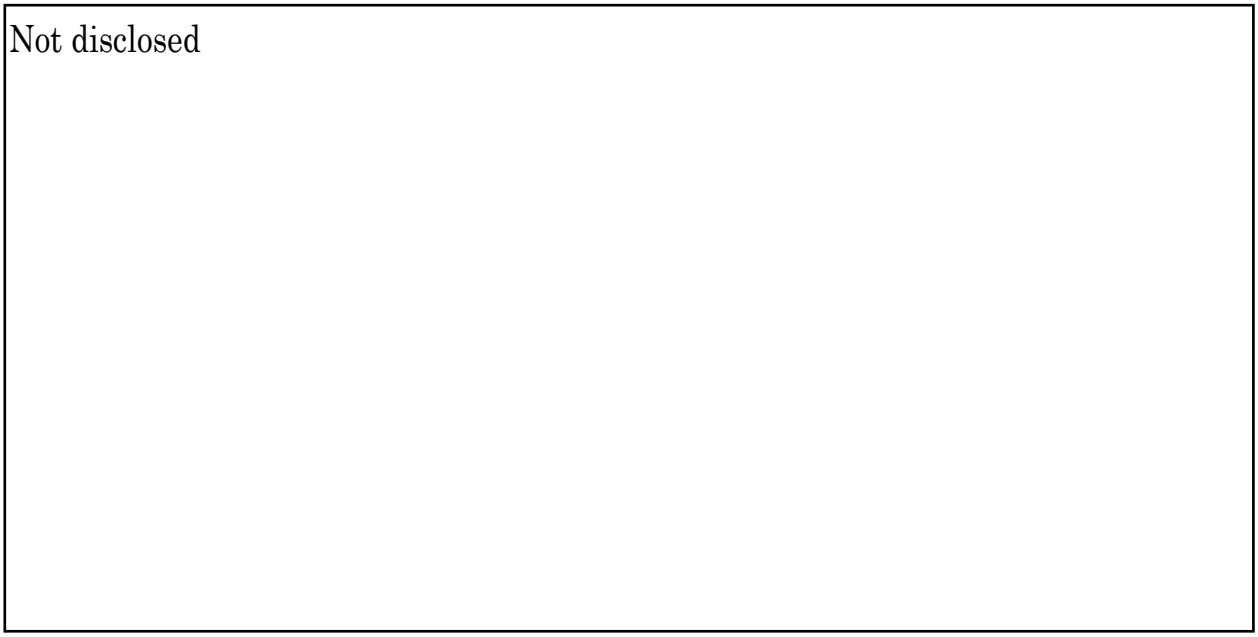


Figure 16.11 Present Features of Reconstructed Bridges

As a general policy, the proposed bridges shall be designed to maintain the existing road function and geometric configuration, minimize additional road right-of-way take from the adjacent properties, and provide accessibility with adjacent properties.

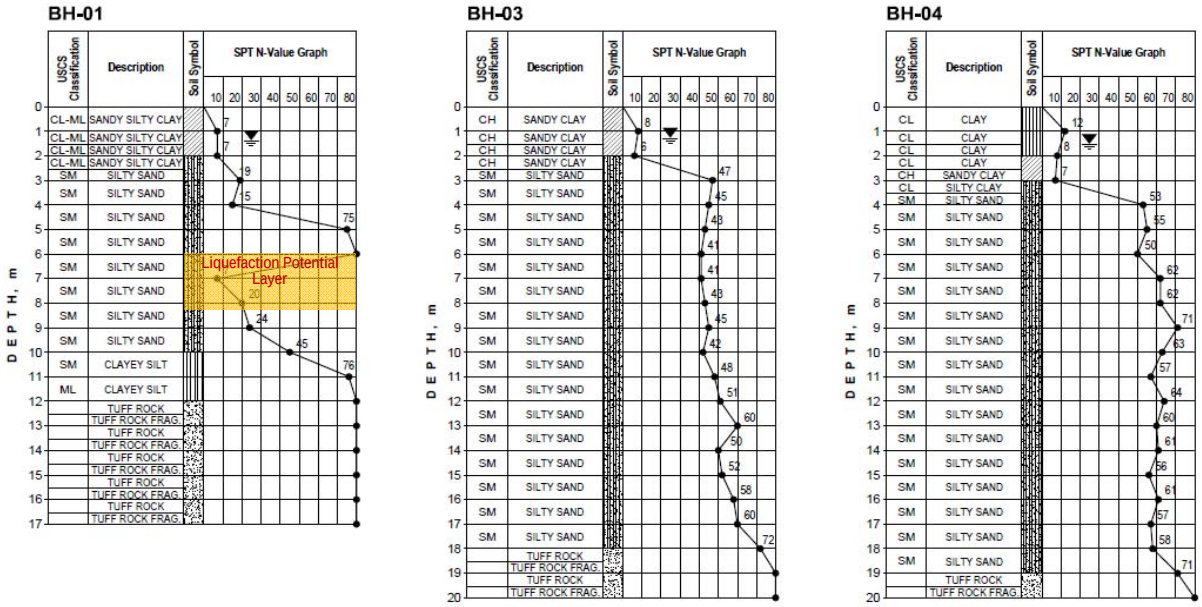
(1) Design Conditions

(a) Topography and Surrounding Areas

The proposed bridges are located within the lowland area of the project and located on existing roads in heavily built residential areas, it is necessary to consider the road approaches to the bridge in relation to accessibility of adjacent houses and properties.

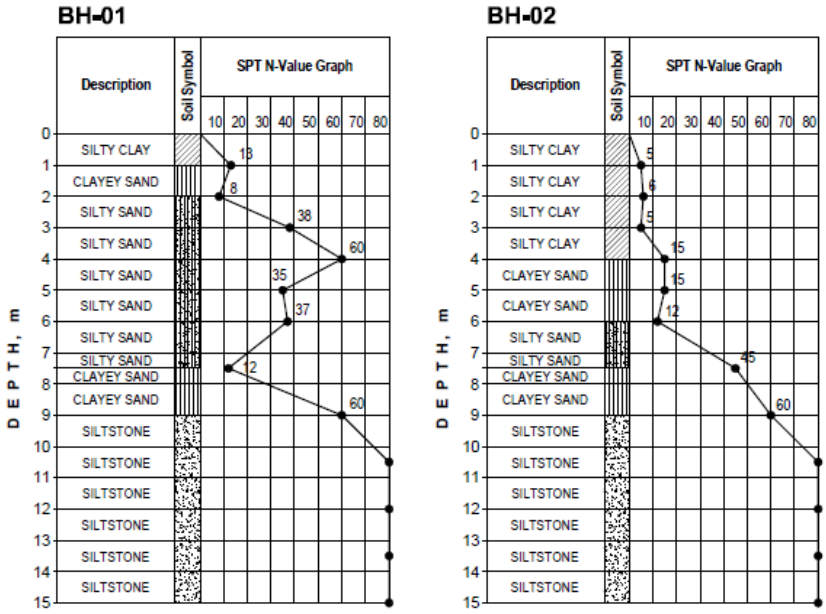
(b) Geotechnical Conditions

The soil profile, as shown in Figure 16.12 and Figure 16.13, is predominantly silty sand with a 2.5m thin clay layer at the top with the soil cover thickening from 12m to 19m. The clayey soil generally have low N-values (6-8) while the lower sandy layer had moderate to high N-values (20-70) in general. A few gravel components further enhance the N-vlues. The soil appears to be mostly transported, although some are residual, particularly those found a few meters before reaching the bedrock. Liquefaction assessment indicated that the sand layer at around 7.0m depth for BH-01 has a high potential for liquefaction. The underlying tuff bedrock, belonging to the Taal Tuff Formation, is found at 12m to 19m below the ground surface. In general, the tuff is slightly weathered, hard and shows random presence of vesicles. Ground water is observed from 1.30m to 1.60m from the ground surface.



Source: JICA Study Team

Figure 16.12 Borehole Soil Profiles (1/2)



Soil Profile at Ylang-Ylang River Bridge

Source: As-built Drawings for Antel Grand Village Bridge

Figure 16.13 Borehole Soil Profiles (2/2)

(c) River/Channel Conditions and Bridge Hydraulics

Br-1 to Br-5 are proposed to provide continuity of the existing roads with sufficient opening for the design discharges and flood levels of the diversion and drainage channels. On the other hand, the river improvement works requires replacement of existing bridges (Br-6 and Br-7) which provides access to the Antel Grand Village residential subdivision.

Source: JICA Study Team

Figure 16.14 Existing River Conditions

(d) Bridge Hydraulics

Table 16.7 presents the 50-year design flood and 100-year check flood discharges and flood water level for the proposed bridges (DPWH Design Guidelines, Criteria and Standards (DGCS) Vol. 5 – Bridges).

Table 16.7 Bridge Hydraulics and Span Length

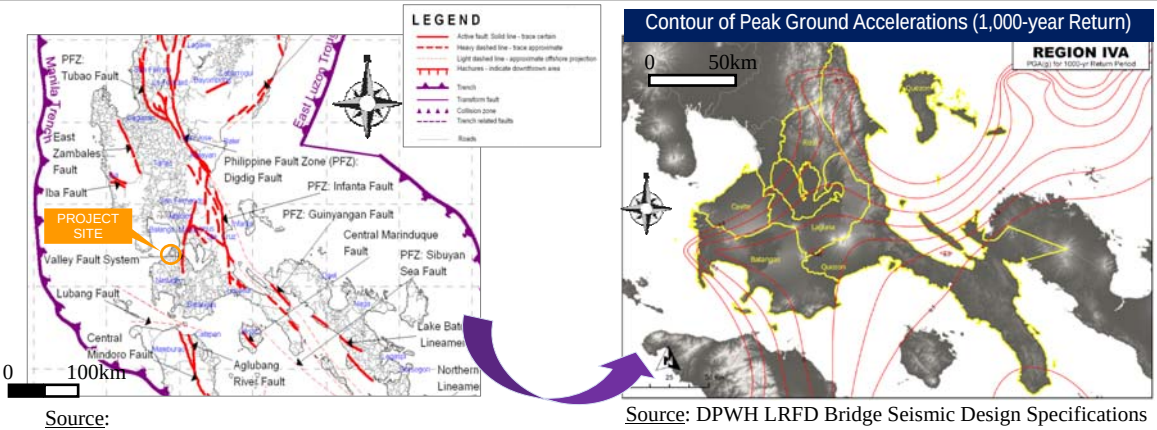
Flood Frequency: 50 years (Design Flood)								
Bridge No.	Sta. No.	Channel	Bed Elevation (m)	Flow Area (m^2)	Velocity (m/s)	Discharge,Q (m^3)	Flood Water Level (m)	Span Length (m)** L = 20 + 0.005Q
Br-1	2+353	SJDC*	Not disclosed					
Br-2	2+200	SJDC						
Br-3	1+400	SJDC						
Br-4	0+900	SJDC						
Br-5	0+750	Maalimango						
Br-6	6+006	Rio-Grande						
Br-7	1+016	Ylang-Ylang						
**SJDC – San Juan Diversion Channel* ***Desired Span Length – DPWH DGCS Sect. 4.2*								
Flood Frequency: 100 years (Check Flood)								
Bridge No.	Sta. No.	Channel	Bed Elevation (m)	Flow Area (m^2)	Velocity (m/s)	Discharge,Q (m^3)	Flood Water Level (m)	Span Length (m)* L = 20 + 0.005Q
Br-1	2+353	SJDC	Not Disclosed					
Br-2	2+200	SJDC						
Br-3	1+400	SJDC						
Br-4	0+900	SJDC						
Br-5	0+750	Maalimango						
Br-6	6+006	Rio-Grande						
Br-7	1+016	Ylang-Ylang						

Note: The DPWH DGCS requires the design flood to have a 1/50 years flood frequency with sufficient freeboard for bridges. The freeboard provided is checked against a 100-year return flood.

Source: JICA Study Team

(e) Site Seismicity

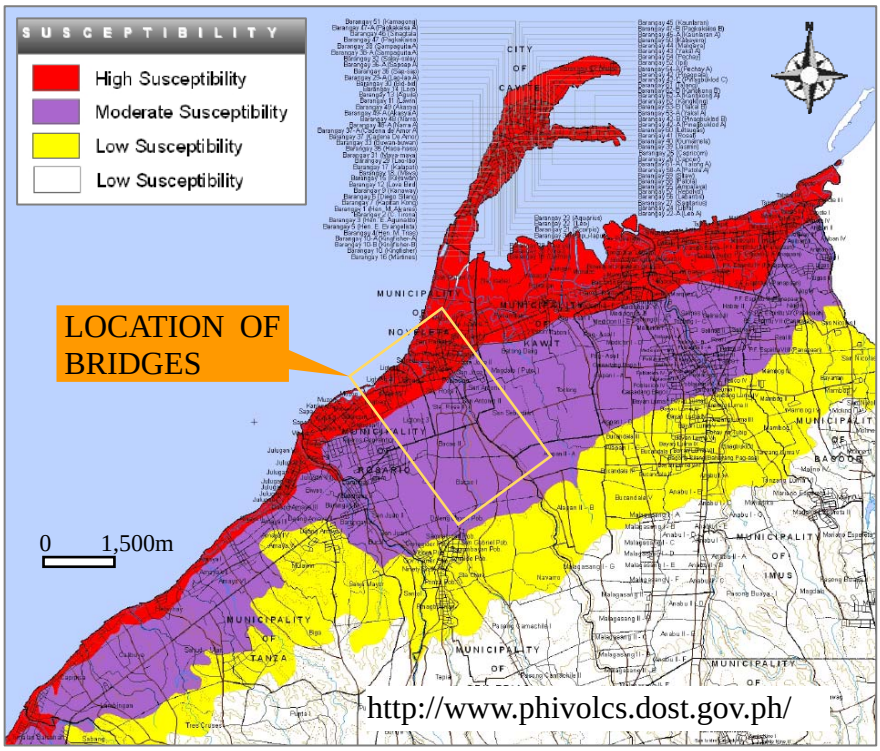
Figure 16.15 illustrates the project site seismicity with high liquefaction potential (Figure 16.16). The DPWH Bridge Seismic Design Specifications (BSDS) specifies a 0.60g PGA in the project area.



Source:
PHIVOLCS (Extract from Distribution of Active Faults and Trenches in the Philippines)

Source: DPWH LRFD Bridge Seismic Design Specifications

Figure 16.15 Earthquake Generators and Peak Ground Acceleration



Source: PHIVOLCS

Figure 16.16 Liquefaction Hazard Map in Noveleta

A detailed assessment of the liquefaction potential of the area based on the procedures given in Sect. 6.2.3 of the BSDS was undertaken using the results of the field and laboratory tests for boreholes BH-01 to BH-03. The assessment indicated that the area near the coast (BH-01) is highly susceptible to soil liquefaction (see Figure 16.12) while the area covered by BH-03 and BH-04 are not susceptible to liquefaction.

(2) Bridge Planning and Design Requirements

(a) River/Channel Improvement Plan and Bridge Length

Bridge lengths are planned to span these waterways and minimize obstruction in the discharge section. It is a common practice for piers located inside the river channel not to obstruct the waterway area by more than 5%. Further, since the banks are defined in the river/channel improvement plans, bridge abutments shall be set back at least 1.0m from the bank edge to enable inspection of bridge bearings at abutment locations.

(b) Freeboard

The vertical clearance between the design flood level (DFL) and the soffit of the lowest superstructure member is taken at 1.50m (DGCS Sect. 4.4) since woody debris flow was experienced during the last major floods. This satisfies Article 20 in the Manual for Government Ordinance for Structural Standard for River Administration Facilities (a freeboard corresponding to the discharge is at 1.0m) and Article 64 in the same manual (the freeboard should be larger if the river has problems on its safety such as driftwoods during the flood).

(c) Bridge Deck Section

The bridge deck cross-section elements were developed based on the requirements of the DGCS Sect. 6.1.3 and are summarized inTable 16.8.

Table 16.8 Bridge Deck Section

Br. No.	Road Class	No. of Lanes	Lane Width (m)	Carriageway Width (m)	Sidewalk Width (m)	Deck Width (m)	Remarks
1	Local						- As required by Noveleta the bridge travel way should be 5.0m which is the same as the local road
2	National						- Initial bridge function shall be 4 lanes to be consistent with the DPWH widening plan. However, the final bridge function shall be 5 lanes, consistent with the road class.
3	Local						- Same as Br-1
4	National						- Follows the DPWH standard 2-lane road with wider shoulder at urban area
5	Local						- Same as Br-1
6[1)]	Local/ Private						- Bridge replacement to follow existing bridge deck section
7[1)]	Local/ Private						- Bridge replacement to follow existing bridge deck section

Note: [1)] The bridge cross-sectional elements follow the existing bridge and approach road sections.

Source: JICA Study Team

(d) Span Configuration and Bridge Superstructure Type

Table 16.7 gives the desired minimum span lengths for the proposed bridge while Table 16.9 summarizes the span arrangement and the type of superstructure for the proposed bridges.

Table 16.9 Span Configuration and Bridge Type

Br. No.	Total Bridge Length (m)	Desired Span Length (m)[1)]	Span Arrangement (m)	Superstructure Type	Remarks
1				PCDG[2)]	- bridge is moved 10m west of existing road
2				PCDG	- bridge skew = 83 deg
3				PCDG	- bridge skew = 60 deg
4				PCDG	- normal bridge
5				PCDG	- bridge skew = 73 deg
6				PCDG	- an 8m RC box tunnel is provided next to bridge as local road inside the subdivision
7				PCDG	- a 10.33m RC slab span is provided over the exiting local road

[1)] Based on the DPWH DGCS Sect. 4.2, where L = 20 +0.005Q (Q = design discharge)
[2)] PCDG – Prestressed Concrete Deck Girder (AASHTO Girder)

Source: JICA Study Team

For the span ranges given in Table 16.9, concrete bridges are preferred than steel bridges in the Philippines due to minimal maintenance requirements especially due to the proximity of the project with the coastal area. For the range of spans, the prestressed concrete girder is more practical and economical to use as the superstructure type (refer to Figure 16.17).

Not disclosed

Figure 16.17 Typical Prestressed Girder with RC Deck Slab

(e) Substructures – Piers, Abutments and Foundations

Oval and circular piers are used following the recommendations in the DPWH Design Guidelines Criteria and Standards (DGCS Sect. 3.3.8.1). Closed-type inverted T cantilever wall abutment type is adopted, which is more stable when built near the proposed embankment dikes. Refer to Figure 16.18.

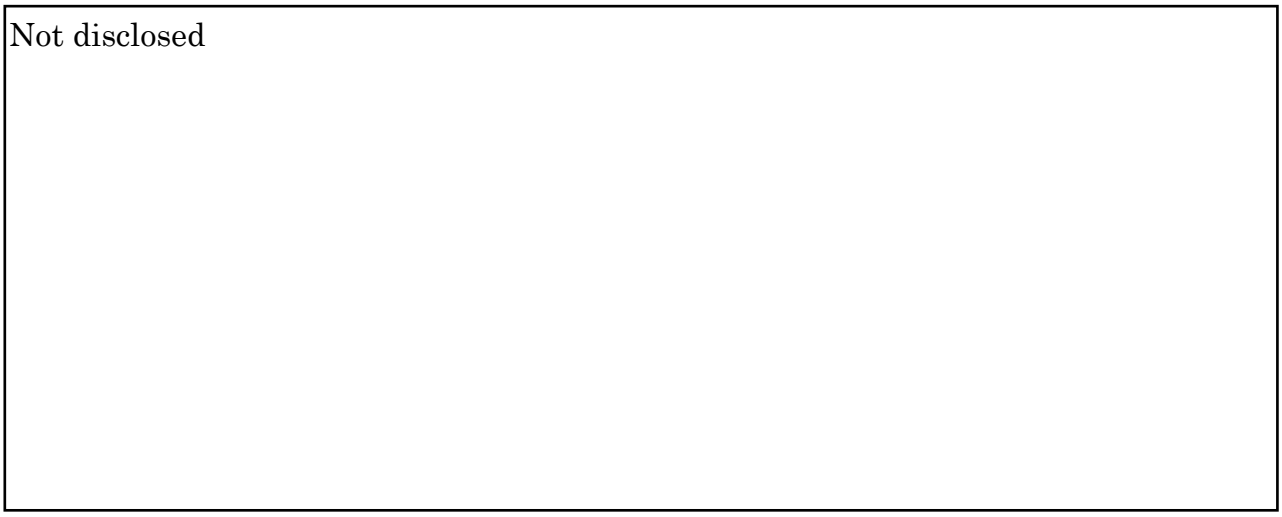


Figure 16.18 Typical Substructure Types and Foundation

Pile foundation is recommended since the bearing layer is predominantly medium dense silty sand soil profile which is prone to scouring. The following were adopted in pile foundation design: (a) bored pile diameter is ϕ1.2m for the pier and ϕ1.2/1.0m for abutments, (b) bored piles shall be deeper than the anticipated scour level and at a more stable soil layer, and (c) top of pile cap is 1.0m below the channel/river bed. Moreover, to minimize the effects of scouring, Riprap Class C rocks (60-100kg) are proposed as pier foot protection above the pile caps (Figure 16.18 (c)).

(3) Preliminary Design of Bridge and Approach Road

(a) Design Specifications and Criteria

The following design specifications are used to guide the preliminary design for bridges:

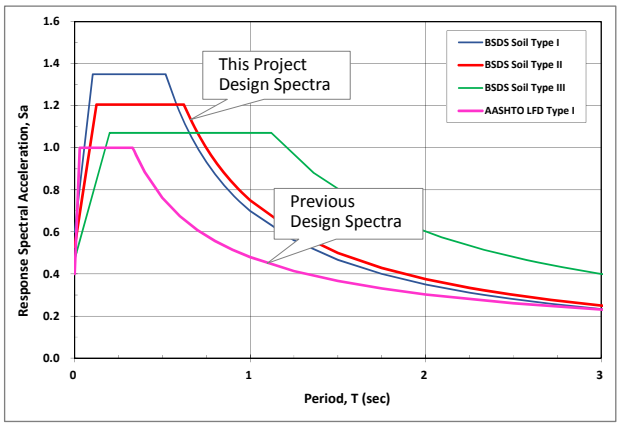
- DPWH Design Guidelines, Criteria and Standards (DGCS) , Volume 5 – Bridges, 2015 (DPWH D.O. 179, Series of 2015)
- DPWH LRFD Bridge Seismic Design Specifications (BSDS), 2013 (DPWH D.O. 45, Series of 2016)

(b) Live Loading

The AASHTO HL-93 live loading (DGCS 2015) which specifies the combination of lane load with either truck or tandem loads is used for the preliminary design of superstructure.

(c) Earthquake Loading

The new BSDS requires a PGA of 0.60 in the area of interest (Noveleta) with a 1/1,000 years flood frequency (refer to Figure 16.19 for the PGA contour in Cavite**)**. The design acceleration response spectra for the Noveleta site is plotted in Figure 16.19**.**



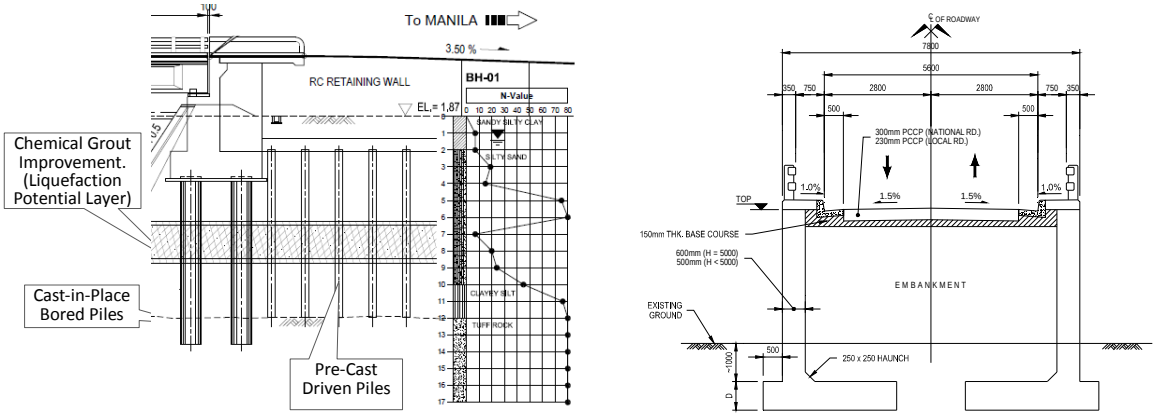
EQ Design Spectra	
Soil Profile Type	II
PGA	0.60
S_s	1.35
S_1	0.50

Source: JICA Study Team

Figure 16.19 Bridge Design Response Spectra

(d) Countermeasure for Soil Liquefaction

The liquefaction countermeasures proposed for bridges Br-4 and Br-5 includes chemical grouting (2.5m thick soil layer) to solidify and stabilize the liquefiable soil layer and the used of bored piles for bridge foundation and precast driven piles (450mm x 450mm) for retaining walls of approach roads.



(a) Liquefaction Countermeasure (b) Approach Road

Source: JICA Study Team

Figure 16.20 Countermeasures for Soil Liquefaction and Approach Road

Since the geotechnical investigation undertaken during the feasibility study stage is very limited, a more detailed investigation of the soil conditions is necessary during the detailed design stage for a more accurate liquefaction assessment and the choice of the most appropriate countermeasure.

(e) Approach Road

Since the finished bridge deck levels are higher than the existing roads, the approach roads are designed with grades of 3.5%-5.0% on RC retaining walls to minimize additional RROW take. For bridges subjected to soil liquefaction (Br-4 and Br-5), the retaining walls are on precast RC piles while for other bridges, the retaining walls are on RC spread footing. The pavement type for the approach road is Portland cement concrete pavement

(PCCP) 300mm thick for national roads and 230mm thick for local roads on 300mm thick base course. The approach road section is illustrated in Figure 16.20.

(f) Summary of Preliminary Design

Table 16.10 summarizes the preliminary design conditions for bridges. The drawings for bridges are given in the Annexes 1.1.19 to 1.1.17 in Volume 3.

Table 16.10 Summary Preliminary Design Conditions

Particulars	Br-1	Br-2	Br-3	Br-4	Br-5	Br-6	Br-7
River Name							
Road Name							
Road Class							
No. Lanes @ Width (m)							
Bridge Length (m)							
Bridge Width (m)							
Carriageway Width (m)							
Sidewalk (m)							
Span Arrangement (m)							
Design Speed (km/hr)							
Wearing Course (mm)							
Design Flood Level (m)							
Freeboard (m)							
Superstructure Type							
Deck Slab (mm)							
Abutment							
Pier							
Foundation							
Approach Road Grade (%)							
Approach Road Pavement							
Pavement Thickness (mm)							
Base Course (mm)							
Retaining Wall for Approach Roads							
Live Load							
Seismic PGA							
Design Standard							

***NOTES**:*
PCDG – Prestressed Concrete Deck Girder PCCP – Portland Cement Concrete Pavement *RC – Reinforced Concrete* *CIP – Cast-in-Place*

Source: JICA Study Team

16.2 Applicable Japanese Technology

Taking into account the applicable Japanese technology to this priority project, the following methods are selected by the first screening.

(a) Bridge Pier Protection against Scouring by Steel Sheet Pipe Pile: The steel sheet pipe pile is concurrently used as temporarily cofferdam. Thus the pier and the foundation are able to

be installed under a dry state.

(b) Steel Sheet Pipe Pile Revetment along Ylang-Ylang River and Rio Grande River: Freestanding steel sheet pipe pile revetment contributes to reduction of the channel width and the project affected area. ("Steel Sheet Pile" and "Hat-type and H-shaped Combined Steel Sheet Pile" are not applicable since there is no such sheet pile meeting the requirement of the moment of inertia of area at 1,600,000 cm^4/m calculated for the revetment with the height of approximately 7 m.)

(c) High-Performance Steel Bridge: The High-Performance Steel Bridge could make a contribution to expansion of the span between the bridge piers, reduction of number of piers and maintenance-free.

(d) Hat-type and H-shaped Combined Steel Sheet Pile Revetment along San Juan Diversion Channel: Freestanding Hat-type and H-shaped combined steel sheet pile revetment contributes to reduction of the channel width and the project affected area.

(e) Maalimango Sluice Gate made of Alloy-Saving Two-Phase Stainless Steel Material: This material contributes to the weight reduction of gate and maintenance-free.

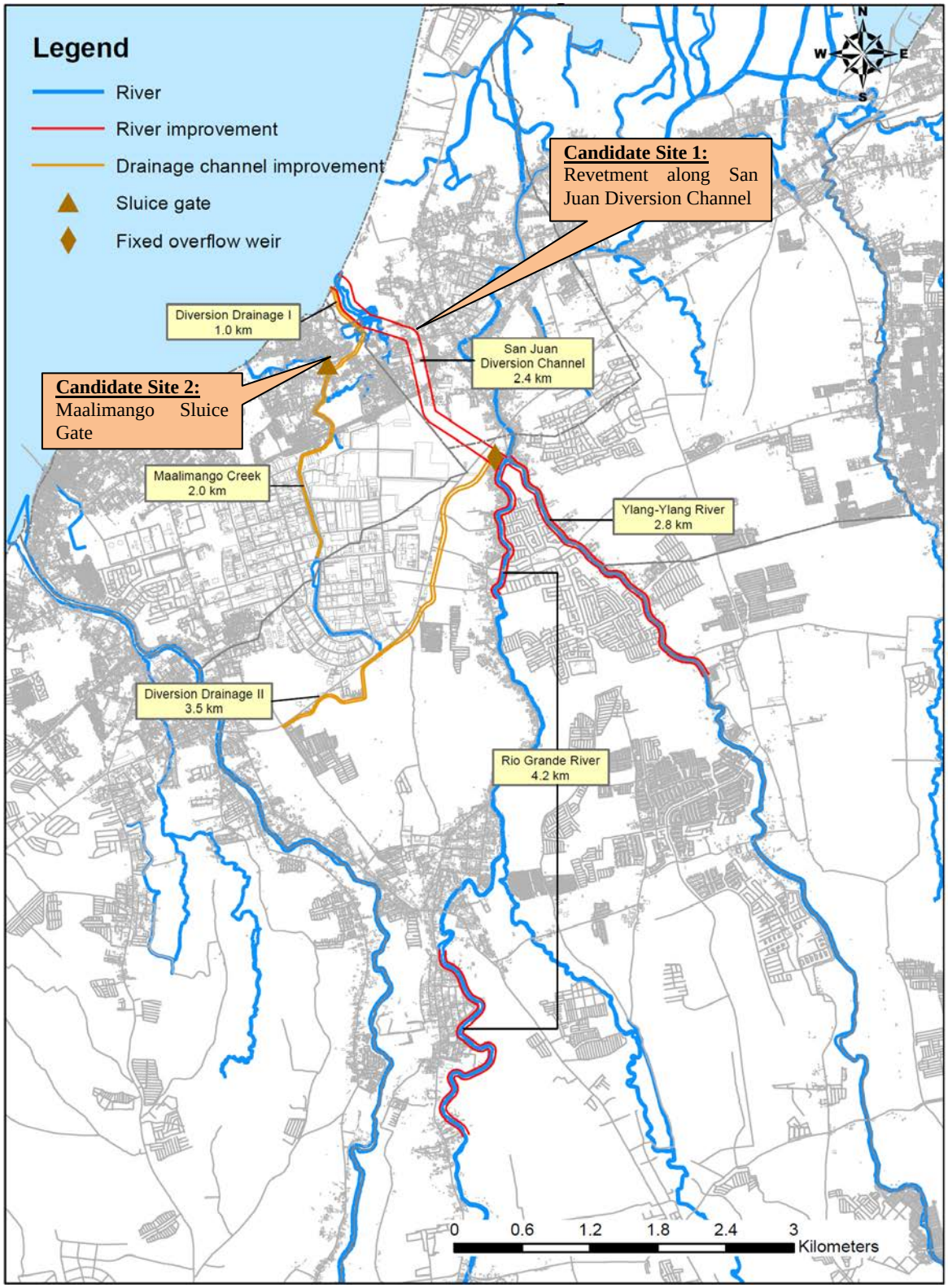
The above Japanese Technologies have been used successfully in river/bridge construction site and are utilizing in Japan and other countries. However, above (a), (b) and (c) are excluded from the application of this project due to the following reasons.

Method	Reason of Exclusion from application of this project
(a) Bridge pier protection against scouring by steel sheet pipe pile	● The sedimentation tends to be in progress at the riverbed around the proposed bridge pier and therefore, large-scale pier protection against scoring is not required. ● Difficulties in works for the bridge piers including construction of cofferdam at the site are not foreseeable. ● The cost performance of protection against scoring by the steel sheet pipe pile is judged to be too low.
(b) Steel sheet pipe pile revetment along Ylang-Ylang River and Rio Grande River	● The principal purpose of the revetment by sheet pile is oriented to reduction of the design channel width which could reduce number of house relocations, while the area along the objective river improvement section of the revetment is less populated, which leads to less contribution to the purpose. ● The cost performance for reduction of number of house relocations by the steel sheet pipe pile revetment is judged to be too low.
(c) High-performance steel bridge	● The principal advantage for utilization of high-performance steel is oriented to expansion of bridge spans, which contributes to reduction of number of piers and maintenance-free. However, expansion of bridge spans is not required judging from the conditions of the project site. ● The cost of high-performance steel Bridge is much higher than ordinary concrete bridge.

Source: JICA Study Team

Excluding the above methods (a), (b) and (c), the objectives of application of Japanese technologies are addressed to the remaining two (2) methods, namely; "Hat-type and H-shaped combined steel sheet pile revetment along San Juan Diversion Channel" and "Maalimango sluice gate made of alloy-saving two-phase stainless steel material". The location map of candidate site for utilization of Japanese technology is as shown in Figure 16.21.

The superiorities of the above two (2) methods by the Japanese technologies over the alternative methods by the conventional technologies in the Philippines are examined and those by the Japanese technologies are recommended, when the superiorities are verified.



Source: JICA Study Team

Figure 16.21 Location Map of Candidate Site for Utilization of Japanese Technology

16.2.1 Reason/Condition for Selecting Japanese Technology

The principal criterions for selecting Japanese technology are as summarized in Table 16.11.

Table 16.11 Prospective Japanese Technology for the Project

No.	Method by Japanese Technology	Location	Principal Criterions for Selecting the Method by Japanese Technology
1	Revetment: (Hat-type and H-shaped Combined Steel Sheet Pile with Water Jet)	San Juan Diversion Channel (Sta. 0+800 - Sta.1+400)	As there are residential areas and cemetery in the vicinity of the candidate site and, therefore the method by the Japanese technology could be applicable, when it is judged to be effective to minimize the land acquisition, improve the workability and shorten the construction period for the site.
2	Gate: Alloy-Saving Two-Phase Stainless Steel Material	Maalimango Sluice Gate (Sta. 1+000)	The method is expected to prevent the gate near to the shoreline from corrosion, which leads to less O&M cost of the gate. This method shall be applied on the premises that the gate made by the method could attain the lower project cost including O&M cost of the gate than the conventional steel material for sluice gate.

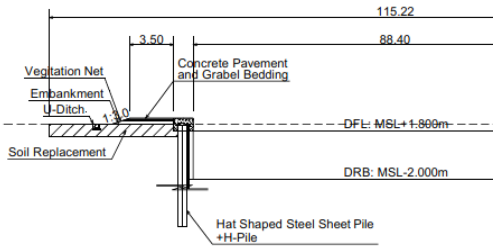
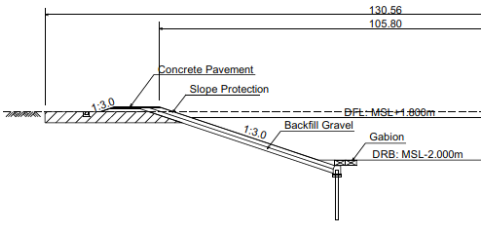
Source: JICA Study Team

16.2.2 Evaluation of Applicable Japanese Technology to Project

(1) Applicability of Hat-type and H-shaped Combined Steel Sheet Pile to San Juan Diversion Channel

Comparison between Hat-type and H-shaped Combined Steel Sheet Pile and Concrete Slope Protection is made as shown in Table 16.2to Table 16.14.

Table 16.12 Features and Workability of Hat-type and H-shaped Combined Steel Sheet Pile and Concrete Slope Protection

Item	Hat-type and H-shaped Combined Steel Sheet Pile	Concrete Slope Protection
Outline Drawing		
Feature	● This method is applicable to 5m in height as freestanding type minimizing the area of land acquisition.. ● Workability is excellent. With a water-jet construction method is applicable in case of hard soil.	● This method is easy access to the river due to gentle slope revetment ● The scenery is not spoiled after construction since this revetment type is the same type as the other section along the San Juan Diversion Channel
Workability	Driving speed: 93m^2/day/party Area of steel sheet pile: 11m^2/m Horizontal driving length: 8.5m/party (=93/11)	Placement speed: 81m^2/day/party Area of concrete slope: 16.5m^2/m Horizontal placement length per day: 5.0m/praty (=81/16.5)
	The influence of sump water and rainfall is small since the construction should not be under a dry state.	The influence of sump water and rainfall is large since the construction should be under a dry state.

Source: JICA Study Team

Table 16.13 Number of House Relocations, Extent of Land Acquisition, Construction Period and Cost for Each of Alternatives

Item	Alt. 1 H-shaped Combined Steel Sheet Pile applied to entire San Juan Diversion Channel	Alt. 2 H-shaped Combined Steel Sheet Pile and Concrete Protection applied to San Juan Diversion Channel	Alt. 3 Concrete Slope Protection applied to entire San Juan Diversion Channel
Extent	Sheet Pile: 0+000 to 2+400	Sheet Pile: 0+800 to 1+400 Concrete: Remaining Section s	Concrete : 0+000 to 2+400
Number of House Relocations (Nos.)			
Extent of Land Acquisition Area (m2)			
Project Construction and Compensation Cost			

Source: JICA Study Team

Table 16.14 Comparison between Hat-type and H-shaped Combined Steel Sheet Pile and Concrete Slope Protection (Comparison of Merit and Demerit for Each of Alternatives)

Alternative	Merit and Demerit
Alt. 1 H-shaped Combined Steel Sheet Pile applied to entire San Juan Diversion Channel	**Merit** - To make the narrowest width of San Juan Diversion Channel attaining the most flexible adjustment of channel alignment and smooth project implementation. - To enhance the least number of house relocations and extent of land acquisition (*The alternative could reduce the number of house relocations by about 80 to 100 houses and the extent of land acquisition by about 4 to 5 ha as compared with those of Alts 2 and 3. - To enhance the fastest speed of construction and allow the construction work even during the rainy season alleviating the noise, traffic jams and other adverse effects caused by construction works. (*This alternative could reduce construction period by 30 to 50% of those for Alts. 2 and 3. **Demerit** - To increase the total of the project direct construction and compensation cost by about 0.86 billion pesos over those for Alt 3. (*The cost increase by about 14 % of those of Alt 3) - To be difficult for the local contractor to undertake the construction works.
Alt. 2 H-shaped Combined Steel Sheet Pile and Concrete Protection applied to San Juan Diversion Channel	**Merit** - To require the compatible cost with that of the Alt. 3 which takes the lowest cost among the alternatives - To require the less house relocations and extent of land acquisition than Alt. 3 (It could reduce the number of house relocations by 27 units and the extent of land acquisition by 0.4ha as compared those of Alt. 3.) - To enhance reduce the second fastest construction speed next to Alt. 1 (*It could reduce the construction period by 10% of that for Alt. 3). **Demerit** - To be difficult for the local contractor to undertake the construction works.
Alt. 3 Concrete Slope Protection applied to entire San Juan Diversion Channel	**Merit** - To be easy for the local contractor to undertake the construction work. **Demerit** - To require more number of house relocations extent of land acquisition than those of Alts. 1 and 2. - To take lowest construction efficiency among the Alts and be difficult to undertake the construction works during a rainy season, which requires the longer construction period causing more significant noise, traffic jam and other public nuisances caused by the construction works.

Source: JICA Study Team

Judging from the results of evaluations as shown in the above comparisons in Table 16.13 and Table 16.14 the Hat-type and H-shaped Combined Steel Sheet Pile is judged to be applicable

and it should be adapt to the entire stretch of San Juan Diversion Channel. The principal reasons for the said judgement and recommendation are as enumerated below:

- The cost of Alt. 2 is compatible with that of the Alt. 3. On the other hand, the Alt. 2 could allow more flexible adjustment of channel alignment, less house relocations and land acquisition than the Alt. 3. Judging from these advantages, the Hat-type and H-shaped Combined Steel Sheet Pile is applicable to the revetment works of San Juan Diversion Channel.
- However, Alt. 2 could reduce only 27 house relocations and 0.7ha of land acquisition as compared with Alt. 3. Thus, the advantage of Alt. 2 over Alt. 3 is judged to be relatively small and it is deemed to be difficult to meet the prerequisite of Noveleta Municipality to agree about construction of San Juan Diversion Channel; the prerequisite is such that the width of San Juan Diversion Channel should be narrow as much as possible so to facilitate the flexible adjustment of channel alignment and minimize the house relocations and land acquisition as stated above.
- As compared with the above performance by Alt. 2, Alt. 1 (to adopt the Hat-type and H-shaped Combined Steel Sheet Pile to the entire stretch of San Juan Diversion Channel) could remarkably improve the effects to reduce the number of house relocations by about 100 units and extent of land acquisition area by 5ha from those of Alt.3. Moreover, Alt. 1 could reduce the construction period by 50% as compared with that of Alt. 1
- Alt.1 is evaluated to solely meet the requirement of Noveleta Municipality. This advantage of Alt 1 should take priority in order to promise the smooth implementation of the Project, although its cost is about 14% higher than that of Alt 3.

(2) Applicability of Alloy-Saving Two-Phase Stainless Steel Material for Maalimango Sluice Gate

Approximate cost of common steel material for sluice gate and alloy-saving two-phase stainless steel material for sluice gate are as shown in Table 16.15 and Table 16.6 respectively.

Table 16.15 Approximate Cost of Common Steel Material for Sluice Gate

Item	Approximate Cost	Remarks
Unit Cost of Material	0.18 (Million Peso/tf)	Price escalation is calculated by CPI (Consumer Price Index), based on cost estimate for Navotas Flood Control Gate in the Philippines
Total Cost of Material	7.2 (Million Peso)	40tf
Construction Cost	50.9 (Million Peso)	
Operation and Maintenance Cost (*Only for Protecting Coating)	0.75 (Million Peso)	Cost of protecting coating per occurrence: 1,500 (Peso/m^2) x 50 (m^2) x 2 (Both Faces) = 0.15 (Million Peso/time) The protecting coating is applied once a decade. The operation and maintenance cost for 50 years: 0.15 (Million Peso/time) x 5 (time/50 years)
Construction Cost and Operation and Maintenance Cost	51.7 (Million Peso)	Duration of Operation and Maintenance: 50 Years

Source: JICA Study Team

Table 16.16 Approximate Cost of Alloy-Saving Two-Phase Stainless Steel Material for Sluice Gate

Item	Approximate Cost	Remarks
Unit Cost of Material	1.14 (Million Peso/tf)	By Supplier's Quotation
Total Cost of Material	34.2 (Million Peso)	30tf
Construction Cost	75.5 (Million Peso)	
Operation and Maintenance Cost (*Only for Protecting Coating)	0 (Million Peso)	For 50 Years
Construction Cost and Operation and Maintenance Cost	75.5 (Million Peso)	Duration of Operation and Maintenance: 50 Years

Source: JICA Study Team

The "alloy-saving two-phase stainless steel material" by Japanese technology would not have the dominant advantages as compared with the conventional "Common Steel Material" in the Philippines judging from the following points of view.

- The common steel material for sluice gate is superior to alloy-saving two-phase stainless steel material in aspect of economical efficiency even when O&M cost is included into the total project cost as shown in Table 16.15 and Table 16.6.
- Utilization of alloy-saving two-phase stainless steel material contributes to easier operation and maintenance of gate not requiring the periodical protecting coating, however; it does not promise maintenance-free for all parts of the gate.
- The alloy-saving two-phase stainless steel material has not been adopted in the past projects by DPWH's budget alone as well as those assisted by Japanese ODA Loan only for the reason that the periodical protecting coating of gate surface is unnecessary.

16.2.3 Applicability of the Project to STEP (Special Terms for Economic Partnership) of Japanese ODA Loan

The operation rule and applicability of STEP of Japanese ODA Loan is as shown in Table 16.17.

Table 16.17 Operation Rule of STEP of Japanese ODA Loan

Item	Operation Rule	Applicability
Eligible Country	Countries eligible for Japanese ODA loans and tied aid under the OECD rules	Philippines is applicable to the rule in the left column.
Eligible Project	Projects eligible for STEP are those listed in the designated sectors and fields, and, at the same time, for which Japanese technologies and/or equipment are substantially utilized.	The Project belongs to the Sector of "Urban Flood Control Projects", which fulfill the rule in the left column.
Coverage Ratio	STEP loans can cover up to 100% of the total project cost.	The Project could possibly fulfill the rule in the left column.
Procurement Conditions	For goods and services (Prime Contractor) (1) A Japanese company, (2) A Joint Venture (JV) composed of a Japanese company(ies) 6 and a company(s) in a recipient country. (3) A consolidated subsidiary of a Japanese company in a foreign country 8 ("the company"). For consulting services (1) A Japanese company, (2) A Joint Venture (JV) composed of a Japanese company(ies) and a company(ies) in a recipient country.	The Project could possibly fulfill the rule in the left column.
Country of origin of goods and services procured under STEP loans	● Not less than thirty percent (30%) of the total price of contract(s) (excluding consulting services) financed by a STEP loan shall be accounted for by either (i) goods from Japan and services provided by a Japanese	Refer to Table 16.18.

Item	Operation Rule	Applicability
	company(ies), or (ii) goods from Japan only, depending on the nature of the project. ● If there are more than one (1) contract for goods and services financed by a STEP loan, the minimum ratio of the goods (and services) to be procured from Japan is determined separately by each contract so as to meet the Ratio stipulated above as a project as a whole.	

Source: JICA Study Team

Table 16.18 Percentage of Material Cost of Japanese Technology to Total Amount of Contract Subject to Japanese ODA Loan

No.	Japanese Technology	Cost of Construction Material (million PHP)	Percentage of Material Cost of Japanese technology to Total Amount of Contract (7,101 million PHP) Subject to Japanese ODA Loan
1	Hat-type and H-shaped Combined Steel Sheet Pile		
2	Alloy-Saving Two-Phase Stainless Steel Material		

Source: JICA Study Team

As mentioned above, the percentage of material cost of Japanese technology to total amount of contract subject to Japanese ODA Loan is lower than 30 %. Therefore, the possibility this project is applied to STEP Loan is low.

16.3 Construction Method

16.3.1 Condition of Construction Plan

(1) Scope of Work for the Construction of Proposed Structural Plan

Target structures are shown in Figure 16.22.

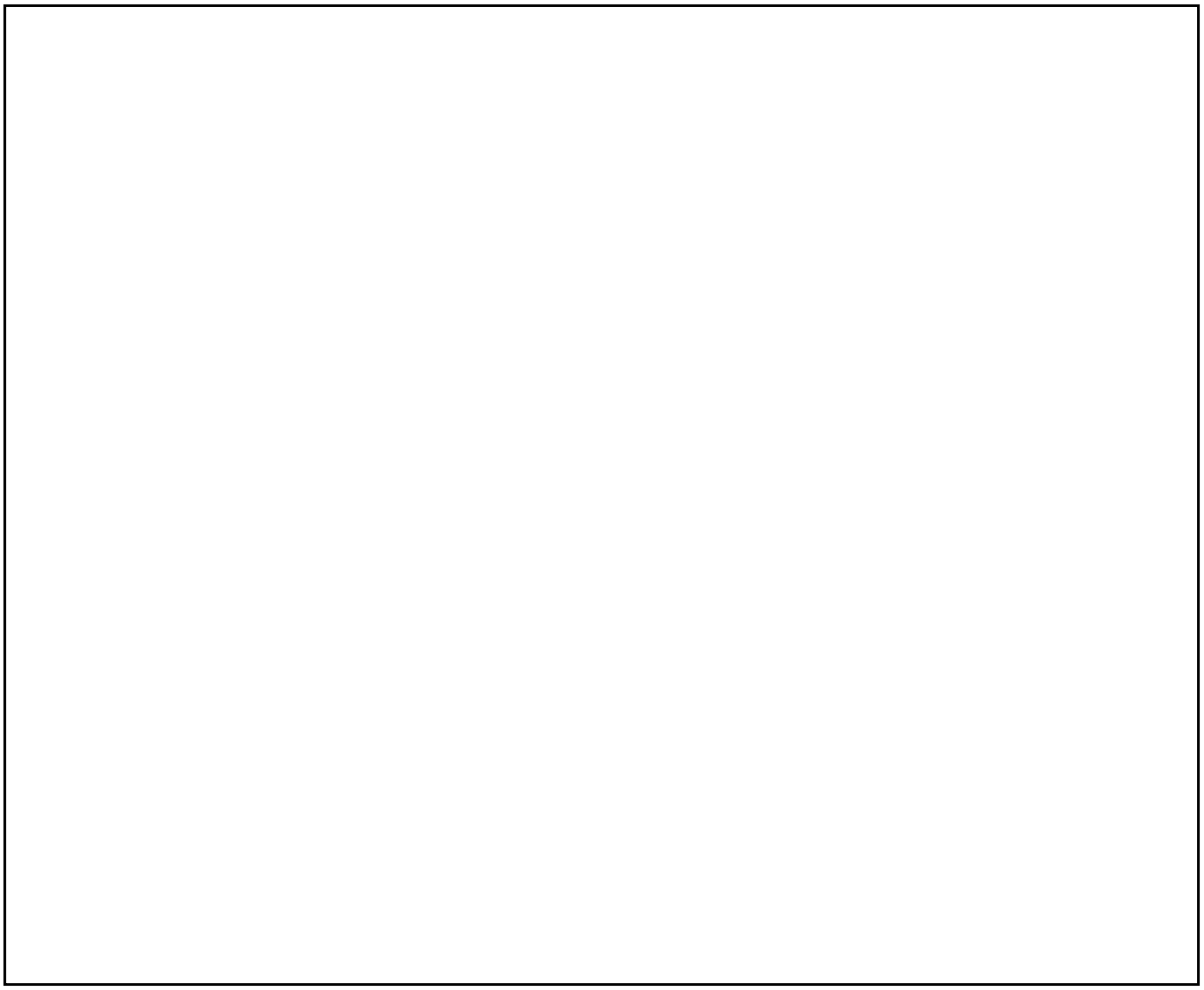


Figure 16.22 Distribution of Target Structure for Priority Project

(2) Quantity of Major Works

Table 16.19 shows the quantity of major works.

Table 16.19 Summary of Construction Works

Item		Description	Length	Work Quantity
River Improvement in San Juan River Basin	San Juan Diversion Channel			
	Rio Grande River Improvement			
	Ylang-Ylang River Improvement			
Drainage Improvement at Maalimango	Maalimango Creek Improvement			

Creek	Maalimango Diversion-I	
	Maalimango Diversion-II	
Resettlement Site Development	Resettlement Site Development	

Source: JICA Study Team

(3) Annual Working Day

Annual working days are shown in Table 16.20.

Table 16.20 Annual Working Days for Major Work Items

Work Item	Sunday	Public Holiday	Rainy at Weekday	Suspension Day	Annual Working Day
Excavation	52	19	40	11	243
Dredging	52	19	40	-	254
Embankment /Backfill	52	19	40	11	243
Concrete Work	52	19	40	-	254
Revetment Work	52	19	40	-	254
Piling Work	52	19	40	11	243
Gabion Works	52	19	40	-	254
Drainage Work	52	19	40	11	243
Road Work	52	19	40	11	243

Source: JICA Study Team

(4) Site Condition

(a) Borrow Area and Quarry

As shown in Table 16.19, the excavation volume is much larger than the one of dikes. Hence, the excavated soil material can be reused for the dike and backfill, thus, a borrow area will not be required. Quarries generally used for the construction in the target area are in Antipolo, Calabarzon. In the Project, quarries in Antipolo are selected.

(b) Disposal Area

Disposal area shall be confirmed by DPWH before the commencement of the construction. Possible disposal areas have been preliminarily selected in the Project as reference, for the cost estimation purpose.

Referring to the other projects such as FRIMP-CTI, it is assumed that most of the surplus soil will be stockpiled and given to the LGUs. Considering the developing condition in the vicinities, surplus soil is considered to be hauled for 3 km. and stockpiled.

Disposal material except for the surplus soils are assumed to be hauled and dumped at LGU recommending site within the hauling distance of 6 km.

16.3.2 Labor, Equipment and Material

Labor, equipment and most of the material can be procured in the vicinity of the construction site, surrounding cities/municipalities or in the Philippines. However, a Hat-type and H-shaped combined steel sheet pile and a large sluice gate and the related parts are not produced in the Philippines. Hence,

The Hat-type and H-shaped combined steel sheet pile will be procured and transferred from Japan and the gate and related tools will be done from Japan and the third countries.

16.3.3 Construction Method

Most of the construction includes concrete work and earth work. Considering the general market in the target area, ready mixed concrete is available for the construction and applied in the construction method and cost estimation.

16.3.4 Performance of Construction Machines

Work force and combination of major equipment for work items are selected based on the Detailed Unit Price Analysis (DUPA) issued by the DPWH. For particular works such as concrete block retaining wall, for which there is no DUPA, a manual in Japan for cost estimation was used as reference.

16.3.5 Packaging

The contract packages are assumed to be broken down into five (5) taking account of amount of direct construction cost, geographic layout of each segment for construction, trafficability of construction equipment/material, etc. It is also assumed that Package 1 involving Hat-type and H-shaped combined steel sheet pile revetment is under international competitive bidding and the others will be under local competitive bidding.

Package 1: Construction of San Juan Drainage Channel including Diversion Weir and Maalimango Diversion-I
Package 2: Improvement of Rio Grande River
Package 3: Improvement of Ylang-Ylang River
Package 4: Maalimango Diversion-II, Sluice Gate and Maalimango Creek Improvement
Package 5: Resettlement Site Development

Considering the longitudinal location of the structure therefore the priority of the package, Package 1 shall be installed firstly and the rest shall be done secondly.

16.3.6 Construction Plan

Figure 16.23 shows the overall project schedule of the construction plan and Figure 16.24 shows the construction schedule for the priority project.

Not disclosed

Figure 16.23 Overall Project Schedule

Not disclosed

Source: JICA Study Team

Figure 16.24 Construction Schedule of Priority Project

16.4 Cost Estimate

16.4.1 Quantity and Total Project Cost for Priority Project

The summary of quantity and total project costs for the priority project are shown in Table 16.21 and Table 16.22.

Table 16.21 Summary of Quantity for Flood Mitigation Structure

Name of River Basin/ Catchment Area	Name of River / Drainage	Design Scale (year)	Works of Water Way			Works of Bridge		Area of Project Site (ha)
			Length (km)	Width (m)	Exca-vation/ Dredging Volume (10^6m^3)	Number of Bridges (Nos.)	Length (m)	
San Juan	Rio-Grande Rive	25						
	Ylang-Ylang River	25						
	San Juan Diversion	25						
	Sub-total							
Maalimango	Maalimango Drainage	15						
	Maalimango Diversion I	15						
	Maalimango Diversion II	15						
	Sub-total							
Total								

Source: JICA Study Team

Table 16.22 Cost Estimation for Flood Mitigation Structure

Breakdown of Cost	Foreign Currency Portion (million PHP)			Local Currency Portion (million PHP)			Total (million PHP)		
	Total	ODA Portion	GOP Funds	Total	ODA Portion	GOP Funds	Total	JICA Portion	GOP Funds
Package 1: San Juan Diversion Channel + Maalimango Diversion-I									
Package 2: Rio Grande River Improvement									
Package 3: Ylang-Ylang River Improvement									
Package 4: Maalimango Creek + Maalimango Diversion-II									
Package 5: Resettlement Site Development									
Price Escalation									
Physical Contingency									
Engineering Services									
Land Acquisition									
Administration Cost									
VAT									
Import Tax									
Interest during Construction									
Front End Fee									
Total									

Source: JICA Study Team

16.4.2 Operation and Maintenance Cost

The annual operation was accumulated and estimated at Philippine Pesos per year, which is of the direct cost.

17. ESTABLISHMENT OF NON-STRUCTURAL FLOOD MITIGATION PROJECTS

17.1 Contents of Priority Projects

The following six (6) components of the non-structural flood mitigation projects are proposed as the priority projects as described in the foregoing subsection 9.5:

- Clean-up of Waterways,
- Management of River Area and Flood Control Area,
- Enactment of Ordinance for On-site Flood Regulation Pond,
- Development of Flood Forecasting and Monitoring System,
- Development of Flood Warning/Evacuation System, and
- Establishment of Management System for Flood Warning/Evacuation.

Expansion of the existing Flood Mitigation Committee (FMC) is further proposed as the core agency to operate and manage the above priority projects. The contents of these priority projects are summarized in Table 17.1 below:

Table 17.1 Summary of Components of Priority Projects

Segment	Contents of Project Activities
Expansion of Flood Mitigation Committee (FMC)	The members of existing FMC and other relevant cities/municipalities will expand the existing organization of FMC for Imus River Basin by adding nine (9) cities/municipalities as the new members of FMC to manage the flood mitigation for San Juan River Basin in addition to Imus River Basin.
Clean-up of Waterway	The cities and municipalities will undertake the actual cleanup of waterways and monitor the status of waterways clogged by garbage, and make effective revisions on the activities of cleanup on waterway The cities and municipalities undertake the IEC for cleanup on waterway, and make effective revisions on the activities of cleanup on waterway under the management of FMC.
Management of River Area and Flood Control Area	The DPWH will set up the boundaries of the river area and/or flood control area through authorization by the secretary of DPWH The DPWH will update the GIS database for the river structures and the land use conditions within the boundaries of the river area and/or the flood control area The cities and municipalities will execute resettlement of informal settlers in the river area and/or flood control area based on the updated GIS database
Enactment of Ordinance for On-site Flood Regulation Pond	The Cavite Provincial Government will prepare the "Ordinance on On-site Flood Regulation Pond", which obligates the developer of a subdivision of more than 5ha to construct a flood regulation pond at the downstream end of the subdivision as drafted in the JICA Study 2009. The Cavite Provincial Government will enhance the consensus-building of the Cavite Provincial Council (SP) to enact the Ordinance for On-site Flood Regulation Pond
Development of Flood Forecasting and Monitoring System	The PDRRMO in collaboration with the relevant city or municipality will install a tidal gauging station and other necessary flood monitoring stations equipped with the telemeter communication system.

Segment	Contents of Project Activities
	The DPWH in collaboration with PDRRMO will develop a model to forecast the flood based on the gauged rainfall and tide level which are collected, as real-time bases, to the operation center through the telemeter system The PDRRMO in collaboration with the relevant cities or municipalities will forecast the flood based on the gauged rainfall, the river water level and tidal level at the real-time bases and upload the forecasted data to the website of the Cavite Provincial Government
Development of Flood Warning/Evacuation System	The LDRRMO will establish the rules and procedures for flood warning and evacuation in response to the gauged rainfall, river water level and tidal level The LDRRMO will set up the communication system to quickly distribute the accurate information on the flood warning/ evacuation quickly among the local residents. The FMC will demarcate the roles of the members of FMC and other relevant agencies for flood warning and evacuation and prescribe them in an ordinance The LDRRMO in collaboration with FMC will facilitate awareness/understanding of the local residents on flood warning and evacuation system through the IEC and drills
Information, Education and Communication	The FMC, the DPWH, the Provincial Government and/or cities/municipalities will undertake the activities for the information, education and communication (IEC) on the structural and non-structural measures adopted to the Project,

Source: JICA Study Team

17.2 Cost of Priority Project

The activities of projects are divided into two categories of stage, one is for start of process such as "Expansion of FMC Membership" and "Establishment of river clean-up monitoring system", and another is stage of operation and maintenance such as IEC activities. For this reason, the project costs were estimated with dividing into two categories, one is "Start of Process" and another is "O&M Stage". As the results, the total project cost at the Start of Process is estimated at 42.3 million, while the annual cost at the O&M Stage 44.4 million pesos in total as shown in Table 17.2. The competent agencies to shoulder these projects costs are further proposed as shown in Table 17.3.

Table 17.2 Project Costs of Non-Structural Flood Mitigation Projects

Projects	Start of Process thousand. pesos	Costs (O&M) thousand pesos/year
1. Expansion of FMC Membership		
2. Clean-up of Waterways		
3. Management of River Area and Flood Control Area		
4. Enactment of Ordinance for On-site Flood Regulation Pond		
5. Development of Flood Forecasting and Monitoring System		
6. Development of Flood Warning/Evacuation System		
7. Establishment of Management System for Flood Warning/Evacuation		
8. Information, Education and Communication (IEC)		
Total		

Source; JICA Study Team

Table 17.3 Cost Burden for Non-Structural Flood Mitigation Projects

Project	Work Contents	Cost (Thousand Pesos)		Agency for Cost Burden
		Start of Process	O&M	
Expansion of FMC membership	Organization Setup			Existing FMC and additional nine cities/municipalities
	Administration of cleanup of waterway			FMC
	Administration of river area and flood control area			FMC
	Administration for flood waning and evacuation			FMC
	Sub-total			
Clean-up of Waterways	Implementation of river clean-up and monitoring			Twelve cities/municipalities
	Sub-total			
Management of River Area and Flood Control Area,	Identification of the river area			Twelve cities/municipalities
	Updating of database			Provincial Planning and Development Office (PPDO)
	Sub-total			
Enactment of Ordinance for On-site Flood Regulation Pond	Preparation of Ordinance			Cavite Provincial Council (SP)
	Hold consensus- building meeting and enact the ordinance			Cavite Provincial Council (SP)
	Sub-total			
Development of Flood Forecasting and Monitoring System,	Installation of a station of tide level			Cavite Provincial Disaster Risk Reduction Management Office (PDRRMO)
	Building flood forecasting model			
	Installation of flood forecasting model			
	O&M for flood forecasting system			
	Sub-total			
Development of Flood Warning/Evacuation System	Updating and operating the rule			Cavite Provincial Disaster Risk Reduction Management Office (PDRRMO), Cities/Municipalities Disaster Risk Reduction Management Office (C/MDRRMO)
	Functional enhancement of communication system			
	Sub-total			
IEC	Clean up of waterway			Flood Mitigation Committee (FMC)
	Flood warning and evacuation			Flood Mitigation Committee (FMC)
	Sub-total			Flood Mitigation Committee (FMC)
Total				

17.3 Implementation Schedule of Priority Project

Of the aforesaid eleven (11) priority projects for non-structural measure, the high performance in particular is expected in the three projects; namely: "(a) expansion of exiting FMC, (b) information, education and information (IEC) and (c) clean-up of waterways", which should be immediately undertaken by the relevant agencies and/or the residents. From this point of view, the said three (3) projects are scheduled to start at first and then other priority projects follow in order as shown in Figure 17.1

Project	Work Contents	2019	2020	2021	2022	2023	2024	2025	2026
Expansion of FMC Membership	Concludie MOA on expansion and activities of FMC	■							
	Undertake coordination of project implementation for structural measures		■	■	■	■	■		
	Undertake operation and mangement of the project facilities and execution of the non-structural measures							■	■
Cleanup of Waterways	Formilate the plan for clean-up of waterway	■	■	■					
	IEC on river cleanup and waste disposal ban in the rivers		■	■	■	■	■	■	■
Information, Education and Communication (IEC)	Formulate plaf for IEC	■	■	■					
	Undertake IEC		■	■	■	■	■	■	■
Management of River Area and Flood Control Area	Set up the boundary of river area and flood control area		■	■					
	Updating of database on structures iand land use conditions in river area and flood control area			■	■				
	Adminustrate the river area and flood control area				■	■	■	■	■
Enactment of Ordinance for Onsite Flood Regulation Pond	Preparethe the ordinance for on-site flood regulation pond		■	■					
	Make consensus building on the ordinance and enact the ordinance			■	■	■			
	Make the ordinance in effect						■	■	■
Development of Flood Forecasting and Monitoring System	Install a tide level station and other necessary flood monitoring stations		■	■					
	Develop flood forecasting model			■	■				
	Operate and manage flood forecasting mode				■	■	■	■	■
Establishment of Rules for Flood Warning and Evacuation	Updae and operat rule for warning and evacuation system		■	■					
	Enhance the functional communication system			■	■				
	Reinforce warning and evacuation system				■	■			
	IEC campaign on flood warning and evacuation system						■	■	■
Strengthening of Institutional Setup for Flood Warning & Evacuation	Formulate the plan for flood warning and evacuation		■	■					
	Monitor and improve the system development and activities for warning and evacuation system			■	■	■	■	■	■

Source: JICA Study Team

Figure 17.1 Project Schedule of Non-Structural Flood Mitigation Projects

17.4 Expected Benefits

The major expected benefits of the proposed non-structural flood mitigation projects are assumed and summarized as shown in Table 17.4.

Table 17.4 Expected Benefits of Non-Structural Flood Mitigation Projects

Projects	Expected Benefits
Clean-up of Waterways	The original flow capacity of waterways would be maintained by removal of garbage in the waterways making a great contribution to flood mitigation in the Cavite lowland area.
Management of River Area and Flood Control Area	The database of houses/buildings and land in the river area and flood control area would be developed to facilitate the effective and consistent management of the river area and flood control area reducing the flood damage potential and securing the available land for construction of flood mitigation facilities.
Enactment of Ordinance for On-site Flood Regulation Pond	The Ordinance will obligate the developer of the subdivision to construct the flood regulation pond at the downstream end of every new subdivision of more than 5ha. The flood regulation pond would function to offset the increment of the peak flood runoff discharge from the subdivision making a great contribution to preservation of the basin flood retention capacity.
Development of Flood Forecasting and Monitoring System	Development of flood forecasting and monitoring system could facilitate acquiring of earlier and more accurate information on the floods and reducing of the risk of loss of the human lives in particular against the floods which are hardly controlled by the existing structural flood mitigation measures.
Development of Flood Warning/Evacuation	Development of flood warning/evacuation system could facilitate the following which could

Projects	Expected Benefits
System	lead to reduction of the flood potential damage: - Immediate and simultaneous distribution of the message for flood warning/evacuation among many residents - Consistent and timely issuance of the order of flood evacuation and - Enhancing of the awareness of the residents on flood warning and evacuation system
Establishment of Management System for Flood Warning/Evacuation	Establishment of management system for flood warning/evacuation would enhance the necessary verification and necessary corrective measures for ongoing flood warning/ evacuation promising the sustainable flood warning/evacuation system.

Source: JICA Study Team

17.5 Point to Note for Implementing Projects

The mainly point to note of the proposed non-structural flood mitigation projects are assumed and summarized as shown in Table 17.5.

Table 17.5 Point to Note for Implementing Non-Structural Flood Mitigation Projects

Projects	Point to Note for Implementing Projects
Clean-up of Waterways	The cities/municipalities in the upper reaches of the waterway tend to be less concerned with the cleanup of the waterways, because of little damage of flood from the waterway. Removal of garbage from the entire stretch of the waterway is, however, indispensable, to keep the original flow capacity of the waterway. From these points of view, all cities/municipalities not only in the lower reaches but also upper reaches are required to participate to cleanup of the entire stretch of waterway including the bottleneck sections. In order to ensure such consistent activity of cleanup of waterway, the IEC is important to rouse the awareness of all cities/municipalities on the necessity of cleanup of waterways.
Management of River Area and Flood Control Area	The boundaries of the river area and the flood control area are not well authorized causing increment of informal settlers dwelling within the boundaries. Hence, the DPWH as well as the relevant LGUs are required to set up the authorized boundaries and install the clear indications of the boundaries such as markers/sign boards. Development and updating of database on the dwellers as well as the land use conditions in the boundaries are also required to ensure the sustainable management of the river areas and the flood control areas.
Enactment of Ordinance for On-site Flood Regulation Pond	The Ordinance for the on-site flood regulation pond has not been resolved by the Cavite Provincial Assembly yet, ever since it was originally proposed in the JICA Study 2009. Difficulty in resolving the Ordinance would be attributed to increment of the cost for development of the new subdivisions imposed the developers, which may hinder the regional development. Nevertheless, expansion of the subdivisions will also cause the serious reduction of the basin flood retention capacity, which is being the greater hindrance of the regional development. From this point of view, the Ordinance should be deliberated by Cavite Provincial Assembly again and enacted in the earliest opportunity.
Development of Flood Forecasting and Monitoring System	The flood forecasting model would hardly promise the adequate accuracy within a short term, because of the inadequate gauging data of rainfall and river/tide level accumulated. The model would need to be improved in parallel with increment of the gauging data and the flood to be forecasted through the model should be published upon completion of the model, the accuracy of which is assured.
Development of Flood Warning/Evacuation System	The flood warning and evacuation system should function for the entire river basin, and therefore, the basin-wide system has to be established covering the rules for communication and demarcation of roles of the relevant organizations. From this point of view, it is recommended that the Cavite Provincial Disaster Risk Reduction Management Office (PDRRMO) acts as the leading agency to establish the basin wide

Projects	Point to Note for Implementing Projects
	warning/evacuation system in collaboration with DRRMO of each city/municipality.
Establishment of Management System for Flood Warning/Evacuation	Delay of establishment of the flood warning and evacuation system and/or inadequate IEC for awareness of system are foreseeable due to inadequate man-power and budget of the cities/municipalities in particular. Hence, the Provincial Government-Disaster Risk Reduction Management Office (PDRRMO) should extend the staffing and budgeting support to the cities/ municipalities.

Source: JICA Study Team

18. ENVIRONMENTAL IMPACT ASSESSMENT AND FORMULATION OF DRAFT RESETTLEMENT ACTION PLAN

18.1 Environmental Impact Assessment

18.1.1 Baseline of the Environmental and Social Conditions

The baseline of the environmental and social conditions in the project area refers to Chapter 2 and 3 of this report respectively.

18.1.2 EIA Requirements for the Project

According to the Presidential Decree (PD) 2146 (1981), the EIA process covers projects which have been originally declared as Environmentally Critical Projects (ECPs) (Category A) or projects in Environmentally Critical Areas (ECAs) presumed to have significant impacts on the quality of the environment (Category B). On the other hand, non-covered projects are required environmental safeguard if deemed necessary by DENR. As for the feasibility study (F/S) on priority projects, the environmental category is determined referring to the requirements of EIA and EII in the Philippines stipulated by PD 2146 and EMB. After reviewing the content of the project, DENR judged that flood mitigation measures of the priority projects directly facilitated the improvement of the local environment and classified the project as Category C, which is not comparable to Category A or B (refer to section 10.2 of this report about the ECP for flood control projects).

18.1.3 Scoping

The scoping for the EIA study of priority project was conducted based on the result of field survey of MP conforming to JICA guidelines. Regarding the Pre-/Construction phases, involuntary resettlement (No.17) is rated as "A-"(significant negative impact is expected) and 25 items are rated as "B-"(negative impact is expected). 2 items are rated as "C" (extent of positive/negative impact is unknown) and the rest of 2 as "D" (No impact is expected). Regarding the operation phase, as positive impacts, 2 items (No.11 Hydrological Situation and No.18 Local economy such as employment and livelihood etc.) are rated as "A+" and 5 items as "B+". As negative impacts, 6 items are rated as "B-", and the rest of 17 items are "D". The TOR was made for items evaluated as A, B or C, and a baseline survey was conducted in accordance with the TOR. Table 18.1 indicates major anticipated impacts before/during construction and in operation (Details can be found in section 4.1 of Volume 3).

Table 18.1 Scoping for Environmental and Social Impacts Evaluation

No	Item	Rating	Description of Impacts
Pre-/during construction			
1	Air Pollution	B-	Pollution by exhaust gas and dust from construction machines and vehicles
2	Water Pollution	B-	Pollution by soil and drained water from construction sites to the river. Salt water uprush
3	Noise and Vibration	B-	Noise and vibration from construction machines and vehicles
4	Soil Contamination	B-	Contamination by oil leakage from construction machines
5	Waste	B-	Construction waste soil, dredged soil and wastes from workers' camp

No	Item	Rating	Description of Impacts
6	Ground Subsidence	B-	Subsidence caused by uplifting of groundwater by excavation
7	Offensive Odor	B-	Odors of exhaust gas, drained water and wastes from construction sites
8	Bottom Sediment	B-	Soil erosion and deposition caused by insufficient protection of cut and fill
10	Flora, Fauna and Biodiversity	B-	Deforestation of mangrove trees along the coastal area
11	Hydrological Situation	B-	Disturbance of river flow by soil erosion caused by insufficient protection of cut and fill
12	Topography and Geographical Features	B-	Change of current topography by excavating the diversion channels
13	Soil Erosion	B-	Soil erosion into the rivers by cut and fill
14	Groundwater	B-	Impact on groundwater quality by excavation
15	Coastal Zone	B-	Topographic change of the coast by construction of diversion channel and impact on the mangrove ecosystem
17	Involuntary Resettlement	A-	Large-scaled land acquisition and resettlement by diversion channel construction
19	Land Use and Utilization of Local Resources	B-	Change of current land use caused by land acquisition of the project
21	Existing Social Infrastructures and Services	B-	Impact on traffic on the existing roads by diversion channel construction
22	Misdistribution of Benefit and Damage	B-	Misdistribution of benefit between relocated people and the non-relocated derived from loss of livelihood or income by the involuntary resettlement
27	Landscape	B-	Change of current landscape by array of construction machines
29	Working Conditions/ Accidents	B-	Accidents during construction work, traffic accidents around the work area
30	Gender/Children's Rights	C	Incomplete payment execution of fair compensation to women of households to be relocated, concern on traffic accident to children during construction
In Operation			
2	Water Quality	B-	Salt water uprush in the diversion channel, impact on the aquifer by saltwater intrusion
12	Topography and Geographical Features	B-	Change of current topography by the excavated the diversion channels
14	Groundwater	B-	Impact on the aquifer by saltwater intrusion
15	Coastal Zone	B-	Impact on the coastal topography and landscape by the diversion channels
27	Landscape	B-	Impact on the coastal topography and landscape by the diversion channels
29	Work Conditions/ Accidents	B-	Traffic accidents to pedestrians passing through the new bridges over the diversion channel

Source: JICA Study team

18.1.4 Result of Baseline Survey

The baseline survey was done in accordance with the result of scoping and the TOR. Table 18.2 shows the results on water quality (No.2), flora, fauna and biodiversity (No.10), coastal zone (No.15) and Involuntary Resettlement (No.17), which are needed much consideration. Details are discussed in section 4.1 of Volume 3.

Table 18.2 Result of Baseline Survey (Excerpt)

<table>
<tr><th></th><th>No</th><th>Item</th><th>Results of Survey</th></tr>
<tr><td>Pollution</td><td>2</td><td>Water Pollution</td><td>
・ The table below shows the result of water quality measurement conducted by JICA Study Team (Date: 17th & 18th of Feb, 2016).
<table>
<tr><th>Area</th><th>Site Item</th><th>pH</th><th>Turbidity (NTU)</th><th>TSS (mg/L)</th><th>BOD (mg/L)</th><th>DO (mg/L)</th><th>Salinity (mg/L)</th></tr>
<tr><td rowspan="4">River mouse</td><td>S1*1</td><td>8.1</td><td>34</td><td>276</td><td>12</td><td>6.6</td><td>31,800</td></tr>
<tr><td>S2</td><td>7.6</td><td>31</td><td>40</td><td>59</td><td><2.2</td><td>7,430</td></tr>
<tr><td>S9</td><td>8.2</td><td>13</td><td>29</td><td>14</td><td>6.3</td><td>1,550</td></tr>
<tr><td>S10</td><td>8.2</td><td>8.4</td><td>17</td><td>14</td><td>4.5</td><td>979</td></tr>
<tr><td rowspan="4">Mid stream</td><td>S3</td><td>7.9</td><td>6.0</td><td>11</td><td>4</td><td>5.9</td><td>5,710</td></tr>
<tr><td>S4</td><td>8.0</td><td>1.7</td><td>20</td><td>7</td><td>5.7</td><td>490</td></tr>
<tr><td>S7</td><td>8.1</td><td>10</td><td>21</td><td>3</td><td>8.1</td><td>979</td></tr>
<tr><td>S8</td><td>7.7</td><td>12</td><td>22</td><td>3</td><td>6.9</td><td>88</td></tr>
<tr><td rowspan="2">Upper</td><td>S5</td><td>7.8</td><td>24</td><td>38</td><td>5</td><td>7.3</td><td>53</td></tr>
<tr><td>S6</td><td>8.0</td><td>3.5</td><td>12</td><td>4</td><td>9.4</td><td>71</td></tr>
<tr><td colspan="2">Domestic Standard*2</td><td>6.5-8.5</td><td>-</td><td>30</td><td>7.0</td><td>5.0</td><td>350 (as Cl)</td></tr>
<tr><td colspan="2">Japan’s National Standards (class-C river water*3)</td><td>6.5-8.5</td><td>-</td><td>30</td><td>7.0</td><td>5.0</td><td></td></tr>
</table>
*1 Mouth of San Juan River (Sample was salt water)
*2 DENR Class C River standard (Fishery, Recreational (boating, etc.), Industrial water supply)
*3Fishery 3, Industrial 1
・ As for the river water, in the Site S2, S9 and S10, the value of BOD exceeded the standard. The values of DO met the standard except for the Site S2 and S10. These sites are located in overcrowded residential areas. Thus, the impact of domestic water discharged from houses is big.
・ It is said that there is a relatively strong correlation between turbidity and TSS. The correlation coefficient (R) of this survey was 0.690. The value of TSS concentration in the river mouth in the overcrowded residential area is high. The high concentration of TSS triggers sedimentation, impacting BOD and DO concentration.
・ The value of saline concentration exceeded the standard from the river mouth to Site S7. It is foreseen that the sea water has run up to these sites.
</td></tr>
</table>

<table>
<tr><th></th><th>No</th><th>Item</th><th>Results of Survey</th></tr>
<tr><td>Natural environment</td><td>10</td><td>Flora, Fauna and Biodiversity</td><td>
[Plant]
・ By the field survey, 123 species belonging to 37 families were identified in the Project site. Butter fruit (Kamagong or Dorspyros blancoi), which is classified as VU (Vulnerable species) in the Red List of IUCN (ver. 3.1, 2001), was found along the Ylang-Ylang River, but the others are classified as LC (Least Concern).
・ The most predominant was Fabaceae of 13%, followed by Moringaceae of 9.8% and Moraceae of 8.9%.
・ The table below shows the diversity index (Shannon-Wiener (H')) and the evenness index (Pielou (J')). It shows low diversity and high evenness.
<table>
<tr><th>Project site</th><th>Plot No.</th><th>Diversity Index Shannon-Wiener (H')</th><th>Evenness Index Pielou (J')</th></tr>
<tr><td>Diversion channel I</td><td>10</td><td>2.33</td><td>0.92</td></tr>
<tr><td>Ylang-Ylang River</td><td>7</td><td>2.38</td><td>0.85</td></tr>
<tr><td>Rio Grande River</td><td>6</td><td>2.42</td><td>0.89</td></tr>
<tr><td>Diversion channel II</td><td>3</td><td>1.91</td><td>0.87</td></tr>
<tr><td>Maalimango drainage</td><td>6</td><td>2.15</td><td>0.87</td></tr>
<tr><td>Average (overall)</td><td>32</td><td>2.24</td><td>0.88</td></tr>
</table>
[Animal]
1) Fish
・ By the survey in the downstream, 8 fish species and 3 crustacean species (1 shrimp and 2 crabs) were identified. Tilapia was observed in abundance at each site. Goby, Tarpon and Ten-pound are common species.
2) Amphibian
・ 2 species were identified and categorized as LC (Least Concern) of the IUCN Red List.
3) Reptile
・ 6 species were identified during the survey and categorized as LC except for Naja philippinensia which is categorized as NT (Near Threatened). However, Python reticulatus is designated as an endangered species by DENR DAO.
4) Mammal
・ 2 species of bats and 2 species of rodents were identified and categorized as LC.
5) Birds
・ 38 species were identified and all categorized as LC. Yellow vented Bulbul, Golden bellied flyeater and Pied Bushchat were found in abundance.
[Mangrove]
・ There were mangrove forests mixed with indigenous species in the downstream of the drainage channel of the San Juan River.

The vegetation spreading out in the project site is the secondary forest and plants which are occasionally found in urban areas. The rare vegetation and animals such as birds to be protected have not been identified by the site visits and the hearings from the environmental officers of the Cavite Province. However, it is necessary to protect considerably the mangrove forests in the river mouth.
</td></tr>
</table>

	No	Item	Results of Survey
	15	Coastal Zone	**San Juan diversion channel and Maalimango diversion channel I** ・ Mangrove forests to be affected by the construction of diversion channels are densely located in the mouth of San Juan River in Bacor Bay. ・ Affected area is 3.67ha, out of which by estimate 3.02ha (82%) for San Juan diversion channel and 0.65ha (18%) for Maalimango diversion channel I. LGUs and barangays to be affected are as follows. - San Juan diversion channel: Nobeleta (San Rafael II) - Maalimango diversion channel I: Rosario (Ligtong I, Ligtong II), Noveleta (San Rafael I) ・ Summary of mangroves in the project area is shown in Figure 18.1. ・ Mangroves to be cut down are not under the protection of DENR. However, permit is necessary to cut them down. ・ Mangrove species is sporadically observed in these areas as a congregate with fish cultivation ponds, built-up areas and residential areas. This congregate is divided by existing water courses such as Maalimango River. A part of mangrove areas are already inhabited by residents and individual land ownership is claimed. Another part has been already converted to residential areas and industrial areas. ・ The mangroves form part of the coastal scape. Deforestation may change the scape in the coastal area. ・ Except for Philippine cobra (Naja philippinensis) which is designated as NT (Nearly Threatened) of IUCN red list, there are no species of the IUCN Red List (ver. 3.1, 2001) and species designated as endangered by DENR order (DAO) 2007-01[9]. ・ Barangay San Rafael IV (Noveleta) supports National Greening Program (NPG) which is a national program of DENR. However, it is out of the project area.
Social Environment	17	Involuntary Resettlement	・ Based on the maps and the result of the site visits, the number of households to be relocated is expected to be 877 and the land area to be acquired to be 52 ha. ・ This includes ordinary houses, offices, governmental facilities (barangay halls, clinics) etc. ・ Religious institutions: two small chapels and a part of grave yards need to be relocated.

Source: JICA Study team

18.1.5 Re-rating of Scoping Results

The rating of scoping was re-evaluated based on the results of baseline survey. Ratings of most items were not changed, and the altered items after the re-rating and its reasons are shown in Table 18.3 (Section 4.1 of Volume 3 for details).

[9] "Establishing the National List of Threatened Philippine Plants and Their Categories, and the List of Other Wildlife Species"

Table 18.3 Re-Rating of Scoping and its Reasons (Excerpt)

	No.	Item	Rating during Scoping		Re-Rating		Reasons for Re-Rating
			Pre-/ Const.	Operation	Pre-/ Const.	Operation	
Natural Environment	2	Water Pollution	B-	B-	B-	D	[Construction] The river to be improved is classified as C (main use is fishery and industry). The anticipated impact by construction may be an increase in turbidity caused by soil inflow and the waste water from the construction sites and workers' camp. However, decrease of water flow and a large amount of soil flow-down are not anticipated since a large-scaled cofferdam is not settled in due to most works during the dry seasons and the amount of dredged soils is not limited. [Operation] Since the flowing up of sea water is confirmed around the mouth of the river to be improved, such a flowing up is anticipated in the new diversion channel to an extent. However, serious water pollution is quite unlikely because inflowing polluted water in the new diversion channel is limited. Although excavation in the coastal area of the river mouth may incur salinity intrusion, additional impact on the groundwater by the intrusion is limited especially for daily life water due to a high saline level of groundwater around the coastal area. Improvement of river water is expected in the river due to smooth river water flow.
	12	Topography and Geographical Features	B-	B-	B-	D	[Construction] Since construction of the new diversion channel needs to excavate the land in super-low and low areas on the alluvium formation, change in the original topography is anticipated due to demobilizing the existing structures and constructing the new one. [Operation] Since the new diversion channel has dug -down structure, the coast will be excavated near the river mouth. However, the alignment of San Juan diversion channel uses that of the existing natural waterway and the mouth escapes the sand bar where fishery boats stay in. This indicates there would be less impact on the coastal topography by maintaining the natural water flow in operation. The coastal line around the mouth drastically changes by tidal movements, natural factors could contribute to the change of coastal form rather than impacts by the structure. On the other hand, the pile of sands flowing down at the end of the diversion channel is anticipated by constructing the new structure.
	14	Groundwater	B-	B-	B-	D	[Construction]Although the construction of diversion channel needs shallow excavation of 3-4.5m deep, there is a concern that excavation put impacts on aquifers. [Operation] The salinity level of well water near the mouths of diversion channels is generally high. The salt water has already penetrated into the groundwater. Although there is a concern of salt water wedge, impacts on daily lives are not expected concerning the wide usage of tap water and the frequency of well water use.
Social Environment	24	Water Usage or Water Rights and Rights of Commons	C	D	B-	N/A	[Construction] The water in the rivers to be improved is unlikely used by local people for their daily use. On the other hand, the construction of the new diversion channel may give an impact on the fishery activity at the mouth of the channel around the coastal area. [Operation] The river improvement does not change water usage or water rights. Any impacts are not expected because the new diversion channel is to be managed the government without private water rights.

	No.	Item	Rating during Scoping		Re-Rating		Reasons for Re-Rating
			Pre-/ Const.	Operation	Pre-/ Const.	Operation	
	27	Landscape	B-	B-	D	D	[Construction] The existence of construction machineries (heavy machineries, vehicles, structures) may harm the surrounding landscape. However, the impact is quite limited because the project area is being urbanized or cultivated without any scenic points, as well as no claims from the stakeholders. [Operation] The diversion channel becomes a newly emerged permanent structure. Although it is located in overcrowded residential areas, it takes time for the diversion channel to fit in the surrounding landscape. However, the degree of impact is quite limited because of few scenic points and recreation spots in and around the area, as well as no claims from the stakeholders..
	30	Gender/ Children's Rights	C-	D	B-	N/A	[Construction]In case of resettlement, there is a concern of non-compliance of proper compensation for women. There is also a concern of increase of traffic accidents of students and children. [Operation]Flood mitigation measures are expected to contribute to protection of life of women and children and to facilitate their active social participation through promoting local employment.

Rating: A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent. C+/-: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
D: No impact is expected. N/A: No change when re-rating for D at the scoping (Not Applicable)
Source: JICA Study team

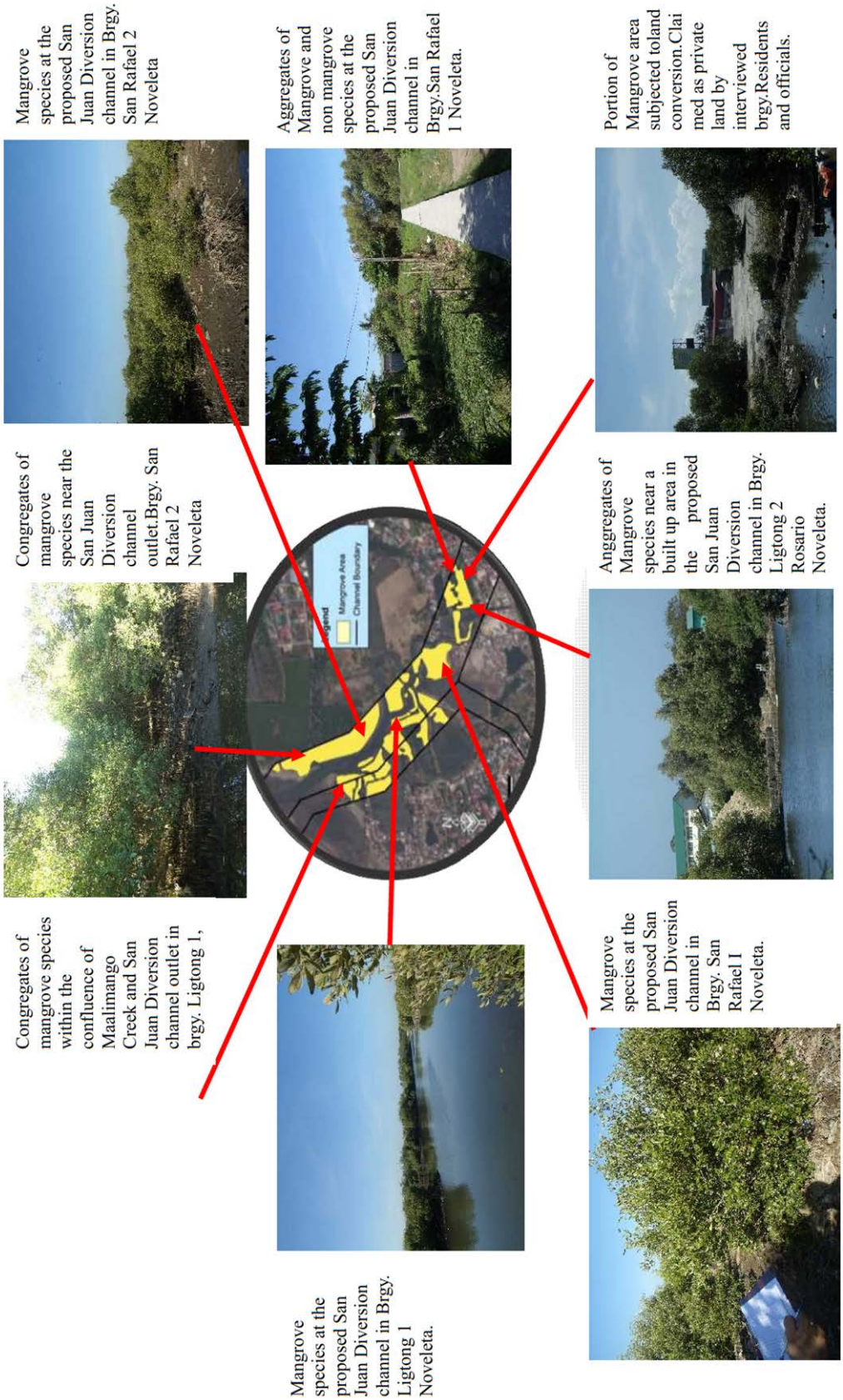


Figure 18.1 Summary of Mangroves in the Project Area

Source: JICA Study team

18.1.6 Environmental Management Plan and Monitoring Plan

The environmental management plan (EMP) is developed including possible mitigation measures and responsibilities for implementation. The monitoring plan is also developed in order to implement the EMP for sure. Table 18.4 shows the excerpted EMP regarding pollution and natural environment. Confirming to the JICA environmental and social consideration guidelines, items are monitored for at least 2 years after operation. Details of the EMP and monitoring plan (including monitoring form) are discussed in section 4.1 of Volume 3.

Table 18.4 Environmental Management Plan (Excerpt)

	№	Evaluation Item	Mitigation Measures	Responsibilities for Implementation		Burden Agency (Estimated Cost)
				Implementing entity	Responsible Organization	
Pre-/Construction						
Pollution	1	Air Pollution	- Watering near residential areas - Use of low-emission machineries and vehicles during construction - Regular check of construction machineries and vehicles	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 400,000)
	2	Water Pollution	- Discharge of wastewater treated by grit chamber and silt fence. - Installation of portable toilets for workers - Proper management of wastes and construction machineries.	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 500,000)
	3	Noise and Vibration	- Speed limit for vehicles in construction sites near residential areas - Regular check of construction machineries and vehicles	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 800,000)
	4	Soil Contamination	- Implementation of regular checks in order to avoid the leakage of oil and dangerous substances from construction machineries.	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 220,000)
	5	Waste	[Construction and demolition waste] - Transportation to disposal sites designated by Proponent or Local administrative organs and proper treatment. [Waste from work areas and camps] - Designation of waste collection points in construction sites and treatment according to the management by Contract Administrator. At the same time, clean environment maintenance of work areas at any time.	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 220,000)
	6	Ground Subsidence	- Applying a proper method for excavation based on ground survey results and groundwater level	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 100,000)
	7	Offensive Odor	- Dewatering of excavated soil as much as possible and prompt transportation to disposal sites. - In transportation to disposal sites, prevention of scattering to the ground by covering truck beds with sheets. - In case of a complaint from residents, suspension of works and implementation of proper response	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 100,000)

	№	Evaluation Item	Mitigation Measures	Responsibilities for Implementation		Burden Agency (Estimated Cost)
				Implementing entity	Responsible Organization	
			by Proponent and Contractor.			
	8	Bottom Sediment	- Application of construction methods to reduce stirring and excavation of bottom sediment. - Proper removal of deposited sand.	Supervisor & Contractor	DPWH, LGUs	Contractor (Php 200,000)
Natural Environment	10	Flora, Fauna and Biodiversity	- Application of construction methods no to interfere migration of fish (without closing the river course) - Implementation of survey to confirm the absence of flora and fauna to be protected in case of construction for river bank protection. - Before tree-clearing of mangroves, confirmation of target trees to be cut and inhabitant creatures (number and kind).	Supervisor & Contractor	DPWH, LGUs, DENR (where necessary)	Contractor (Php 1,800,000)
	11	Hydrological Situation	- Application of construction methods not to interfere water flow of rivers and channels (without closing the river course)	Supervisor & Contractor	DPWH, LGUs	Contractor
	12	Topography and Geographical Features	- Application of construction methods to minimize the change of river bank slopes in consideration of strengthening the protection of river banks. - Construction in the minimum area in coastal areas. Countermeasures against collapse at the excavation points (revetment).	Supervisor & Contractor	DPWH, LGUs	Contractor
	13	Soil Erosion	- Implementation of protection of river banks along new discharge channels.	Supervisor & Contractor	DPWH, LGUs	Contractor
	14	Groundwater	- Excavation methods for river beds and new discharge channel to avoid impacts on underground water vein.	Supervisor & Contractor	DPWH, LGUs	Contractor
	15	Coastal Zone	- Design of discharge channel to avoid mangroves near the river mouths as much as possible. - Application of construction methods not to disturb the ecosystem (fish) in the coastal zone as much as possible. - Compensated replantation of mangroves cut (Reforestation plan to be determined by DENR during the detailed design (DD) stage)	Supervisor & Contractor	DPWH, LGUs, DENR	Contractor (included in Item No. 10)
Operation						
Natural Environment	12	Topography and Geographical Features	- Removal of deposited sand at the mouths of diversion channels - Dredging diversion channels	DPWH	DENR LGUs	DPWH (Php 800,000)
	15	Coastal Zone	- Removal of deposited sand at the mouths of diversion channels - Dredging diversion channels	DPWH	DENR, LGUs	DPWH (included in Item No. 12)
S. Env	29	Working Conditions/ Accidents	- Number of accidents	Near the new bridges	Annually	DPWH, LGUs

Source: JICA Study Team

18.1.7 Stakeholder Meetings

The JICA guidelines for environmental and social considerations require having resident's committee meetings several times in order to achieve consent with affected people and stakeholders smoothly. In order to gain understanding and approval for the project content, potential impacts on the environmental and social aspects and the mitigation measures, holding two stakeholder meetings is supposed in this study (1st meeting on 11th of Feb. 2016, 2nd on 28th of Nov.2016). The summary and major questions and answers are shown in Table 18.5 and Table 18.6.

Table 18.5 Summary of Stakeholder Meeting

1st Meeting

Item	Content	Remark
Date & Time	11th of Feb. 2016 9:30 AM -12:00 PM	Language: Tagalog, English
Place	Casa Hacienda Tejeros Convention (Rosario, Cavite)	
Participant	38 (Ratio of women: 24%) Representatives from Province and municipalities, Environmental officers, Barangay representatives, residents, NGOs	
Agenda	1. Explanation of project summary 2. Concerned environmental and social impacts 3. Introduction of alternatives 4. Study schedule 5. Question and answer, Discussion	

2nd Meeting

Item	Content	Remark
Date & Time	28th of Nov. 2016 9:00 AM -12:00 PM	Language: Tagalog, English
Place	Casa Hacienda Tejeros Convention (Rosario, Cavite)	
Participant	66 (Ratio of women: 39%) Representatives from Province and municipalities, Environmental officers, Barangay representatives, DENR-EMB, residents, NGOs、private sectors	
Agenda	1. Explanation of the results of environmental impact 2. Results of assessment studies 3. Plan of mitigation measures and monitoring 4. Future schedule 5. Question & answer and discussion	

Source: JICA Study Team

Table 18.6 Major Questions and Answers in Stakeholder Meeting

1st Meeting (11th of Feb. 2016)

Stakeholder	Questions/ Comments	Answers
Engr. Rolinio Pozas (PG-ENRO)	The river will be widened and creek will be improved. Up to what extent will the river be widened?	JST presented the project scheme development which shows the length and width of each area needed for improvement.
Engr. Rolinio Pozaz (PG-ENRO)	When the river will be widened, the water from the ocean during high tide will go upstream and flood will still not be mitigated. He clarifies that retarding basin that will be constructed will collect excess water on the rainy months so that the river will not overflow. The water will undergo to a treatment process so that the water can also be utilized as irrigation, domestic use and others. During dry months on the other hand, the basin may serve as football area, park, etc.	Yes, what you have said are the purpose of the basin but there is a separate EIA study for the retarding basin. (JST)
Renato Escurel,	There are houses that are located close to the	There are river easements which are

1st Meeting (11th of Feb. 2016)

Stakeholder	Questions/ Comments	Answers
CENRO-General Trias	river, what will happen to the private lands that will be affected by the implementation of the project?	considered as no build zone. If ever, you will be compensated based on the market value of the land or houses. (Engr. Pozaz) There are other group of consultants that will focus on this issue. They will be visiting each household. There are also laws enacted regarding land and house acquisition. (JST)
Renato Escurel, CENRO-General Trias	Are the highlighted areas are the focus sites of the project? What is your basis in choosing the area to be improved? Can improving these areas solve the problem in flooding?	Selection of the area for this project underwent thorough studies and considered all rivers in the project area. Consultations and meetings with the DPWH throughout the studies were also undertaken. Areas that have lesser project affected people were also considered in the site selection. Other areas will be improved at the next stage of the project. (JST)
Kgwd.Rey Sasa Brgy. Tejero Gen. Trias	Will you add a creek as part of improvement of the river?	The river will be improved through widening and construction of additional drainage in other areas. (JST)
Rodolfo Dizon APO Alumni Association-Cavite City	When will the project start?	Depends on the phasing of the activities but most probably hopefully, 3 years from now. (JST)
Ronald Redondo Rep.MENRO-Noveleta	So this consultation focuses on the red dotted line (referring to the map).	Yes, they include river improvement and new diversion channel construction. (JST)
Zenaida Santiago Local Council for Women	We have experienced a lot of floods, in the development of this project, is there any effect that would worsen the flooding occurrence? What if the river will overflow?	The improvement of the river/creek will avoid the overflow of water. You have a lot of benefit from this project. (Engr. Pozaz) The study of JICA is holistic not just a "peace meal". All aspects will be covered so that the positive effect of the project will be realized. (JST)

2nd Meeting (28th of Nov. 2016)

Stakeholder	Questions/ Comments	Answers
Laarni Meniado Brgy. Salcedo II, Noveleta	Improvements and developments to be undertaken will not only impair household properties but also may cause work displacement such as existing business in the affected area. I am concerned whether this would be considered by the project.	There is a separate study about this matter on RAP and still on-going survey and consultation will be undertaken. (JST)
Laarni Meniado Brgy. Salcedo II, Noveleta	Is there an emergency fund about the structure damages after the construction and availability of funds?	The project is not critical in terms of environmental impact but considered as an enhancement project based on the previous meeting with the Environmental Management Bureau (EMB). The EMB imposes an Environmental Guarantee Fund (EGF) but is usually adopted to environmental critical projects such as dams. In addition, a grievance mechanism will ensure that any project-related problems be considered and allocated. (JST)
Laarni Meniado Brgy. Salcedo II, Noveleta	What is sedimentation problem which will possibly occur during project implementation	The application of silt traps will be employed to address sedimentation brought about by construction activities. (JST) Ms. Meniado suggested the regular dredging of the river/channels should be

1st Meeting (11th of Feb. 2016)

Stakeholder	Questions/ Comments	Answers
		undertaken. JST agreed that the recommendation will be considered as part of mitigating measures.
Some participants (mainly residents)	There will be a lot of sacrifices for this project especially those private legal land owners that will be affected. They are concerned on how the proponent will ensure that there are no illegal settlers that will penetrate along the improved/developed rivers/channels.	Noted. This project will be strictly coordinated with the LGUs concerned. On the specifics, this will be noted for the Resettlement Action Plan (RAP) Team in order to consider this concern on their study. (JST)
Representatives from San Rafael I and II, Noveleta	The improvements/ developments will result displacement. In case their settlements will be affected, where will they be relocated and how to be compensated?	This is not part of the EIA study but will be detailed in RAP assessment. (JST)
Elizabeth Pascua Brgy. Salcedo I, Noveleta	In terms of health impacts related to the project implementation, how will this concern be addressed?	Health impacts are the most likely related to air quality specific on dust emissions. Regular sprinkling of water in the construction area is advised. The contractor will also be required to provide measures/safety plan to minimize/prevent this issue.
Resident (Name & area unknown)	There is confusion on the final project design since there are series of survey conducted.	The original plan is considered as final as of this time. The surveys conducted are part of the comparative analysis to assess the best area for development/improvement. (JST)
Napoleon Suaverlas, Noveleta	Is the schedule presented on time? And also if the ECC will not be acquired, how much time will be added before project implementation?	We are positive that ECC will be acquired within the timeframe since this project will have no critical impacts on the environment. The target time for project implementation will possibly be delayed because of RAP issues. (JST)
JST	The importance of updated baseline data.	JST explained that the data used during the study is updated and considered the possible changes in the future. (JST)

Source: JICA Study Team

18.2 Draft Land Acquisition and Resettlement Action Plan

18.2.1 Objective Projects for Formulation of Land Acquisition and Resettlement Action Plan

The following are selected as the components of the priority project and the objectives for formulation of land acquisition and resettlements plan (refer to Figure 16.22).

- Project for River Flood Mitigation: (a) San Juan Diversion Channel connecting the confluence of the Ylang-Ylang and Rio Grande rivers to Manila Bay at the scale of 75.5 meter width with 2.44 kilometer length, and (b) the river improvements of the Rio Grande River and the Ylang-Ylang River with the entire improvement section of about 6.9 kilometer length.
- Project for Storm Water Drainage: (a) Widening of existing drainage channel of 2.0 kilometer length, (b) deepening of existing drainage channel of 1.0 kilometer length by dredging and (c) construction of Maalimango Diversion Drainage I of 1.0 kilometer length and II of 3.0 kilometer length.

18.2.2 Legal Framework

The legal foundation for resettlement policies in the Philippines is stipulated in the Philippine Constitution (1987). The key policy frameworks are based on the DPWH's "Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples (LARRIP) Policy (2007)", RA 8974 "An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects (November 2000)", and "Indigenous Peoples' Rights Act (IPRA) of 1997". Other environmental and social safeguards of the financing institutions are also applicable especially of ADB/World Bank Resettlement Policies and JICA Guidelines.

Particularly, the LARRIPP stipulates policies on eligibility, compensation and other entitlements, indigenous peoples who will be affected by the project, public participation and consultation, grievance procedures, institutional arrangements, monitoring and evaluation as policy frameworks of the land acquisition and resettlement for DPWH projects.

In addition, Republic Act No. 10752 (2016) and its implementation guidelines, Implementing Rules and Regulations of R.A. No. 10752 (2016), were enacted to promote the Right-of-Way Acquisition of national infrastructure projects in July 2016. In the act and guidelines, compensation by the negotiated sale is defined as one of the mode of acquiring real property. The project implementation agency shall offer to the property owner concerned as compensation price, the sum of: the current market value of the land; the replacement cost of structural and improvements, therein; and the market value of crop therein.

18.2.3 Scope of Land Acquisition and Resettlement

(1) Scope of Land Acquisition and Resettlement

There were households refused population census, asset survey and socio-economic survey. Thus, no information was obtained for these denial households and unvisited households.

Furthermore, no information was obtained for the households who were absent through visits three times. Thus, in order to show the overall impact scale, the results of this study include in the following estimations/assumptions. The RAP will be updated during the detailed design phase, where the census and socio-economic surveys on the final project affected persons (PAPs) will be carried out based on the results of detailed design. The denial households and absentee households will be requested again to provide necessary information for calculation of compensation amount and etc.

- Affected Population: With the limitation of the survey as above, total number of households and population affected by the project were estimated in 877 households and 3,346 population. Among them, it was estimated that formal households were at 578 households, informal households were at 299 households, with 2,197 and 1,149 population for each.
- Households identified were a total of 628 households, and the population total of 2,350 people. Among them, the formal households were at 417 households and informal households were at 211 households, with 1,553 people and 797 population for each. Informal households were assumed those who reside in public land, without right or permit of residence even in private land.
- Affected Land: The area of project affected lands is total 515,476 square meters, about 51.5 hectors.
- Affected Buildings: The number of project affected buildings is total 828 building. Among them, 499 buildings were surveyed and 329 buildings were not surveyed. Those whom buildings were studied on the satellite photo, and observed from outside the premises to study types of buildings on the sites.
- Improvements and Trees: The project affected improvements and trees were total 73 improvements and 929 trees with the 499 buildings surveyed.
- Graves: In the Noveleta public cemetery, there were graves affected by the project as 56 graves of shelter type (surrounded by roof and wall), 459 graves of coffin type which are placed independently, and 69 graves of the aggregated coffin type that several coffins are stacked.

(2) Socio-economic Conditions of Affected Households

The socio-economic conditions of project affected households were studied based on the information of 715 households who were interviewed in the population and socio-economic surveys.

(a) Characteristics of the Household Head

The gender rates of household heads in the area were 64% for male and 36% for female, and regarding the age structure, 41-50 year-old group was the highest at 22%. The most

common educational attainment of household heads was high school graduate at 34%, followed by 14% in elementary school graduate. In the place of origin, 47% of the household heads originated from outside of Cavite Region, Manila, Luzon, other outside of Luzon, which was higher than those of the province. There were many types of main occupations and income sources of the household heads. Those of rather higher ratios were personal business, Tricycle/jeepney driver, skilled laborer and unskilled laborer. The gender composition of the occupation and income sources of household heads was at 63% for male and 37% for female. 55% of respondents answered that they owned land.

(b) Characteristics of Household

The average household sizes of Kawit, General Trias and Noveleta were three, four, are four people for each, and the most common household size range was 3-4 people. The gender rates of household members were 49% for male and 51% for female. Regarding the age structure of household members, 20 and below year-old group was the highest at 44%. As this is the apex, the ratios became lower by older age groups. The most common educational attainment of household members was high school graduate at 24%, followed by 21% in elementary school graduate. There were many types of main occupations and income sources of the household members. Those of rather higher ratios were personal business, Tricycle/jeepney driver, skilled laborer and unskilled laborer as well as household heads. The gender composition of the occupation and income sources of household members was at 57% for male and 43% for female.

The most common monthly income range was under Php 10,000 in Kawit, General Trias, Noveleta and Rosario. In the range of under Php 15,000, those whom ratios were from 60% to 80% among them. The average monthly incomes were at Php 14,261, Php 15,175 and Php 11,192 in Kawit, General Trias and Noveleta. On the other hand, if per household poverty threshold is calculated from the National Statistical Coordination Board (NSCB), Per Capita Poverty Threshold in Region IV-A, 2012, Php 4,785, Php 6,380, Php 6,380 per household per month is calculated for each. The average household monthly incomes of them were higher than these amounts, however, 40%-50% of households were below Php 10,000. It is assumed that there were households below or on the poverty line.

80% of households were electrified, and 51 % of households had water supply from the water systems of piped and pump well. Regarding toilet facility, 64% of households used semi-flush or pit latrine type, and 67% of households used LPG for cooking fuel. Although higher ratios of length of stay ranges were totally divided into over 25 years and less than 10 years, the households in over 25 years were the most at 39% in Kawit. In General Trias, the households in over 25 years were at 28%, and the other ranges were distributed almost evenly. In Noveleta, the length of stay less than 10 years was at 42%.

(c) Awareness, Perception and Attitude of the Project and Resettlement

63% of the respondents were aware of the project. Furthermore, for the opinions to the project, 56% of the respondents were answered "good" and "very good". 65% of respondents answered “Yes” or “Yes, depends on the condition” to “If the project necessitates resettlement of the affected households, would you consider or agree to be relocated?”.

39% of the respondents, the largest portion, answered “Same barangay” as an answer to “If you are asked to relocate, what is your preferred site?”. Other respondents also preferred the neighboring area. For the type of relocation, 28％ of respondents, the largest portion, answered “Resettlement on government sponsored site”, followed by “Self-relocation with project assistance” at 27%.

As preferred assistance for livelihood and income restoration, 40% of respondents had interested in “Skill development training”, and 29% of respondents had interested in “Entrepreneurship development assistance”. 40% of households with employable members answered that they had interested in skill and business and training needs. Specifically, preferred skill training were cooking/food-related/baking, welding/construction/electrician, business and clothing. Preferred businesses were retail store, personal business, food-related as the majority, and other minor items were cosmetology, soap making, computer programming, online business, etc.

(d) Vulnerable Households

Mostly half (46%) of households had vulnerable persons (landless, household with elderly head, female-headed household, solo-parent household, child-headed household, household belonging to indigenous group, household with physically or mentally disabled members). In particular, female-headed household was the majority at 32.5%. Furthermore, female-headed households comprised 41% of the informal settler families.

(e) Fishing Activity

According to the Municipal Agriculture Office of Noveleta LGU, no fishery was running near the mouth of the San Juan Diversion Channel. Meanwhile, on the west side of the river mouth of the channel, there is a berth facility of fishing bunker boats, which is used by approximately 500 small fishing bunker boats (for 2 to 3 persons). These are mainly used for coastal fishery to catch sardines. Many of them are processed to dried fish and sold in neighboring areas. In the Project, the alignment of San Juan Diversion Channel was planned to avoid the facility by designing the alignment to the east side, and to consider adverse impact on the fishermen as much as possible. Although several fishing bunker boats were put on the sandbar on the west side of the mouth, DENR recommended them to moor in the fishing boat berth.

18.2.4 Measures of Compensation and Supports

(1) Compensation for Losses

(a) Eligibility

The persons who are residing, doing businesses, cultivating land or using other resources within the project area as of the census survey date will be eligible for compensation and/or other rehabilitation programs, regardless of their tenure statuses. Those include lessees who cannot verify the legal rights and claims for land occupied, traders, workers and employees. The resettlement assistance is extended to the informal settlers if they are underprivileged and homeless Filipino citizens who do not own any real property, whether in urban or rural areas. However, professional squatters and members of squatting syndicates, who exploit the compensation to aim at profits, are not eligible for any compensation and resettlement assistances.

(b) Entitlement

The affected assets are compensated with reference to RA 10752. The affected lands are compensated at the current market value, and structures and improvements are compensated at 100% replacement cost. Crops/trees/perennials are also compensated at the current market value. If the present means of livelihood is no longer viable and the affected family will have to engage in a new income activity due to the loss of assets, livelihood rehabilitation assistance is provided in the form of skills training. Also, there are subsidies for inconvenience allowance for relocation and new construction, rental subsidy for temporarily renting, transportation assistance. If qualified as ISFs, relocation is applied in LGU or NHA resettlement sites. Regarding these entitlements, an entitlement matrix was drafted as shown in Table 18.7 based on LARRIPP.

Table 18.7 Entitlement Matrix (Draft)

Type of loss	Application	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Responsible Organization
1. Lands (Classified as Agricultural, Residential, Commercial, or Institutional)	Severe Impact	PAPs with Transfer Certificate of Title (TCT) or Tax Declaration (TD) (Tax declaration can be legalized to full title)	• Cash compensation for loss of entire land at the current market value of land • If feasible, land for land will be provided in terms of a new parcel of land of equivalent value or productivity, at a location acceptable to PAPs • Cash compensation for damaged crops at the current market value • Rehabilitation assistance in the form of skills training equivalent to Php 15,000 per family, if the present means of livelihood is no longer viable and the affected family will have to engage in a new income activity	• UPMO-FC MC (DPWH)
		Holders of Certificates of Land Ownership Award (CLOA) granted under the Comprehensive Agrarian Reform Act		
		PAPs without TCT and TD	• Compensation on land improvements only • If PAPs do not own any real property whether in the urban or rural areas as defined in RA 7279, may apply for housing in LGU or NHA resettlement sites	• UPMO-FC MC (DPWH) • LGUs • NHA • PHDMO • NGO
		Holders of free or	• Compensation on land improvements only	• UPMO-FC

Type of loss	Application	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Responsible Organization
		homesteads patents and Certificates of Land Ownership Award (CLOA) under CA 141. Public Lands Act	• Cash compensation for damaged crops at the market value • Disturbance compensation equivalent to five times the average of the gross harvest for the past 5 years but not less than PhP15,000	MC (DPWH)
		Lessors or lessees of agricultural land	• Disturbance compensation equivalent to five times the average of the gross harvest for the past 5 years but not less than PhP15,000	• UPMO-FC MC (DPWH)
	Marginal Impact	PAF with Transfer Certificate of Title (TCT) or Tax Declaration (TD) (Tax declaration can be legalized to full title)	• Cash compensation for affected land at the current market value of land • Cash compensation for damaged crops at the current market value	• UPMO-FC MC (DPWH)
		Holders of CLOA granted under the Comprehensive Agrarian Reform Act		
		Holders of free or homestead patens and CLOA under CA 141. Public Land Act	• Compensation on land improvements only • Cash compensation for damaged crops at the current market value	
2. Structures (Classified as Residential/ Commercial/ Industrial)	Severe Impact	Owners with or without Transfer Certificate of Title (TCT) or Tax Declaration (TD) (Tax declaration can be legalized to full title)	• Cash compensation for entire structure at 100% replacement cost (compliant with RA10752) • Rental subsidy for the time between the submission of complete documents and release of payment on land or structure • Inconvenience allowance in the amount of Php 10,000 for relocation and new construction • Transportation assistance	• UPMO-FC MC (DPWH)
	Marginal Impact		• Cash compensation for affected portion of the structure at 100% replacement cost	
	Severe Impact	Absentee owners of structures with or without TCT or TD	• Cash compensation for entire structure at 100% replacement cost	
	Marginal Impact		• Cash compensation for affected portion of the structure at 100% replacement cost	
	Severe Impact	Renters and Rent-free occupants	• Rental Subsidy will be given to PAFs without sufficient additional land to allow the reconstruction of their lost house under the following circumstances: a. The concerned properties are for residential use only and are considered as severely affected. b. The concerned PAFs were physically residing in the affected structure and land at the time of the cut-off date. c. The amount to be given will be equivalent to the prevailing average monthly rental for a similar structure of equal type and dimension to the house lost. d. The amount will be given for the period between the delivery of house compensation and the delivery of land compensation. If the compensation for was provided prior to construction, no rental subsidy will be provided.	
3. Business	Severely or marginally affected	Business owners	• Income rehabilitation assistance not to exceed one month net income according to business/income level based on a tax record, income statement and/or a business permit during reestablishment period • Rehabilitation assistance in the form of livelihood and skills training, capital for small business	• UPMO-FC MC (DPWH) • LGUs • DA • TESDA • CDA • DSWD • PESO (DOLE) • DTI • PCLEDO • NGO
		Employees	• Rehabilitation Assistance in the form of special skills training or other development activities (budget of Php 15,000) in coordination with other government agencies, if the present means of livelihood is no longer viable and the affected family will have to engage in a new income activity	

Type of loss	Application	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)	Responsible Organization
4. Improvements (other non-dwelling structures)	Severely or marginally affected	PAPs with or without Transfer Certificate of Title (TCT) or Tax Declaration (TD)	• Cash compensation for the affected improvements at 100% replacement cost	• UPMO-FC MC (DPWH)
5. Crops, Trees, Perennials	Severely or marginally affected	Owners of crops, trees, perennials	• Cash compensation for crops, trees, and perennials at the current market value as prescribed by the concerned LGUs (PAPs are allowed sufficient time to harvest their crops.)	• UPMO-FC MC (DPWH)
6. Graves	Severely or marginally affected	Owners of graves	• Relocation by LGU which manages the public cemetery	• LGU • DPWH
7. Vulnerable Households	Severely or marginally affected	Households with poor, women, children, female-headed households, elderly, disabled	• Rehabilitation Assistance in the form of special skills training or other development activities (budget of Php 15,000) in coordination with other government agencies • Transportation assistance to transfer to relocation place	• UPMO-FC MC (DPWH) • LGUs • PHDMO
		Homeless, landless, underprivileged, informal occupants of public land, except Professional Squatters and Squatting Syndicates[1)] as defined in RA 7279	• If qualified, may apply for housing in LGU or NHA resettlement sites • Rehabilitation Assistance in the form of special skills training or other development activities (budget of Php 15,000) in coordination with other government agencies • Transportation assistance to transfer to resettlement site or return to place of original province	• UPMO-FC MC (DPWH) • LGUs • NHA
8. Losses of community or public structures	Severely or marginally affected	Community or public structure owners/ administrators	• Cash compensation for entire or affected portion of the structure at 100% replacement cost	• UPMO-FC MC (DPWH)
9. Displacement of social infrastructure	Severely or marginally affected	Owners/operators of social infrastructure services	• Compensation to cover the cost of temporary relocation of social infrastructure and rehabilitations through coordination and negotiations with owners/operators of social infrastructure services and communities	• UPMO-FC MC (DPWH)
10. Temporal loss of control of land use	Owners of unused parcels of land along the project sites	Land owners	• Land owners will be paid for the rent/lease of land parcels based on market value and length of occupation by DPWH. • DPWH will return the land parcels to the owner after the lease contract is over and will recover the condition of the land at pre-project level.	• UPMO-FC MC (DPWH)
11. Other loss or impact not predicted when the RAP is prepared	Severely or marginally affected	PAPs, households, or parties affected by unanticipated impact identified during the RAP implementation	• DPWH, in coordination with other concerned institutions, will recognize the impact to assess the severity, and negotiate with the PAPs for adequate assistances and compensations of impacts.	• UPMO-FC MC (DPWH) • Concerned institutions

Note: Severe Impact: More than 20% of the total landholding lost or where less than 20% lost but the remaining land holding become economically unviable.
Marginal Impact: Less than 20% of the total landholding lost or where the remaining structure can still function and is viable for continued use.
1) As defined by Republic Act 7279, "persons who have previously been awarded home lots or housing units by the government but who sold, leased or transferred the same to settle illegally in the same place or in another urban area, and non bona fide occupants and intruders of lands reserved for social housing. The term also refers to individuals or groups who occupy lands without the expressed consent of the landowner and who have sufficient income for legitimate housing.) However, individuals or groups who simply rent land and housing from professional squatters or squatting syndicates are included.
Source: LARRIPP, JICA Study Team

(c) Support for Vulnerable Groups

The projects will pay special attentions on the poor and landless residents, elderly, women and children, particularly for households below the poverty line, with disabled people, with women/elderly household heads. The results of socio-economic survey showed that mostly half (46%) of households had vulnerable persons, in particular, female-headed

household was the majority at 32.5%. Therefore, they are given priority for the supports with vocational training, financing and food aid.

(2) Support for Rebuilding Lives

(a) Livelihood Rehabilitation

Based on the results of socio-economic survey, the respondents had interest in own businesses even micro scales, or in the skill development trainings. Preferred businesses were retail store, personal business, food-related as the majority, and other minor items were cosmetology, soap making, computer programming, online business, etc. Preferred skill trainings were cooking/food-related/baking, welding/construction/electrician, business and clothing.

On this basis, the following measures are used for livelihood rehabilitation: i) Livelihood and Employment Development particularly by producing household-based products with the Techno-Livelihood Caravan for poor communities or resident groups and gender supports by Cavite Provincial Cooperative, Livelihood and Entrepreneurial Development Office (PCLEDO), ii) skill development trainings by the Technical Education and Skills Development Authority (TESDA), iii) access to financing opportunities by Department of Social Welfare and Development (DSWD), iv) cooperative development support by the PCLEDO in coordination with LGUs, DTI and partner NGOs in Cavite, v) livelihood development programs by NHA.

The measures to support livelihood rehabilitation will be implemented around before and after relocation, so that the affected people can recover their livelihoods promptly after relocation. In the detailed design (D/D) phase, the draft RAP will be finalized based on the works of parcellary survey with mapping, census survey/structure tagging (C/T), inventory of PAPs' assets, master list of eligible PAPs and entitlement, evaluation of PAP's assets for compensation. The measures to support livelihood rehabilitation will also be determined based on these results in the RAP.

United Project Implementation Office or the Project Management Office-Flood Control Management Cluster (UPMO-FCMC) of the DPWH will program the livelihood rehabilitation measures through technical guidance of ESSD. UPMO-FCMC will coordinate and cooperate with supporting agencies, Cavite Provincial Cooperative, Livelihood and Entrepreneurial Development Office (PCLEDO), Technical Education and Skills Development Authority (TESDA), National Housing Authority (NHA) or other agencies mentioned below to program the livelihood rehabilitation measures. The measures such as the skills trainings will be designed six months before the relocation starts at the latest, and implemented between 4 months before and one year after the relocation.

Table 18.8 Livelihood Rehabilitation Measures

Item	Responsible Organization	Program	Description
i) Livelihood and Employment Development	Cavite Provincial Cooperative, Livelihood and Entrepreneurial Development Office (PCLEDO)	Techno-Livelihood Caravan	For the poor or woman's supports, cooperatives, livelihood and entrepreneurial developments particularly by producing household-based products are provided so that low-income families can produce commercially in their backyards to earn income. The typical products are processed foods (chocolate, cold cuts, boneless bangus, tinapa, fish/squid balls, spicy dried anchovies, fish nuggets, siomai, tahong chicharon, crispy crustaceans and seaweeds snacks, fruit preserves, coated candies, etc.), and handicrafts or novelties (decorative balloons, fashion accessories, flower arrangement, candle-making, liquid soap and conditioner, perfume, disinfectant, etc.).
	LGUs, NGO	Gender responsive intervention	As well as PCLEDO, LGUs and NGOs can conduct sewing classes, computer literacy, automotive mechanics and adult education programs for mothers and out-of-school youths. NGOs also can support women to develop the livelihoods in dried fish production, backyard gardening and vending, and those are also expected potential supports to develop income sources.
ii) Skill development	Technical Education and Skills Development Authority (TESDA)	Skill development training	The TESDA conducts community based skill trainings which are specifically designed to the needs of the barangays, and is carried out in partnership with LGUs, non-government groups, civil society organizations, people's organizations, and other national government agencies. The training programs are conducted as basic capability building courses for such as carpentry, masonry, electrical work, cosmetics, crafts making. The target beneficiaries include the poor and under privileged residents such as out of school youth, women, and unemployed adults, subsistence farm workers/fisher folks, indigenous people, and informal sector people. TESDA provides the standard training modules and related equipment, supplies and materials, qualified trainers, competency assessment and certification, monitoring and evaluation and if possible, starter tool kits to graduates.
iii) Access to financing opportunities	Department of Social Welfare and Development (DSWD)	Self-employment Assistance	The Self-employment Assistance-Kaunlaran (SEA-K) Program aims to enhance the socio-economic skills of poor families through the organization of community-based associations for entrepreneurial development including social preparation, formation of groups and association, capital assistance, savings mobilization, technical assistance, and access to other social services.
iv) Cooperative development	PCLEDO, LGU, DTI, NGO	Cooperative Development Support	Supports to establish, register and operate the cooperatives, suggests and introduce available programs for necessary funds and trainings in order to provide more opportunities and capital for livelihood development through coordination with LGUs, DTI and partner NGOs. Actually, the PCLEDO supports for organizing and registering the cooperatives
v) NHA livelihood development programs	NHA, TESDA, LGU-Public Employment Service Office (PESO), City Social Welfare and Development Office (CSWD), Cooperative Development Authority (CDA)	Skill Training	Programs for skills training courses in coordination with government agencies (especially TESDA) and private organizations according to the interests and skills of relocated people. Typical skills trainings are i) Fancy Jewelry Making, ii) Waste Recycling, iii) Basic Cosmetology, iv) Cell Phone Repair, v) Masonry, vi) Dishwashing Liquid, Fabric Conditioner and Perfume Making, vii) Hand Wash, Shampoo, Cologne and Perfume Making, and viii) Candle Making.
		Job Referrals and Placements	Coordination with business establishments around resettlement sites to identify potential job opportunities and employments for relocated people through examining job applicants whose qualifications meet the job requirements to refer to employers. The most referable job opportunities are construction companies for resettlement sites. Coordination with the LGU-Public Employment Service Office (PESO) and the City Social Welfare and Development Office (CSWD) are also used for the job referrals.
		Access to Micro Financing Institutions	Coordination with government agencies and non-government organizations in order to support PAPs to access micro-credit facilities, e.g. Self- Employment Assistance (SEA-K) supported by DSWD in order to enable relocated people to establish small

Item	Responsible Organization	Program	Description
			businesses such as a pharmacy and a waste recycling and junk shop operation, or with CSWD in providing cooperative and credit trainings
		Cooperative Development	Supports in organizing service or product cooperatives such as transport, market, water bottling business, food processing, or construction workers co-ops with micro-finance, training for cooperative formation and management under the cooperation of CDA

Source: JICA Study Team

(b) Social Rehabilitation

The LGUs, city, municipalities and barangays which receive relocated people, will extend the social services to meet the increased population for health care, education, sport/recreational activities (additionally build health care centers, schools, sport/recreational facilities). Besides, they should maintain the security order and secure the habitability and harmony in the resettlement sites.

On the other hand, as NGOs have been assisting the poor relocated people through comprehensive community settlement development in Cavite, these proven NGOs are asked cooperation or to be involved in the social rehabilitation supports.

(3) Resettlement Sites

(a) Development of Resettlement Sites in the Concerned LGUs

The location of resettlement site should be accepted by PAPs with coordination. In principle, the location should be considered i) proximity to original location, ii) proximity to employment and livelihood opportunities, iii) accessibility (access roads and public transportation provided), iv) capacity of population and social services, v) proximity to public facilities, especially schools and health centers. In addition, the results of socio-economic survey showed that the respondents preferred the relocation within the same Barangay or nearby it. They also preferred resettlement on government sponsored site. Therefore, the development of resettlement sites will be proposed in the concerned LGUs.

(b) Resettlement Sites as Land Swapping for Affected Formal Settler Families:

The project affected formal settler families shall be paid/compensated with the sum of (a) the current fair market value of the land, (b) the replacement cost of structures and improvements, and (c) the current fair market value of crops and trees, in accordance with the Republic Act No. 10752 (RA10752) and its Implementing Rules and Regulations (RA10752-IRR). Meanwhile, considering that the affected people prefer to resettle places as close as possible to the current residence, land swapping in nearby developed resettlement sites can be another entitlement to be offered for the formal settler families.

Therefore, the project affected formal settler families shall be also entitled to choose land swapping if feasible, instead of the monetary compensation by the current fair market value of the land in the above item (a). In this connection, DPWH has agreed to allocate the necessary budget and coordinate with the relevant LGUs to meet the land swapping as the results of discussions with the JICA Fact Finding Mission. It is also agreed that a part of amount of the JICA Loan will be allocated to development of land and infrastructure for land swapping. Thus, resettlement sites to be alternative residence with basic infrastructure will be developed for the formal settler families as the land swapping in the Project.

(c) Resettlement Sites for Affected Informal Settler Families:

The project affected informal settler families may apply to housing in the resettlement site in accordance with RA 7279 and shall be paid/compensated with the sum of (a) the replacement cost of structures and improvements, and (b) the current fair market value of crops and trees. In Novelera, the Mayor indicates to support for preparing the resettlement site within the municipality. The resettlement sites will be provided with the Mayor's agreement although the locations are under coordination.

While the resettlement in the same municipality is preferred, if the affected peoples agreed, relocation to the existing resettlement sites is more practical than new development to reduce time and cost for the resettlement. Regarding the other four municipalities, the candidate resettlement sites are four existing resettlement sites managed by the Cavite Provincial Government in Kawit as Table 18.2 shows those locations. The basic infrastructures are already developed in the sites. There are vacant spaces for 80 units for detached houses, which can accommodate the expected 83 ISFs except Noveleta by building multi-dwellings partially in the vacant spaces.

Figure 18.2 Locations of the Existing Potential Resettlement Sites in Kawit

(d) Further Activities and Roles of Concerned Agencies for Resettlement Site:

DPWH and Noveleta LGU shall take the following roles at the time of detailed design of the Project in order to develop the resettlement sites mentioned above.

DPWH commits the following tasks and to expend its own GOP fund to shoulder the cost for:

- Land acquisition of the resettlement sites for the formal setter families, who choose the aforesaid land swapping;
- Land acquisition, for the informal settler families at their resettlement;
- Development of resettlement sites with using of JICA Loan

DPWH shall also design the resettlement site plan for its development.

The Local Government Unit (LGU) of Noveleta commits to undertake the following:

- To find parcel of land for possible relocation for the affected formal settler families, who choose the land swapping;
- To find parcel of land for possible relocation site for the affected informal settler families; and
- To shoulder the cost of housing for the affected informal settler families at the designated resettlement site.

Besides, Noveleta LGU shall identify and register the informal settler families in cooperation with NHA based on RA 7279.

Meanwhile, the Japan International Cooperation Agency (JICA) will commit to ensure the land grading and preparation of infrastructures for the relocations sites both for the formal and informal settler families by providing the JICAl loan amount.

(4) Relocation of Graves

Regarding the graves affected by the project in the Noveleta public cemetery, the following basic agreements were made among DPWH as the project implementer, Noveleta municipality as the administrator of the municipal cemetery, and the private cemetery owner adjacent to the municipal cemetery.

- DPWH will acquire the open space of the adjacent private cemetery at the market price for the relocation of graves.
- The above relocation site will be transferred to the municipal cemetery, and the graves will be managed by Noveleta municipality after the relocation.
- The owners of graves will receive the graveyards for free and the compensation to transfer and rebuild the graves.

18.2.5 Grievance Redress Mechanism

A grievance will be filed by the PAP with the City/Municipality Resettlement Implementation Committee (C/MRIC) which will be established in concerned LGUs, Imus, Kawit, General Trias, Noveleta and Rosario, who will act within 15 days upon receipt thereof. If no understanding or amicable solution can be reached, or if the PAP does not receive a response from the C/MRIC within 15 days of registry of the complaint, the PAPs can appeal to the DPWH Region IV-A Office (RO IV-A), which should act on the complaint/grievance within 15 days from the day of its filing. If the PAP does not satisfied with the decision of the RO IV-A, the PAP, as a last resort, can submit the complaint to any court of law.

18.2.6 Institutional Framework

The implementation of RAP activities is led by the DPWH involving various government offices, LGUs, PAFs and/or other organizations representing PAFs. Particularly, The United Project Implementation Office or the Project Management Office-Flood Control Management Cluster (UPMO-FCMC) of the DPWH has overall responsibility for implementing the project. The UPMO-FCMC manages and supervises the project, including resettlement activities and land acquisition, in coordination with relevant agencies, ensures the funds and accounts for the expenses. The Cavite First District Engineering Office (CDEO) is the major implementer of the RAP activities. The Region IV-A Office (RO IV-A) acts as the liaison between ESSD and the Cavite First District Engineering Office (CDEO), and ensures that the RAP is implemented as planned.

As a supporting organization, the City/Municipality Resettlement Implementation Committee (C/MRIC) will be established in each LGU, Imus, Kawit, General Trias, Noveleta and Rosario. The C/MRIC is mainly composed of representatives from the Region IV-A Office (RO IV-A) and Cavite First District Engineering Office (CDEO), the City/Municipality LGUs, representatives of affected barangays/PAFs/PAPs, and NGOs working in City/Municipality. Furthermore, women's participation will be encouraged for the members of C/MRIC in consideration of gender balance. Meanwhile, the ESSD provides technical guidance and support in the implementation of the RAP activities.

As other related supporting organizations, the LGUs of Imus, Kawit, Noveleta, General Trias and Rosario, will work to provide resettlement sites and social services, and coordination with concerned agencies and the other LGUs relating to the project, but not only as a member of the C/MRIC. The Cavite Provincial Cooperative, Livelihood and Entrepreneurial Development Office (PCLEDO) will provide the programs of livelihood and employment development, and gender responsive intervention,, cooperative establishment support. Cavite Provincial Housing Development Management Office (PHDMO) will provides low-cost housing.

Furthermore, the supports from other government agencies are: resettlement site development with LGUs and livelihood recovery supports for the residents in the resettlement sites by Livelihood Development Department (NLDD) by NHA; the skill development trainings by TESDA; provision of

available financing opportunities by DSWD; the cooperative establishment and operation by Cooperative Development Authority (CDA); the job referrals and placements by Public Employment Service Office (PESO)/ City Social Welfare and Development Office (CSWD); the micro-small and medium-sized enterprise developments by Department of Trade and Industry (DTI).

18.2.7 RAP Implementation Schedule

The RAP drafted in the F/S will be reviewed and finalized in the detailed design (D/D) phase based on the works of parcellary survey with mapping, census survey/structure tagging (C/T) including identification and registration of the ISFs, inventory of PAPs' assets, master list of eligible PAPs and entitlement, evaluation of PAP's assets for compensation. Ahead in these activities, the RAP implementation structure, especially C/MRIC and the grievance redress system will be built. In a parallel way with these activities, public consultations, grievance redress, monitoring and evaluation will be started and conducted throughout the entire process of resettlement activities until the completion of construction. Negotiations and consensus building will be started according to each construction schedule of project component, and the payment is completed before relocation. In a parallel way with the negotiations and consent building, the preparations of resettlement site development plan, the livelihood recovery support and the other supports will also be started.

Table 18.9 RAP Implementation Schedule

Not disclosed

18.2.8 Cost and Finance

The cost required for the RAP implementation was calculated total 1,603 million pesos. Among them, 1,333,521 thousand pesos for asset compensation (land, buildings and improvements), 41,893 thousand pesos for compensation, 108,800 thousand pesos for resettlement site development, 151,296 thousand pesos for the cost of RAP activity implementation and 76,335 thousand pesos for physical contingency. The cost of resettlement sites is excluded from the RAP implementation cost because the cost is considered as the construction cost of Package 5.

The project implementer, the DPWH, is responsible for the budget of the RAP implementation costs as a part of the project cost. The ESSD together with the UPMO-FCMC will prepare the RAP budget plan, and the UPMO-FCMC will submit the budget plan to the DPWH Central Office. The UPMO-FCMC will claim expenses at an appropriate time in the RAP implementation process according to the approved RAP budget plan, and secure the budget so that they can allocate the budget quickly.

18.2.9 Monitoring System

A monitoring will be conducted to evaluate whether the resettlement activities are implemented as planed in the RAP. In the monitoring, regular data collection with analysis and reporting on the progress shall be held throughout the entire resettlement activities. The monitoring activities consist of internal monitoring and external monitoring. The Environmental and Social Services Division (ESSD) of the DPWH shall conduct the internal monitoring as the Internal Monitoring Agent (IMA). ESSD will assign internal staff of DPWH or local consultants as the members of IMA. Meanwhile, the UPMO-FCMC will commission a qualified individual or a consultancy firm with qualified and experienced staff as an External Monitoring Agent (EMA) to undertake independent external monitoring and evaluation.

The monitoring indicators will be set based on the ones shown in the LARRIPP in accordance with the conditions of priority projects and affected people. The main items of monitoring indicators are: i) internal monitoring: budget and timeframe, delivery of compensation and entitlements, public participation and consultation, benefit monitoring, and ii) external monitoring: basic information on PAP households, restoration of living standards, restoration of livelihoods, levels of PAP satisfaction, effectiveness of resettlement planning, other impacts (unintended impacts). Meanwhile, the preparations of resettlement sites and the grave relocations in Noveleta are specific concerns for the Project. Those activities will be monitored in both internal and external monitoring.

18.2.10 Public Consultation Meetings

(1) LGU Coordination Meetings

The LGU Coordination meetings were held to inform and coordinate with the concerned LGUs and affected barangays the future schedule and activities that would be done for the preparation of the Resettlement Action Plan of the Project. The proposed project was presented to the LGUs

as well as the activities for the preparation of the Resettlement Action Plan (RAP) report, which included: i) DPWH's Land Acquisition Resettlement, Rehabilitation and Indigenous People Policy (LARRIPP), ii) The "Cut-Off Date" which is set to be the day of the conduct of PAF's socio-economic survey, iii) the need of a creation and formation of the City/Municipality Resettlement Implementation Committee (C/MRIC) to assist the DPWH in the implementation of the RAP. The Barangay Captains were also advised of future activities to be done in their area. The LGUs and Barangay Captains assured full support in all project undertakings and cooperate with all activities related to the project.

(2) 1st Public Consultation Meetings

The 1st public consultation meetings were held in Noveleta, Kawit, General Trias and Rosario. The meetings were designed to inform the Project Affected Families (PAFs) with respect to the LARRIPP of the DPWH as per RA 8974, and other topics including: (i) the concept and objective of the project; (ii) definition of severe and marginal impacts; (iii) importance of tagging the structures to be affected; (iv) the need to photograph the PAFs, together with the structures and improvements to be affected; (v) conduct of census and socio-economic survey of PAFs; and (vi) the cut-off date.

There were 397 participants, of which 219 were female and 178 were male. The main opinions from the participants in each public consultation are summarized as follows.

- Noveleta: there were opinions mainly expressed about the alignment of diversion channel, compensation policies for affected people including informal settlers, project contents/schedule, function and effect of the retarding basins, the influence of the structures inside the rivers on the flood.
- Kawit: there were opinions mainly expressed about the scale of river improvement project, impacts on the neighboring roads, impact on the residence along the river, valuation policies for the affected land and structures.
- General Trias: there were opinions mainly expressed about the problem of traffic congestion during construction, subjects to compensation such as land and structures.
- Rosario: there were opinions mainly expressed about compensation policies for affected people, the scale of diversion channel, extent of the project affected area, sentiments of residents on the current residence, suggestions for dredging in the rivers rather than the project, consideration for formal settlers and facilitation of resettlement of informal settlers, valuation policies for the affected land and structures, the influence of the structures inside the rivers on the flood, concern for land acquisition and resettlement.

(3) 2nd Public Consultation Meetings

The 2nd public consultation meetings were held in General Trias, Kawit, Rosario, and Noveleta municipalities. In the public consultation meetings, DPWH presented the history of the flood occurrence situation in Cavite Province, the flooding simulation model based on a 10-year hydrological data, maps showing areas affected by the previous flooding as well as damages to life and property. DPWH also explained the project components proposed as the flood countermeasure project, the possible affected areas and structures, the project implementation schedule, and the estimated project cost. DPWH also explained the procedures/policies of land acquisition, resettlement, and compensation for assets affected by the project, the legal framework of land acquisition and resettlement. The resettlement activities and schedules were also discussed.

In Noveleta, the chief staff of the municipality stated that: this project is still under the study and in the preparatory stage; the project will start on 2020; the Mayor of Noveleta and DPWH agreed that all informal families will be moved to a resettlement site and provided houses with rights and titles before the project starts; the informal families will not be informal; the resettlement site will be developed in Noveleta.

There were 252 participants, of which 103 were female and 149 were male. The main opinions from the participants in each public consultation are summarized as follows.

- General Trias: there were opinions mainly expressed about suggestions for cleaning garbage and dredging in the rivers rather than the river widening as not to involve land acquisition and resettlement, concerns about the existing structures in the rivers, compensation policies.
- Kawit: there were opinions mainly expressed about Antel subdivision area extends into Ylang-Ylang River, neighboring area such as within the barangay was preferable in the case of resettlement. On the other hand, a resident representative of Barangay San Sebastian on the right bank of Ylang-Ylang River delivered DPWH a letter signed by the residents stating their requirements on the project. The representative did not participate in the meeting and recommended not to push through with the planned river widening. Instead, he suggested to dredge the bay area in Kawit.
- Rosario: there were opinions mainly expressed about suggestions for cleaning garbage and dredging in the rivers rather than the river widening as not to involve land acquisition and resettlement, concern for land acquisition and resettlement, and sentiments of residents on the current residence.
- Noveleta: there were opinions mainly expressed about the reasons and concerns on the large scale (area) and the alignment of the diversion channel, necessity of environmental approval from DENR, suggestions for cleaning garbage and dredging in the rivers, concern about the influence of the structures inside the rivers on the flood, concern on the capacity of the rivers

to drain rainwater, development control in the upstream area, more consideration to the formal residents.

(4) 3rd Public Consultation Meeting

Based on the major comments raised in the 2nd Public Consultation Meeting, DPWH has decided that the formal settler families, who are affected by the project, will be entitled to have the supplementary option for compensation by land swapping in the vicinity of their present dwellings. Hence, the 3rd Public Consultation Meeting was held in order to explain to and discuss with the formal settler families about the land swapping. Moreover, the agenda on the graves, which are to be affected by the project, had not been raised in the former 1st and 2nd Public Consultation Meetings, and discussed in the 3rd Public Consultation Meetings.

Regarding the relocation of graves, it was explained that DPWH as the project implementer will acquire the open space of the adjacent private cemetery at the market price for the relocation of graves; the relocation site will be transferred to the municipal cemetery and the graves will be managed by Noveleta municipality after the relocation; and the owners of graves will receive the grave yards for free and the compensation to transfer and rebuild the graves. The objective participants of the 3rd Public Consultation Meeting were addressed to residents from Municipalities of Noveleta, General Trias, and Rosario in particular, who questioned about the project implementation.

There were 57 participants, of which 25 were female and 32 were male. The principal opinions, suggestions and comments given in the 3rd Public Consultation Meeting were about the schedules of the project implementation, the hydraulic effects of San Juan Diversion Channel, and the requirement of disclosure of the study reports related to the project. Moreover, the participants commented that the supplementary option for compensation by the land swapping raised by DPWH will be verified after the definite location of the resettlement site is confirmed.

(5) Further Public Consultation Meetings

Since there were households who did not receive the announcement of 3rd public consultation meeting (the households who were mainly affected by the construction of bridge over the diversion channel), the 4th public consultation meeting will be held. After that, as necessary, DPWH will explain the affected persons and make efforts to promote understanding of project implementation.

19. EVALUATION OF PRIORITY PROJECT

19.1 Economic Viability of the Project

The economic viability of the priority project is made on two (2) components of the structural priority projects, namely: "(1) San Juan River Flood Mitigation Project at First Development Stage" and "(2) Malimango Creek Storm Water Drainage Improvement". As for the non-structural priority projects, however, the economic evaluation was not made, because their economic benefits are intangible and further, both of their economic benefits and economic costs are extremely small as compared with those of the structural priority projects, which lead to little meaning of the economic evaluation.

The Economic Internal Rate of Return (EIRR) of the San Juan River Flood Mitigation and the Maalimango Creek Storm Water Drainage Improvement Project are estimated at 20.3% and 15.1%, respectively as shown in Table 19.1. The EIRR of the priority project as a whole is further estimated at 19.2 %. Thus, the priority projects have the EIRRs of more than the Shadow Discount Rate of 15% guided in the ICC Project Evaluation Procedures and Guidelines by NEDA and therefore their economic viabilities are verified.

Table 19.1 EIRR of Priority Project

Project Component	EIRR	NPV (mil. pesos))	B/C*
San Juan River Flood Mitigation Project	Not disclosed		
Maalimango Creek Drainage Improvement Project			
Priority Project as a Whole			

* Note: Subject to discount rate of 15%
Source; JICA Study Team

19.2 Social and Natural Environmental Impacts by the Project

As described in the foregoing 18.1, the results of scoping in the EIA show that the structural measures for the priority project would not cause any significant negative impact (the rating of "A-") to the natural environment taking the present conditions of the objective area and adaptation of the eligible mitigation measures for the negative impact into account. The non-structural measures selected as the priority project are also evaluated to cause the little physical impact to the natural environment.

On the other hand, the structural measures for the priority project would cause the significant negative impact (the rating of "A-") to the social environment, especially in the aspect of the involuntary resettlement. According to the results of the questionnaire survey on the social impact, the projected affected families (PAFs) who answered to agree or conditionally agree the resettlement, are counted as 357 units corresponding to 44% of the total number of PAFs (807 families) as shown in Table 19.2. On the other hand, the PAFs, who showed negative response on the resettlement or refusal to respond the questionnaire survey itself, are 242 families, about 30% of the total PAFs. Thus a substantial number of PAFs are deemed to hardly agree the resettlement caused by the Project.

Table 19.2 Perceptions of Project Affected Families on Resettlement

(Unit: families)

City/Municipality	Agree/conditionally agree	Not agree	Refused to questionnaire	Not decided	Total
Noveleta	227	108	68	111	514
	44%	21%	13%	22%	100%
Rosario	31	0	15	59	105
	30%	0%	14%	56%	100%
General Trias	81	34	7	44	159
	51%	21%	4%	28%	104%
Kawit	17	10	0	1	28
	61%	36%	0%	4%	100%
Imus	1	0	0	0	1
	100%	0%	0%	0%	100%
Total	357	152	90	215	814
	44%	19%	11%	26%	100%

Note: The blank answeres in thr questionnaire were not counted into the above figures..
Source; JICA Study Teans

Reconsideration of the PAFs on negative perception to the resettlement would be the key issue to attain the successful project implementation and the utmost efforts to obtain the PAFs' agreement on the Project, have to be made taking the following conditions into account:

(1) The Municipality of Noveleta has had a commitment to provide the house/lot for the project affected informal setter families (ISFs) within its administrative boundary. The Cavite Provincial Government also agreed to accommodate the ISFs in other four (4) municipalities (i.e., Rosario, General Trias, Kawit, and Imus) into the vacant lots at existing resettlement sites, which are administrated by the Cavite Provincial Government in Kawit. The relevant municipalities are required to make their utmost effort to meet the ISFs' request on the living conditions of the new resettlement sites and support on the livelihood rehabilitation. At the same time, the municipalities have to make the close coordination with DPWH and Provincial Government to attain the requirements of the ISFs on their resettlement.

(2) The formal settles are entitled, in principle, to take the cash compensation for loss of entire land at the current market value and house at 100% replacement cost. In stead of the cash compensation, however, the land swapping would have to be adopted as the eligible measure for compensation of the loss of house and lot taking the following conditions into account:

- A rather large number of the formal settlers are deemed to wish to maintain their present living conditions being provided with the new house and lot near the present residence.
- There still remains the rather extensive unused land around the sites of the flood diversion channels, the river channel sections, and other project facilities.

(3) The potential resettlement sites are located adjacent to the proposed San Juan Diversion Channel and Maalimango Diversion Channel I. The excavation volume of these diversion channels is estimated at about 1.4 million m^3. Hence, there is an advantage to utilize the excavation volume for development of the potential resettlement area.

19.3 Project Viability from Technical Viewpoint

The structural measures for the priority project consist of the river channel improvement and construction of diversion channels. Construction of all of these measures has been well experienced in Philippines and therefore, any difficulties in construction are not foreseeable. However, there are the technical issues on the detailed design and the operation and maintenance for the San Juan Diversion Channel. Moreover, in connection with the ordinance for construction of the on-site flood regulation pond proposed as one of the non-structural flood mitigation measures in the Study, the spread of the construction technology in Philippines would be one of the important issues. The definitive contents of the above technical issues on the structural and non-structural flood mitigation measures are further described hereinafter:

(1) Issue on Detailed Design of San Juan Diversion Channel

The fixed weir at the diversion point to San Juan Diversion Channel is proposed, in the Study, as the structure to control the necessary diversion discharge. The structural dimensions of the weir are preliminarily estimated based on the hydraulic calculation with referring to the results of previous relevant hydraulic model tests. The hydraulic model test would be, however, required in the following detailed design stage in order to finally determine the structural dimensions of the weir considering the rather complicated river flow conditions just upstream of the diversion channel

(2) Issue on Operation and Maintenance for Estuary of San Jun Diversion Channel

There exists a small creek around the estuary of the proposed San Juan Diversion Channel and, the sandbar tends to be developed at the estuary of the creek during a dry season. In spite of development of sandbar, however, the existing creek keeps the minimum waterway with the bottom level of about EL. -2m above MSL even during a dry season. Such preservation of the waterway could be attributed to the current of waterway caused by a tidal range and the less volume of sand-drift. Taking these conditions into account, the estuary of San Juan Diversion Channel could continue to be opened throughout a year even without construction of particular structures such as jetty to keep open of the river mouth. However, the estuary conditions of San Juan Diversion Channel have to be monitored after completion of the Channel. Depending on the results of monitoring, the maintenance dredging around the estuary may be required.

(3) Issue on Construction of On-site Flood Regulation Pond

One of the important non-structural flood mitigation measures for priority project is addressed to the enactment of an ordinance that obligates the land developers to construct an on-site flood regulation pond at the down stream end of the new subdivision developed by them. The on-site flood regulation pond functions to control the increment of the peak flood runoff discharge from the subdivision.

However, actual construction of the on-site flood regulation pond has not been experienced yet in Philippines. By contrast, there are many precedents of actual construction of the on-site flood regulation pond in Japan. Hence, the model construction of the on-site flood regulation pond is recommended on the premises of the technical support by the Japanese Engineer and, the technologies for design and construction of the on-site flood regulation pond should be spreaded over Philippines based on the model construction.

19.4 Overall Evaluation

The priority projects for structural measure are evaluated to be economically viable having their economic internal rate of return (EIRR) over the SDR of 15% recommended by NEDA in ICC Project Evaluation Procedures and Guidelines. Moreover, any fatal issues are not foreseeable in the aspects of the project's negative impacts to the natural environment and the technologies required to implementation of the project.

The present oppositions of the project affected families against the resettlement requited to the project could be the potential hindrance for the project implementation Nevertheless, the issues of resettlement are expected to be solved through straightforward consensus building among DPWH as the project proponent, the relevant LGUs, and all other agencies relevant to the project.

19.5 Operation and Effect Indicators

19.5.1 Definition of Indicators

The indicators are defined as described in the following items (1) and (2):

(1) Operation Indicator: The indicator is used to measure whether or not the project facilities are appropriately operated, maintained, and managed.

(2) Effect Indicators: The indicator is used to measure the effects brought about by the project facilities to the objective project area.

The priority project consists of (a) the river flood mitigation project for San Juan River Basin with the design scale of 1/25years flood frequency and (b) the storm water drainage improvement project for Maalimango Creek Drainage Area with the design scale of 1/15 years flood frequency. In this Chapter, the specific operation indicators and effect indicators for the facilities of the priority projects are as described hereinafter.

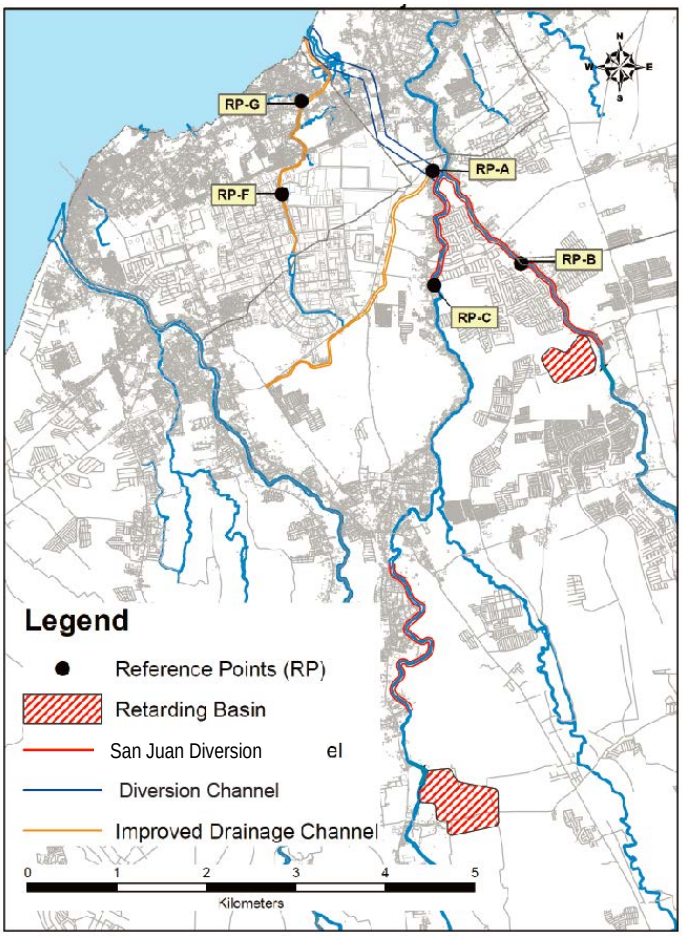


Figure 19.1 Objective Project Facilities of Operation Indicator

19.5.2 Proposed Operation Indicators

The facilities to be constructed under the priority project include the improved river channel, the diversion for San Juan River and the improved drainage channel for Maalimango Creek Drainage Area. The operation indicators are proposed for the said river channel improvement, diversion and the drainage channel improvement.

As for the operation indicators for the improved river channel and diversion, the monitored highest channel water level together with the basin average rainfall monitored at the time of the highest water level is proposed taking the following conditions into account:

(1) The operation indicators generally used to measure the functions of project facilities are (a) the channel flow capacity, (b) the annual maximum channel flow discharge, (c) the annual highest channel water level and (d) the basin average rainfall to be monitored within the project work section.

(2) Of the above indicators, the channel flow capacity would be the most direct indicator to measure the updated function of the improved/newly constructed channels. However, it is difficult to monitor the channel flow capacity, since the river channel survey from the river mouth up to the reference point has to be carried out at least once a year. The monitoring of the annual maximum channel flow discharge also requires the channel cross-sectional survey at the reference point at least once a year. However, such monitoring of the annual maximum channel flow discharge would not be necessarily required to measure the proposed flood mitigation facilities, as long as the annual maximum channel water level at reference point is monitored

(3) For the above reason, the highest channel water level is recommended as the indicator to measure the updated function of the improved/newly constructed channels. The basin average rainfall monitored at the time of the highest channel water level is also proposed as the secondary operation indicators to estimate the recurrence probability of the highest channel water level.

The reference points to monitor the above annual highest channel water levels are proposed as shown in Table 19.3 and Figure 19.1. The annual highest channel water levels at these reference points are used to measure the function of the San Jun Diversion Channel as well as the flow capacity of the river channel sections of Ylang-Ylang River and Rio Grande River. The basin average rainfall is also monitored based on the data given from the nine (9) existing rainfall gauging stations in and around the Study Area.

In addition to the operation indicators for the river channel improvement and diversion channel, the operation indicators for the improved drainage channels are proposed as shown in Figure 19.1 and Table 19.4.

Table 19.3 Reference Point as Operation Indicator for Monitoring Highest Channel Water Level

Code of Reference Point	Location of Reference Point	Context of Selection of Reference Points
Reference Point RP-A	The upstream of San Juan Diversion Weir	The maximum overflow depth above the diversion weir at the upstream end of the diversion channel is recorded based on the annual highest water level at the reference point so as to evaluate the diversion function of the weir.
Reference Point RP-B	Bridge crossing Ylang-Ylang River 1km upstream from the confluence of Ylang-Ylang River and Rio Grande River	The annual highest channel water level is monitored at the existing bridge of Ylang-Ylang River located about 1km upstream from the junction with San Juan River so as to evaluate the channel flow capacity of the channel improvement sections of Ylang-Ylang River.
Reference Point RP-C	Toclong-San-Sebastian Bridge crossing over Rio Grande River	The annual highest channel water level is monitored at the existing bridge of Rio Grande River located about 1.2km upstream from the junction with San Juan River so as to evaluate the channel flow capacity of the channel improvement sections of Rio Grande River. River.

Source: JICA Study Team

Table 19.4 Operation Indicators for Improved Drainage Channel

Operation Indicator	Reference Point	Reasons for Selecting the Reference Point
- The annual highest channel water level and its occurrence time - The tidal level at the time of occurrence of the above highest channel water level. - The 6-hour water level intensity at the time of occurrence of the above highest channel water level.	- The water level of the improved drainage channel is monitored at the Reference Points of RP-F and RP-G shown in Figure 19.1.	- The flow discharge of the improved drainage channel is hardly monitored due to the tidal influence at the river mouth. - For this reason, the safe water level of the improved drainage channel is to be confirmed through monitoring of the highest channel water level. - The tidal level at the occurrence of the above highest channel water level is to be recorded in order to know the tidal influence to the channel water level. The tidal level is given from the tide table. - The recurrence probability of the annual highest channel water level is evaluated based on the record of rainfall intensities gauged at Sangley Point.

Source: JICA Study Team

19.5.3 Effect Indicators

The effect indicators of the project facilities for flood mitigation are generally expressed by (a) the annual widest flood inundation area, (b) the annual maximum number of flooded houses, (c) the annual number of occurrences of flood damage, and/or (d) the annual largest flood damage amount. These indicators are to be added up and made public by the Local Disaster Risk Reduction and Management Office (LDRRMO). However, the extent of the flood inundation and the flood damage amount are usually estimated through adding up of the approximate figures given from the relevant various entities. Therefore, the exact figures of amount are hardly obtained.

On the other hand, the number of flooded houses, occurrences of flood in a year and evacuees to the shelter are estimated based on the actual counting by the competent agencies and therefore deemed to be rather reliable. From these points of view, these are proposed as the effect indicators, and the extent of flood inundation and the amount of the flood damages are to be used as the reference values.

20. PLAN FOR PROJECT IMPLEMENTATION

20.1 Setup for Operation and Maintenance of the Facilities for Priority Project

The ownership of the constructed infrastructure facility in the flood management sector is basically retained by DPWH even after construction since DPWH is the only affordable department for O&M of a large-scale infrastructure project. The responsibility of O&M of the constructed facilities is to be imposed to the Cavite 1st DEO of DPWH which has the jurisdiction over the whole Study Area.

As determined in the DPWH Department Order (DPWH DO. No. 24, S. 2007 and No. 15, S. 2015), the DEO is obliged to make an inspection of facilities after the natural disaster, and report the damages to the DPWH-BOM through the DPWH Regional Engineering Office (Region IV-A). Due to the Department Order, however, the DEO could only manage the infrastructure work of project amounting to less than 20 million pesos, and any project costing over 20 million pesos would be under a responsibility of the Regional Engineering Office. When they found damages on the facilities, the rehabilitation budget will be prepared in the following ways.

(1) Small Scale Rehabilitation Work

In case the damaged scale is subtle, DEO could obtain a fund from their annual budget for O&M. In addition, LGUs or Cavite Province have their own budget of Development Fund, and it could be used for rehabilitation. Since these budgeting processes are simpler and quicker, this process would be chosen by stakeholders after discussion.

(2) Large Scale Rehabilitation Work

In case the facility was largely damaged by natural disaster, DEO could obtain a budget for rehabilitation from either "(a) QRF allocated to DPWH" or "(b) DPWH annual budget of next fiscal year" based on its prioritization of rehabilitation work. In case the damaged facility is categorized as "Priority 1" which causes huge economic loss on the society and needs immediate rehabilitation, the fund would be obtained from QRF which has been already disbursed to DPWH. The lower priority rehabilitation projects (Priorities 2 and 3) will be postponed to be implemented in the succeeding fiscal year by the normal annual budgeting process.

In addition to the above two funding ways in DPWH, local governments as well as DEO are entitled to apply for the release of NDRRMF which is coordinated by OCD. In this case, the request needs to be approved by OCD, NDRRMC and the President of the Philippines. The funding process of NDRRMF from application to disbursement would take a longer time through its complex procedure than preparing the budget of QRF in DPWH. From the undertaken interviews to stakeholders, it became clear that the administrative processes of obtaining budget for rehabilitation are not organized at present, and stakeholders tend to make administrative processes separately. During the O&M phase of the project, such budgeting

information should be shared among FMC members to avoid duplication and make effective responding works.

20.2 Procurement Method

The civil construction works of the project involve diversion channel with quality control in a short construction period and Hat-type and H-shaped Combined Steel Sheet Pile which is relatively new in the Philippines. Other river improvement and drainage improvement mainly consist of earthworks and concrete protection works.

In order to complete the project effectively referring to the size of the project and technical level of the works, the project is divided into the following five (5) packages considering the cost of civil works, layout of the structures, traffic and so on. Package No. 1 will be under international competitive bidding and the others will be under local competitive bidding.

Table 20.1 Packaging for Work of Priority Project

Package No.	Project Components to be Included in the Package
Package No. 1	- Construction of San Juan Diversion Channel and Maalimango Diversion-I
Package No. 2	- Rio Grande River Improvement
Package No. 3	- Ylang-Ylang River Improvement
Package No. 4	- Construction of Maalimango Diversion-II and Improvement of Maalimango Creek
Package No. 5	- Development of Resettlement Site

Source: JICA Study Team

An international engineering consultancy firm associated with local engineering groups will be procured and engaged to provide consulting services in terms of the provision of the detailed design, construction supervision services, and formulation of non-structural measures to DPWH.

20.3 Implementation Schedule

The implementation schedule is shown in Figure 20.1. The consultant will be procured and the detailed design will be done during 2018 to 2020. During the detailed design, preparation of tender will be started in 2019 and the construction will be completed in 2024. Land acquisition and relocation will be undertaken in 2019 and 2021.

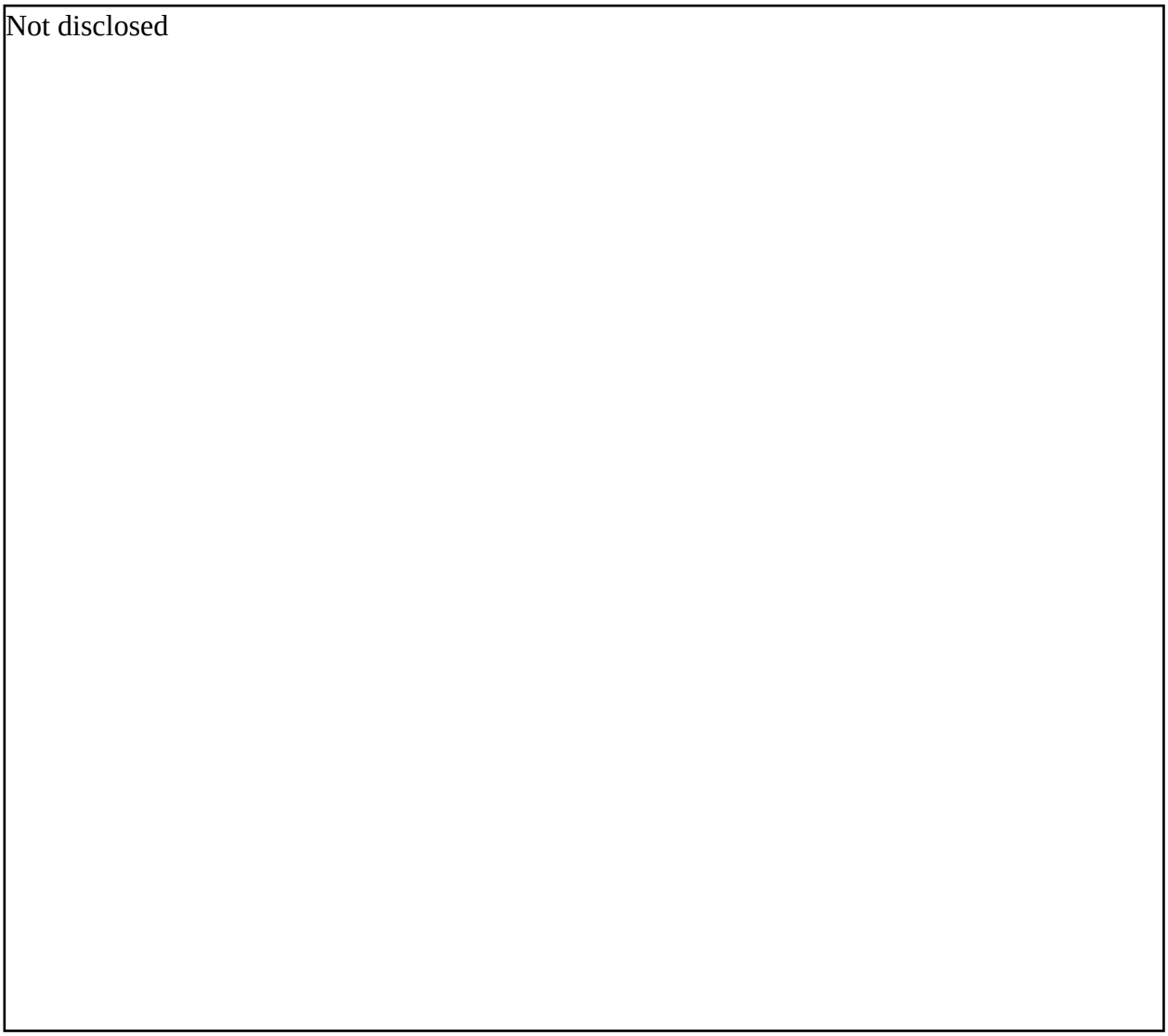


Figure 20.1 Implementation Schedule of Priority Project

20.4 Fundin/Financing

The total cost required for the priority project is shown in Table 20.2 categorizing the foreign currency portion and the local currency portion, then a loan portion and the Philippine government fund portion assuming that this project is going to be implemented as a loan-aid project.

The amount required for the priority project is estimated at billion pesos in total, which is divided into billion Philippines Peso in foreign currency portion and billion Philippines Peso in local currency portion. The loan target amount is also estimated at billion Philippines Peso in total, which is divided into billion pesos in foreign currency portion and billion Philippines Peso in local currency portion.

Table 20.2 Project Cost for Priority Project

Breakdown of Cost	Foreign Currency Portion (million PHP)			Local Currency Portion (million PHP)			Total (million PHP)		
	Total	ODA Portion	GOP Funds	Total	ODA Portion	GOP Funds	Total	JICA Portion	GOP Funds
Package 1: San Juan Diversion Channel + Maalimango Diversion-I									
Package 2: Rio Grande River Improvement									
Package 3: Ylang-Ylang River Improvement									
Package 4: Maalimango Creek + Maalimango Diversion-II									
Package 5: Resettlement Site Development									
Price Escalation									
Physical Contingency									
Engineering Services									
Land Acquisition									
Administration Cost									
VAT									
Import Tax									
Interest during Construction									
Front End Fee									
Total									

Source: JICA Study Team

20.5 Consulting Services

The contents of Draft TOR for Consulting Services are as listed below and the full description of the documents is compiled in Appendix 7 in Vol. 4.

CHAPTER 1. BACKGROUND
CHAPTER 2. OBJECTIVES OF CONSULTING SERVICES
CHAPTER 3. SCOPE OF CONSULTING SERVICES
- 3.1 Detailed Design Phase
  - 3.1.1 Detailed Design
  - 3.1.2 Additional Study Regarding Environmental Considerations
  - 3.1.3 Review and Implementation of Resettlement Action Plan (RAP)
  - 3.1.4 Study on Non-Structural Measures

21. PLAN FOR DISASTER RISK REDUCTION AND MANAGEMENT

21.1 Necessity of Disaster Risk Reduction and Management Plan for the Study Area

The Study Area has suffered from serious natural disasters especially by river over flow which has caused the complete collapse of houses and/or death calamities in almost every two years (refer to Table 2.2). In order to mitigate such serious risk by floods, the Study proposes the combination of structural and non-structural flood mitigation measures to attain the target design level of 1/25 years flood frequency by 2026 and 1/50 years flood frequency by 2030. Flood is, however, a natural phenomenon and there is always the risk of occurrence of unexpected large scale floods. Therefore, it is virtually difficult to completely remove the natural disaster risk through any flood mitigation measure. Hence, it is indispensable to make an utmost effort to minimize the possible flood damages and prepare definitive measures for rehabilitation and recovery against the disasters brought about by flood.

21.2 Ongoing Disaster Risk Management in thePhilippines

21.2.1 Legal Framework for Disaster Risk Management

The legal framework related to the institutional setup and budgetary arrangement for disaster risk reduction and management (hereinafter referred to as “DRRM) in Philippines was established through the enactment of DRRM Act No. 10121 in 2010. The major contents of the act are as summarized below.

Table 21.1 Legal Framework of the Philippine DRRM Act No. 10121

Item	Contents
- Overall Mission	- The relevant agencies in the Philippines have to prepare the policy and action plan to ensure the eligible organizational, institutional and budgetary set up for the DRRM against all possible kinds of disaster including flood, typhoon, earthquake, tsunami, and volcanic eruption in the Philippines.
- Organizational Framework	- The National Disaster Risk Reduction and Management Council (NDRRMC) is to be organized as the highest decision organ for the DRRM in the Philippines. - The Local Disaster Risk Reduction and Management Office (LDRRMO) is to be established as the execution body for the DRRM at each level of region, province, city/municipality and barangay.
- Institutional Framework	- The NDRRMC has to formulate the National Disaster .Risk Reduction and Management Plan (NDRRMP) in order to set up the comprehensive national policy for the DRRM. - Based on the NDRRMP, the LDRRMO has to formulate the Local Disaster .Risk Reduction and Management Plan (LDRRMP) and undertake the necessary actions for the DRRM. - Both of the NDRRMP and LDRRMP have to cover the four (4) categories of; (a) disaster prevention and mitigation measures, (b) disaster preparedness, (c) disaster response, and (d) disaster rehabilitation and recovery. - Both of the NDRRMP and LDRRMP have to be reviewed and updated every five (5) years.
- Budgetary Framework	- The necessary expenditures for the DRRM are to be budgeted from the National Disaster Risk Reduction and Management Fund (NRRNF), the National Quick Response Fund (QRF) and the Local Disaster Risk Reduction and Management Fund (LDRRMF) (refer to Section 12.2).

Source: JICA Study Team

The review on the above Act No. 10121 has been made since 2006. Upon completion of the review works, the fundamental act called "Revised Philippine Disaster Risk Reduction and Management Act of 2016" is to be enacted. The principal concepts contemplated from the review works are as enumerated below:

(1) To establish the National Disaster Risk Reduction and Management Authority (hereinafter referred to as NDRRMA), which would have jurisdiction of DRRM at the level of central government ministry and/or agency; and

(2) To arrange the following organization units, which would undertake the definite project management, financial management, and capacity development relevant to DRRM:

- National Disaster Risk Reduction and Management Secretariat and Operation Center and
- Disaster Risk Reduction and Management Information System.

(3) To handover all authorities and functions relevant to DRRM from the existing Office of Civil Defense (OCD) to the NDRRMA within one year after completion of review on the Act No. 10121[10].

(4) The present NDRRMC will continue to exist with the President to be the chairperson. However, the secretariat of the NDRRMC will be shifted from OCD to the National Disaster Risk Reduction and Management Secretariat and Operation Center which is a part of NDRRMA.

21.2.2 Ongoing Activities for Financial Disaster Risk Management in the Philippines

The disaster rehabilitation and recovery in particular requires an adequate budget immediately after occurrence of the disaster. From this point of view, the various schemes for financial disaster risk management are being made in the Philippines as enumerated below:

(1) Trial operation of disaster insurance based on the Government Service Insurance System (GSIS) supported by the World Bank in order to strengthen the financial capacity of LGUs for disaster rehabilitation and recovery;

(2) Disaster risk management development policy loan with a catastrophe deferred drawdown option, (CAT-DDO) by the World Bank; and

(3) Post Disaster Standby Loan Project by JICA.

[10] The organization of OCD is planed to scale down through review of Act No. 10121. On the other hand, however, the number of staffs of OCD has increased since July 2016. Thus, the plan made in the review of Act No. 10121 is deemed to be still changeable.

21.2.3 Ongoing Effort for DRRM in the Study Area

The LGUs in the Study Area now execute the various efforts for DRRM as described hereinafter:

(1) Establishment of Local Disaster Risk Reduction and Management Office (LDRRMO) and Formulation of Disaster Risk Reduction and Management Plan (DRRMP)

All of the LGUs relevant to the Study Area (i.e., 12 cities/municipalities in Cavite Province) have established their own LDRRMO, which have jurisdiction over the DRRM. Moreover, four (4) cities/municipalities (i.e., Trece Martires City, General Trias Municipality, Tanza Municipality, and Indang Municipality) have formulated the Contingency Plan as a part of LDRRMP setting the definite flood warning and evacuation rules. They also open the information to the residents to prevent from the disaster risk of flood through distributing of disaster prevention hand books and pamphlets.

(2) Budgetary Arrangement for DRRM

The amounts of local disaster risk reduction and management fund (LDRRMF) secured in 2014 were 135 million pesos for Cavite Provincial Government and 199 million pesos for 12 cities/municipalities in total. Most of them were, however, allocated only for procurement of equipment such as lifeboats and/or personnel expenses and not generally used for the recovery/ reconstruction.

(3) Notable Ongoing Activities related to DRRM in the Study Area

The following are enumerated as the notable ongoing activities related to DRRM in the Study Area:

(a) Development of Flood Monitoring System

The Provincial Disaster Risk Management Office called « “Cavite Rescuer 161” together with five (5) real-time gauging stations each for water level and rainfall was established in Imus City in 2014 through the GMMA Ready Project by UNDP.

(b) Campaign for Enlightenment for Flood Warning and Evacuation

The campaign for enlightenment for flood warning and evacuation is being undertaken twice to ten times in a month in the five (5) cities/municipalities (i.e., Bacoor City, Imus City, Trece Martires City, Dasmarinas City, and Noveleta Municipality).

(c) Establishment of Flood Mitigation Committee (FMC)

The FMC for management of flood disaster risk was established in September 2014 through implementation of FRIMP-CTI. The FMC together with the LDRRMO will start the activities relevant to DRRM such as control of illegal housing/land development in the river area, survey on the flood damages, and proposing of the recovery/reconstruction after disaster. The FMC will be organized by the Provincial Governor as the chairperson,

the representative from DPWH as the vice-chairperson and members including three (3) departments of Provincial Government (the Civil Engineering and Construction Department, Plan and Development Department, and LDRRMO), and the representatives from Imus City, Bacoor City and Kawit Municipality.

21.3 Proposed Plan for Improvement of DRRM

21.3.1 Plan for Improvement of Disaster Prevention and Mitigation

The following plans are proposed in the Study on the premise of unexpected large scale floods and issues on the present practices for disaster prevention and mitigation works in the Study Area.

Table 21.2 Proposed Plan for Improvement of Disaster Prevention and Mitigation

Theme	Issues	Proposed Plan for Improvement
Structural Measures	- Excessively tall flood walls exist in the Study Area having the high risk of failure in case of overflow which leads to devastating damage. - Some of the land developers have constructed river dikes and filled up the land along the river without permission of the competent authority leading to the increase of flood risk at the opposite shore. - There exist 53 irrigation dams and headworks in the Study Area. Most of them are deteriorated causing serious damages at the aprons and dam bodies.	- To set the flood levees not to largely exceed the hinterland ground level. - To strengthen the control on unauthorized river structures constructed by land developers - To develop the database on river structures and effectively use it for maintenance of the river structures. - To conduct field investigation and strength test for the existing irrigation dams and headworks and make repair works and removal as required.
Non-structural Measures	- Difficulties in securing the right-of-way for flood control facilities tend to be more prominent due to the ongoing rapid and extensive land development of subdivisions in the Study Area. - There are many dwellers in the high flood risk area. - Information on the land use conditions in the river area is very scarce leading to difficulties in properly managing the river area.	- To secure the land as the right-of-way of the river structures through the effective use of the database on the dwellers and land uses in the river area. - To set the easement for the proposed construction site of the flood diversion channel and flood retarding basins. - To designate the non-built-up area in the CLUP prepared by the City/Municipality and the Provincial Government. - To prevent encroachment into the flood risk area, especially for the area of about 4.5 ha along the downstream section of Canas River from river mouth to about 700 m upstream.

Source: JICA Study Team

21.3.2 Advance Disaster Preparedness

The Government of the Philippines is deemed to emphasize the necessity of advance disaster preparedness. Such advance disaster preparedness is important and many improvements are considered as summarized below:

Table 21.3 Plan for Improvement of Disaster Preparedness

Theme	Issue	Proposed Plan for Improvement
Degradation of Flood Safety Level by the Expansion of Urban Area	- The urban area intensively expands leading to the decrease of basin flood retention capacity and increase of disaster risk by floods.	- The Cavite Provincial Government in collaboration with the cities/municipalities should set the concept of future ideal state of urbanization of Cavite Province as a whole taking disaster risks into account. - The CLUP prepared by each of the cities and municipalities should be reviewed based on the above concept. - The draft of "Ordinance for Urban Growth Management" proposed in the JICA Study 2009 should be made effective. - The draft of "Ordinance for Flood Regulation Pond" proposed in the JICA Study 2009 should be made effective.
Degradation of Flood Safety Level by Climate Change	- Disaster risk by flood will increase due to climate change.	- To designate the flood risk area and accelerate the resettlement of dwellers within the area. - To reinforce the flood warning and evacuation system being directed at climate change. - To spread rainfall storage and infiltration facilities in accordance with the increment of rainfall intensity brought about by climate changes. - To monitor the long-term climate changes and share the monitoring results among the relevant agencies.
Difficulties in Urgent Flood Warning and Evacuation (FEW)	- Information on the flood water levels are not adequately shared among the relevant cities and municipalities. - Some LDRROs in the Study Area still use the unreliable mobile phones for FEW - Less consideration is given in the FEW for those weak during disaster such as aged persons and physically handicapped persons. - Information on the evacuation routes and other necessary information for the emergency evacuation are not well shared among the residents.	- The Provincial Disaster Operation Center (PDOC) should undertake unified management of all flood information. - Communication devices among the LDRRMOs for FEW should be equipped with bi-directional radio communication system. - Counter plans should be prepared for the weak during disaster including the following: • To list up those weak during a disaster in each community. • To designate the eligible measures to convey the flood warning to those weak during disaster. • To designate the particular urgent shelters. • To have a periodical training on flood evacuation. - The flood hazard map should be distributed to the residents through the public notice boards at each of the barangays, schools, public hearings, periodical trainings for the FWB and any other possible opportunities. - The location of not only the flood evacuation centers but also hospitals, the major government buildings, schools and other important facilities used for emergency activities.
Insufficiency of Supply System for Relief Goods	Supply system for relief goods against long-term stoppage of lifeline has not been well prepared since the residents in the Study Area have not experienced unexpected large scale of flood.	The following preparedness should be made assuming the stoppage of lifeline caused by the unprecedented flood: - To make simulations on the possible risks in case of stoppage of the lifeline, - To prepare alternative sources and routes for the supply of relief goods. - To set up the base for agglomeration of the relief goods.

Theme	Issue	Proposed Plan for Improvement
Insufficiency of Business Continuation Management (BCM)	- The guideline on BCM for Cavite Economic Zone was prepared through the JICA Study in 2015. In spite of the JICA Study, the CEZ has not commenced any definite activity related to BCM. The JICA Study in 2015 prepared the guideline assuming unprecedented disasters including large scale of floods, tsunami, and earthquakes. On the other hand, the CEZ's perception on the BCM is based on the experienced flood disasters. For this reason, there would be a significant gap in perception on BCM between the JICA Study and CEZ.	The CEZ is the core of the industrial clusters in Cavite Province, and therefore, it would be important to prepare the advance disaster preparedness for BCM. From this point of view, the following activities directed to BCM are proposed assuming unprecedented flood disasters: - To formulate the Business Continuity Plan (BCP) assuming the long-term stoppage of power/water supply and blockade of transportation system. - To list down the imminent actions required for BCM in case of unprecedented disasters. To hold periodical meetings with the companies related to supply chains, clarify the potential risks, and prepare the counter plans against the blockade of supply chains.

Source: JICA Study Team

21.3.3 Disaster Rehabilitation and Recovery

The ongoing activities for disaster rehabilitation and recovery in the Study Area are reviewed and the contents as shown in Table 21.4 are proposed as the plan for improvement of the activities taking into account the extraordinary scale of the flood disaster in particular.

Table 21.4 Plan for Improvement of Disaster Rehabilitation and Recovery

Theme	Issue	Proposed Plan for Improvement
Long-Term Stay at Evacuation Shelter	Residents in the Study Area have experienced to stay at the evacuation shelter for a few days. However, the unprecedented disaster may possibly force longer stay at the shelter.	- To extend the participation of women in operation and management of the evacuation shelter ensuring the privacy and safety of women at the shelter and arranging the facilities with care of the gender. - To prepare counter plans for the aged and/or handicapped people such as the plan for arrangement of the shelters.
Execution of Rehabilitation and Recovery	It is necessary to recover the facilities and restore the regional community taking the lessons learned from the disaster.	- To develop the database on the condition of facilities damaged by disaster and actively use the information stored in the database for the forthcoming rehabilitation and recovery. - To make the new urban design including new zoning based on the lessons learned from the damaged areas. - To reflect the requirements and suggestions of the victims to the disaster rehabilitation and recovery. - To direct the disaster rehabilitation and recovery toward recovery of the livelihood of the victims and restoration of the community.
Risk Finance	The central and local governments hardly shoulder the full expenditure necessary for the disaster rehabilitation and recovery in case of large scale disasters.	Various risk finance system are being practiced in the Philippines. It is required to apply the sustainable risk finance system based on evaluation of the advantages/disadvantages of the risk financial system so as to complement the present QRF and LNRRDF especially in case of large scale disaster.

Source: JICA Study Team

22. STUDY ON MANAGEMENT OF DATABASE AND ASSET MANAGEMENT SYSTEM FOR FLOOD CONTROL AND DRAINAGE FACILITIES

22.1 Background, Present Condition, Problems and Issues

In order to conduct efficient and systematic maintenance and management of infrastructures developed by the DPWH, and to make efficient allocation and execution of the budget for maintenance and management of the infrastructures, the need for asset management have become higher. In relation to the development of database systems for the basis for asset management, the DPWH developed the GIS Database of roads and bridges along national roads called "Road and Bridge Information Application: RBIA" in 2014 with financial and technical assistance from the World Bank.

In terms of rivers, although there are high needs for developing a similar database system of asset management for river structures, no database system has been developed at present, and there is also a problem with the data of coordinates (latitude and longitude) of the river structures that do not exist. Hence, development of a database of river structures including information of coordinates is an issue. In addition, database including information of coordinates for dredging works does not exist either, so that development of a database of dredging works including information of coordinates is also an issue.

Furthermore, for River Management, not only management for river structures and dredging works, but also management of the entire stretch of the river is necessary. This includes conservation and maintenance of natural river channels and protection of the management zone (easement zone) along the rivers against building of illegal houses in the easement zones. However, river management has been insufficient until the present since there are problems of not setting the management zone (easement zone) along the rivers. Hence, developing the River Management System is an issue. The DPWH should be the leading agency taking the responsibility for River Management. Therefore, in the Study on the database for asset management related to the rivers, the viewpoint of the database for River Management was also taken into account.

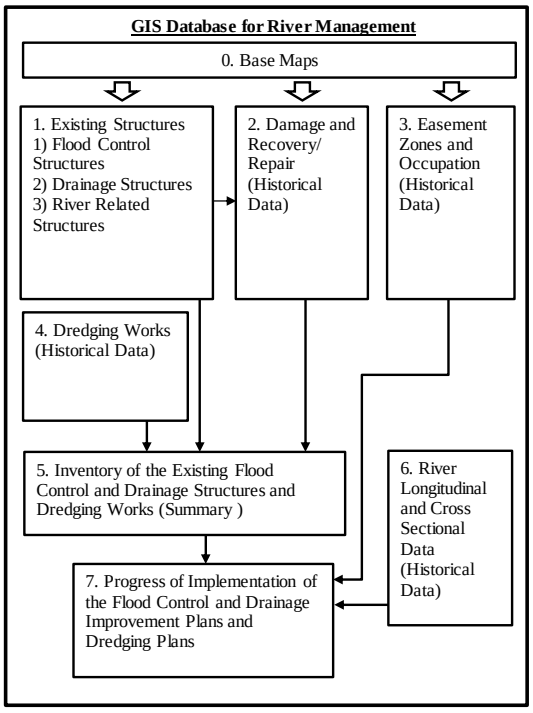
22.2 Proposal of Draft Standard Terms of Reference of the Database

22.2.1 Basic Concept for Developing the GIS Database for River Management

(1) The GIS Database of flood control and drainage structures shall be developed from the "River Management" point of view. Therefore, it is proposed to call the database as the "GIS Database for River Management".

(2) The GIS Database shall include the following data (refer to Figure 22.1):

a) Existing flood control structures, drainage structures and river related structures (bridges, water use dams and others);
b) Historical damage and recovery/repair of the flood control and drainage structures including natural banks causing adverse impacts to the surrounding areas such as damage to houses;
c) Easement zones and historical condition of occupation in the easement zones and in the river cross sections by informal settlers, etc.;
d) Historical data of dredging works;
e) Condition of river channels in terms of historical longitudinal and cross sectional data; and
f) Progress of implementation of the flood control and drainage improvement plans and dredging plans.



Source: JICA Study Team

Figure 22.1 Overall Structure of the Proposed GIS Database for River Management

(3) The GIS Database for River Management shall show not only inventory and corresponding layers, but also detailed information on the concerned flood control and drainage structures, damages and others by drawings, sketches and photographs with coordinates (latitude and longitude) under WGS84 (WGS: World Geodetic System) as an attribute data.

(4) The GIS Database for River Management shall keep compatibility with the existing GIS database such as the GIS Database of roads and bridges.

(5) The GIS Database for River Management shall be developed considering the possibility of future expansion to the GIS Database of Integrated Flood Risk Management (IFRM), Integrated Water Resources Management (IWRM) and Integrated River Basin Management (IRBM), acting as the core portion of these GIS Databases.

(6) The GIS Database for River Management shall be developed by considering user, cost, and sustainable management of the Database.

22.2.2 Technical Proposal of the GIS Database for River Management

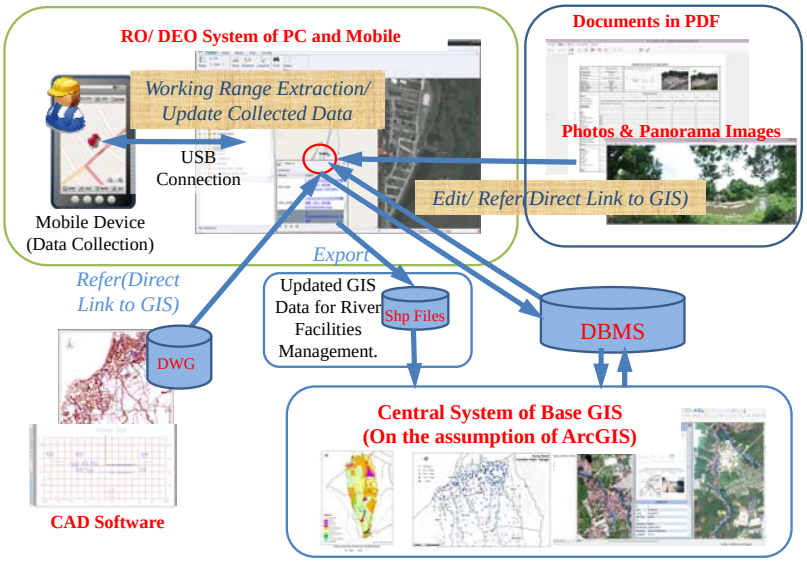
The following are the technical proposal of the GIS Database for River Management (refer to Figure 22.2).

(1) Basic GIS System: It is necessary for the selection of the Basic GIS System to consider compatibility with ArcGIS, adopted in the existing GIS database of roads and bridges of DPWH (RBIA). In addition, IMS stated that since it has already had the contract about licensing of ArcGIS with ESRI (Environmental Systems Research Institute, Inc.), the Basic GIS Software for "GIS Database for River Management" should be ArcGIS. Moreover, IMS is currently allocating ArcGIS to Regional Offices (ROs).

(2) Storage of the Huge Amount of Data: Considering to store the huge amount of data from all over the country, installation of separate Database Management System (DBMS) is required to store attributes and related data such as drawings (CAD files), photos, inventory data, and others.

(3) Input Various Types of Data: Considering necessary software for viewing data with various image files such as CAD files, photos, PDF, etc.

(4) Adoption of Mobile Function: To adopt mobile software for making efficient data input and viewing data at the sites, as well as for effective and timely utilization of Integrated Flood Risk Management Databases in the future.



Source: JICA Study Team

Figure 22.2 Proposed Configuration of GIS Database for River Management

23. CONSIDERATION FOR GENDER DIFFERENCES AND POVERTY REDUCTION

23.1 Introduction

The flood risk reduction and management is closely related to gender differences and poverty reduction as partially described in the foregoing Chapters such as: (a) Non-structural Flood Mitigation Projects in Chap 8, (b) Formulation of Resettlement Action Plan in Chap. 18, and (c) Plan for Disaster Risk Reduction and Management in Chap. 21. This Chapter integrates all aspects to be considered for gender differences and poverty reduction relevant to the flood risk disaster reduction and management including those already described in this Report.

23.2 Features of Households in the Flood Risk Area

23.2.1 Number of Households Resided by Female Family Head and/or Physically Handicapped Person

The interview survey was made on the living conditions and livelihoods of 236 households along the existing river/drainage/channels and/or within the project site for the proposed San Juan Diversion Channel. The houses of interviewees are deemed to be within the flood risk area and they may need to be relocated upon commencement of the priority flood mitigation project proposed in the Study.

As the results of interview survey, it is clarified that about 33% of the interviewees are the female family head and 8.1% support the physically handicapped person as shown in Table 23.1 and Table 23.2.

Table 23.1 Number of Households with Female Family Head among the Interviewees

Area of Intereview	Number of Total Households Interviewed	Number of Households of Female Head	
Along Downstream of Imus River	78	14	17.9%
Along Downstream of San Juan River	96	40	41.7%
Project Site of San Juan Diversion Channel	44	21	47.7%
Along Maalimango Creek	18	4	22.2%
Total	**236**	**79**	**33.5%**

Source: ICA Study Team

Table 23.2 Number of Households with Physically Handicapped Person among the Interviewees

Area of Intereview	Number of Total Households Interviewed	Number of Households with Physically Handicapped Person	
Along Downstream of Imus River	78	9	11.5%
Along Downstream of San Juan River	96	6	6.3%
Project Site of San Juan Diversion Channel	44	2	4.5%
Along Maalimango Creek	18	2	11.1%
Total	**236**	**19**	**8.1%**

Note: Physically handicapped person includes blind personnel, personnel, hearing-impaired person, speech impaired person and/or cognitively impaired person.
Source: JICA Study Team

23.2.2 Average Monthly Income and Occupation of Household

According to the Socio-Economic and Physical Profile 2014 for Cavite Province, the average monthly income per household in the Province is 23,551pesos/household/month, and the number of households, whose monthly income is below the poverty line of 7,400persons/household/month, is limited to 26,088 households, which corresponds to 4.5% of the provincial total households. On the other hand, the average monthly income of the interviewed households is 8.296 pesos/household/month. Moreover, out of the interviewees of 236households, 103 households (44%) have the monthly income below 5,000 pesos as shown in Table 23.3

Table 23.3 Average Monthly Income of Household among the Interviewees

Area of Intereview	Number of Total Households Interviewed	Ave. Monthly Income of One Household (pesos/household/month)	Number of Households Having Monthly Income below 5,000pesos
Along Downstream of Imus River	78	7,540	27
Along Downstream of San Juan River	96	8,347	43
Project Site of San Juan Diversion Channel	44	7,045	25
Along Maalimango Creek	18	14,361	8
Total	**236**	**8,296**	**103**

Source: JICA Study Team

The largest number of population in Cavite Province (47% of the provincial total) is engaged in the manufacturing industries due to the background of the industrial estates concentrating on the Province as shown in Table 23.4. On the other hand, the largest number of the interviewees (24% of the total) is the unskilled labor followed by: (a) the personnel for small-scale independent business such as retail business called “sari-sari store” in Philippines selling miscellaneous goods and the cheap restraint (21%), and (b) the drivers for the motorbike with a side car called “tricycle”, the share taxi called “jeepney” (18%) as shown in Table 23.4. These three (3) occupations (i.e., the unskilled labor, the small-scale independent business, and the driver) do not require the high-grade specialties receiving the rather low income.

Table 23.4 Ranking List of Occupations in Cavite Province and Interviewing Area

Cavite Province			Interviewing Area		
Occupation	Number of Workers	Share	Occupation	Number of Workers	Share
Manufacturing Industry	161,348	47%	Unskilled Labor	62	24%
Independent Business	91,899	27%	Independent Business	54	21%
Government Employee	21,031	6%	Driver	45	18%
Teacher	19,544	6%	Manufacturing Industry	40	16%
Welfare Work	9,952	3%	Jobless	11	4%
Driver and other services	7,193	2%	Government Employee	8	3%
Others	30,798	9%	Others	35	14%
Total	**341,765**	**100%**	**Total**	**255**	**100%**

Source: Socio-Economic and Physical Profile 2014, Cavite Province
JICA Study Team

23.3 Consideration for Gender Differences and Poverty Reduction in Flood Risk Reduction and Management

23.3.1 Consideration Relevant to Resettlement of Residents

As described above, about 30 to 40% of the interviewees are led by the female family head and/or supporting the physically handicapped person. These households tend to have the lower ability to accommodate the financial burdens and/or the new occupation. Moreover, their choices of the new houses for resettlement also tend to be limited as compared with those of the male family head and/or non-poverty groups. For these reasons, the employment support, the financial support, and the housing support would need for these households in the formulation of the Resettlement Action Plan (RAP). The following in Table 23.5 are enumerated as the eligible supports to be considered for the households of the female family head and/or the households supporting the handicapped persons with referring to examples practiced by Cavite Province and or adopted to RAP in the similar projects..

Table 23.5 Support for the Households of Female Family Head and/or Physically Handicapped Person in Formulation of RAP

Purpose of Support	Contents of Support
Employment Support	Vocational trainings of community livelihoods for the poor such as sating of a business for processing industry, which is currently undertaken by the Provincial Cooperative, Livelihood and Entrepreneurial Development Office (PCLEDO)
	Support by the above PCLEO to start a independent business and/or home business for the women, which is being undertaken by the PCLEDO.
	Vocational training by Technical Education and Skills Development Authority (TESDA) for the poor, the women and the jobless/
	Self-employment Assistance by Department of Social Welfare and Development（DSWD）taking establishment of the community organizations, funding, vocational training, and intruding of the social services in order to strengthen the economic infrastructure of the poor.
Financial Support	Funding for the poor in line with the above Self-employment Assistance by Department of Social Welfare and Development（DSWD）
	Livelihood support program for the poor who has the monthly income of less than 5,000 pesos to accesses to the micro-financing institutions
	Community housing loan program offering the fund to purchase the house and lot for the low income person
	System for receiving the housing loan with favorable conditions using the “Home Development Mutual Fund (called “Pag-Ibig Fund”).
Housing Support	Program by NGO to support the activities such that the project affected person works to construct the houses for resettlement by himself
	House development program to develop the low cost housing: the program obligates the developer to offer more than 20% of the development cost for his housing estate for the loe cost housing

Source: JICA Study Team

23.3.2 Poverty Reduction through Implementation of Flood Mitigation Project

The large-scale typhoons and/or southeast monsoons cause the river overflow almost every two years resulting in the serious flood damages such as collapse of houses and death of people in the Study Area. Many of the residents in the flood risk areas along the river and/or on the low lying land belong to the low-income bracket below the poverty line being exposed to the risks of loss of their lives and properties by the flood. Hence, implementation of the structural and non-structural flood mitigation project proposed in the Study is expected to make a great contribution to reducing of the poverty reduction from the following points of view.

(1) The project could reduce frequency of flooding as well as extent, duration, and depth of flood inundation.

(2) The flood risk area would be widely known among the residents through enlightenment activities relevant to flood mitigation and distribution of the flood hazard maps encouraging the residents in the flood risk area to resettle to the safer area and refraining them to return to the flood risk area.

(3) The urban poor in particular are exposed to the spread of disease caused by the flood inundation. Such risk of disease would be reduced leading to the living environment through implementation of the flood mitigation project.

23.3.3 Consideration on Support for Flood Warning and Evacuation

According to the interview survey by the JICA Study Team, the following cares and/or supports have been conventionally made in the Study Area:

(1) The officer of the Barangay Damage Risk Reduction and Management Office (BDRRMO) grasps the living situations of those weak in disaster such as the household headed by the woman, the aged people, and the physically handicapped person giving the priority instructions on flood evacuation for them.

(2) When the chairman of BDRRMO issues the flood evacuation to the residents, the priority of flood evacuation is given to the women, the aged people, the children, and the physically handicapped person, while the adult male evacuates last after he confirms the safety of houses and assets.

(3) The regional community is rather well organized, whereby the neighborhoods support the flood evacuation for those weak in the disaster.

As stated above, the care for the flood warning and evacuation in the Study Area is deemed to be executed well as far as it is judged based on the results of interview survey. However, the past supports for the flood warning and evacuation have been only conventionally made and hardly judged to be the activities based on the well-established system.

The linkage of the regional community may become weak as the urbanization progresses in the Study Area. Moreover, the scales of the flood would tend to be bigger leading to the longer period of flood evacuation in proportion to expansion of the urbanized area and the progress of the climate changes in the future. As the results, the aforesaid cares for those weak in the disaster could gradually be slacked off. From these points of view, it would be required to continuously release the messages on the importance of care for those weak in the disaster through enlightenment activities. At the same time, the following would need to be implemented in order to accomplish the systematic care for those weak in the disaster:

(1) To develop the lists of those weak in disaster and the helpers for them in each community and update them;

(2) To designate the eligible measures to convey the flood warning to those weak in disaster;

(3) To designate the particular urgent shelters such as the upland, and high building in addition to the public shelters; and

(4) To have the periodical training of flood evacuation.

23.3.4 Care for Environments of Flood Evacuation Center

The families of residents are assembled and each of them is separately guided to the existing flood evacuation shelter, which is provided with the toilets divided for the male and female during a flood. According to the hearing to the residents by the JICA Study Team, any cases of trouble and/or violence to the female among the evacuees to the shelters during the flood evacuation have not been reported. Judging from the results of the hearing survey, there are not any significant problems in the care to the female and/or those weak in the disaster during the flood evacuation; which may be attributed to the rather short stay of a few days at the shelter. However, the duration of stay at the flood evacuation center would be prolonged in the future, as the flood scales are enlarges due to the future unfavorable environments such as the climate changes and the expansion of the urbanized area. Due to such prolonged stay at the flood evacuation shelter, the trespassing of female's privacy and/or the violence to the female and those weak in the disaster would possibly occur during the stay at the shelter. In order to avoid such antisocial behaviors, the following would need to be considered.

(1) To improve the living conditions of and access to the flood evacuation center taking the gender differences into account creating the living space individually divided for each of the families.

(2) To promote the participation of the females to management of the flood evacuation shelter grasping the needs of the females; and

(3) To strengthen the security against the violence introducing the counseling service and other relevant countermeasures.

23.3.5 Care to Recovery and Reconstruction from Disaster

The households of the female family head tend to have the less income than those of the male family heads and therefore, the special care on financial support for the recovery/reconstruction from the disaster would be required to the households of the female head. Moreover, since the roles for the recover/rehabilitation works from the disaster tends to be clearly shared between the male and female, there is a risk such that: (a) the share of load to the female is increased leading to difficulties for the female in acquiring the drinking water and fuel and accessing to the new house and employment. In order to cope with these gender problems on the recovery/rehabilitation from the disaster, the following considerations would be required.

(1) To dispatch the experts, who are well posed on the gender problems, to the works of the recovery/rehabilitation from the disaster;

(2) To promote participation of the female to the plan formulation for the recovery/rehabilitation from the disaster and grasp the needs of female on the recovery/rehabilitation from the disaster;

(3) To actively involve those weak in the disaster such as the females, the physically handicapped persons and the elderly to all opportunities and organizations relevant to the recovery and rehabilitation from the disaster; and

(4) To reflect the opinions of those weak in the disaster into development and improvement of the disaster system/environment.

23.3.6 Strengthening of Female's Intervention to Flood Mitigation Works

The females actively go to the important positions of the government organizations as well as the private firms as exampled by the past case of the female president in Philippines. On the other hand, many women also work as housemaid, washerwoman, and babysitter in Philippines. Thus, there exists the clear female hierarchy between the upper and lower classes in Philippines. Most of the women, who live in the flood risk area, belong to the lower class and/or the house worker without compensation. Due to the said backgrounds, the opinions and/or requests of the women living in the flood risk area are hardly reflected to the flood mitigation projects and they tend to be excluded from the common ground for deliberation on the recovery/rehabilitation from the flood disaster, although the women take the important roles for recovery/rehabilitation in community and/or at home. In order to cope with these issues, it is necessary to strengthen the participation of the women to the flood mitigation project, whereby the following measures would need to be introduced:

(1) To urge the women to accumulate their knowledge on the flood disaster risk reduction and management and to participate in the flood mitigation projects taking leaderships; and

(2) To urge women to attend Public Consultation Meeting for the flood mitigation project adopting the viewpoints of the gender to formulation of the flood mitigation plan and ensuring the system to facilitate the women's participation to determination of the flood mitigation project.