NATIONAL WATER RESOURCES BOARD
THE REPUBLIC OF THE PHILIPPINES

THE STUDY
ON
INTEGRATED WATER RESOURCES MANAGEMENT
FOR
POVERTY ALLEVIATION AND ECONOMIC DEVELOPMENT
IN
THE PAMPANGA RIVER BASIN

FINAL REPORT
VOLUME I: SUMMARY

JANUARY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

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Composition of Final Report

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(as of 31st December 2009)


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Executive Summary

1. Background and Objectives of the Study

The objective study area, namely Pampanga river basin with a catchment area of 10,434 km^2, contains various complex and interrelated problems such as: (1) conflicts on water allocation among water users for irrigation, municipal water, hydropower generation; (2) serious flood and/or sediment disasters; (3) deterioration of water-related environment as represented by the sanitary intrusion to the groundwater in the coastal areas; and (4) excessive deforestation in the upper reaches. Many of these problems are left behind without giving the appropriate coordination with all the water-related sectors and adequately reflecting the requirement of the stakeholders to the solution of the problems. Hence, the IWRM Plan for Pampanga river basin was examined in the Study, stressing the following four different principles: (1) the integrated and holistic approach crossing multi-water sectors; (2) the adaptable response to future dynamic changes of socio-economic and natural conditions; (3) the involvement of stakeholders at every stage and step of plan formulation and implementation of water-related projects; and (4) the broader focus points such as fairness, economical effect, efficiency and sustainability of the water-related projects. The objectives of the study include the following two items:

(1) To formulate a IWRM Plan for the Pampanga river basin in coordination with other concerned organizations; and

(2) To transfer relevant skills and technologies on IWRM to personnel of NWRB as well as other concerned organizations.

2. Outline of the Proposed IWRM Plan

2.1 Selection of Eligible Projects as Components of the Proposed IWRM Plan

Taking the national/regional development policies and the water-related problems in the study area into account, “Poverty Alleviation” and “Economic Development” are adopted as the principal visions of the IWRM Plan for Pampanga river basin. “Poverty Alleviation” is oriented to the betterment of livelihood/increase of income for the poverty thresholds and at the same time, it aims at securing the basic human needs such as safe drinking water and safe living conditions against flood and other water-related disasters. Moreover, the approaches to “Poverty Alleviation” shall not be made by sacrifice of the vital ecosystem. Likewise, “Economic Development” is oriented to not only development of the regional economy but also preserving and/or recovery of the ecosystem in Pampanga river basin. In order to attain the said two principal visions of the IWRM Plan, the following 84 projects to be implemented by the target completion year 2025 are proposed:

Table 1 Number of Projects as Components of the Proposed IWRM Plan

Sector	On-going	Proposed	Conceptual*	Total
Agriculture/Irrigation and Fishery	14	11	3	28
Municipal Water Supply, Sanitation and Sewerage	3	4	11	18
Flood and Sediment Disaster Management	4	2	4	10
Watershed Management	12	0	4	16
Water-related Environment Management	3	1	4	8
Inter-sector Water Resources Development, Allocation and Distribution	-	-	4	4
Total	36	18	30	84

Note *: Proposed by JICA Study Team

2.2 Project Implementation Schedule and Investment Plan

On the premises of the target completion of 2025, the project implementation period is divided in to the following three 5-year terms: (1) Short-term for the period from 2011 to 2015, (2) Mid-term from 2016 to 2020 and (3) Long-term from 2021 to 2025. The phased implementation schedule and investment plan for these Short-term, Mid-term and Long-term is proposed for the projects of the IWRM Plan.

In order to facilitate programming of the above phased project implementation schedule and investment plan, the projects of the IWRM Plan are further divided into: (1) 43 projects (named "Group-A projects) which have to be implemented within the definite term(s) according to the basic social and/or natural requirements; and (2) 41 projects (named "Group-B projects), which could be implemented during any optional term(s). The typical Group-A projects are: (1) the municipal water supply projects, which have to be implemented at the proper term(s) in order to cope with the increment of population and its corresponding water demand; and (2) the projects for maintenance/ rehabilitation of the existing water resource facilities, which have to be continuously implemented every term. As for the Group-B projects, the typical examples are given by the irrigation development projects and the flood mitigation projects, which could make a contribution to the regional economic development and betterments of the livelihood for the poverty thresholds. The list of the Group-A and Group-B projects is as shown in Annex- T 11.1.1 at the end of this Report.

The implementation schedule for the Group-A projects is programmed through the following procedures: (1) the development scenarios relevant to the Group-A projects are firstly delineated taking the basic social and natural environmental requirements into account, and (2) then, the implementation schedule is programmed to grasp the development scenarios. The contents of the development scenarios relevant to the Group-A projects are as described in the following subsection 2.3.

In contrast to the above Group-A projects, the priority order of the projects is the principal factor for determination of the implementation of the Group-B projects. The priority order of the projects is set up through the evaluation of the projects by scoring on the viewpoints of: (1) "Viability of the Projects; (2) Enhanced Livelihood; (3) Improved Quality of Life; (4) Decentralized Development; (5) Sustained Ecosystem; and (5) Empowered People. Aside from the priority order of the projects, there are other two factors to determine the implementation schedule of the Group-B projects, namely; (1) the ceiling investment cost of the projects for each of the Sort-term, the Mid-term and the Long-term and required length of the project implementation period.

The implementation schedules of the Group-A and Group-B projects are set through the above procedures as shown in Annex-T 11.2.1 and 11.2.2, respectively. The project investment cost for each of Short, Mid and Long-terms are estimated based on the project implementation schedule as listed below:

Table 2 Project Investment Cost for Short, Mid and Long-Terms

(Unit: million pesos)

Classification of Project	Short-Term	Mid-Term	Long-Term	Total
Agriculture/Irrigation and Fishery Development	22,163	26,164	19,461	67,788
Municipal Water Supply, Sanitation and Sewerage Development	29,137	8,980	31,609	69,726
Management of Flood and Sediment Disasters	6,431	6,597	2,730	15,758
Watershed Management	1,721	1,588	265	3,574
Water-Related Environmental Management	1,501	1,371	793	3,666
Inter-Sector Water Resources Development, Allocation and Distribution	509	7,965	99	8,573
Total	61,462	52,665	54,957	169,085

2.3 Development Scenarios

As described above, the development scenarios for the Group-A projects are firstly delineated as the preconditions of the project implementation taking the basic social and natural environmental requirements into account. On the other hand, the development scenarios for the Group-B are set up as the outcomes of the project implementation. The development scenarios both for the Group-A and Group-B projects thus delineated are as shown in Tables 3 and 4.

Table 3 Development Scenarios Relevant to Group-A Projects

Sector	Development Scenario	Number of Relevant Projects	Implementation Period
Agriculture/ Irrigation and Fishery Development	Enhanced agricultural products through rehabilitation of existing irrigation facilities	6	2011-2025
	Sustainable Fishery Production	4	2011-2025
Municipal Water Supply, Sanitation and Sewerage Development	Short-term development of bulk water supply system for Bulacan Province	1	2011-2015
	Strengthening of water supply capacity of Angat-Umiray system	3	2011-2015
	Full recovery of water supply capacity of Angat-Umiray System	1	2011-2020
	Expansion of Level 3, 2, 1 municipal water supply system	4	2011-2025
	Construction/provision of sanitary toilet for the whole river basin	4	2011-2025
	Development of bulk water supply system for Metro Clark	1	2011-2025
	Long-term development of bulk water supply system for Bulacan and Pampanga Province	2	2021-2025
Management of Flood and Sediment Disasters	Sustainment of maintenance and rehabilitation of river dike and slope	1	2011-2025
	Sustainment of maintenance and rehabilitation of drainage and flood control facilities for LGUs	1	2011-2025
	Improvement of public awareness on IWRM	1	2011-2025
Watershed Management	Sustainment of on-going regular program for watershed management	9	2011-2025
Water-related Environmental Management	Dealing with contamination of surface, ground and coastal water	3	2011-2025
	Reduction of risk for contamination in water body	2	2011-2025
Total		43	

Table 4 Development Scenarios Relevant to Group-B Projects

Sector	Development Scenario	Number of Relevant Projects	Implementation Period
Agriculture/ Irrigation and Fishery Development	Improvement of Irrigation Technologies	3	2011-2015
	Short-Term Development of Infrastructures for Irrigation area of 42,926ha.	7	2011-2015
	Mid-Term Development of Infrastructure for Irrigation area of 109,347ha.	6	2016-2020
	Long-Term Development of Infrastructure for Irrigation area of 31,199ha.	2	2021-2025
Municipal Water Supply, Sanitation and Sewerage Development	Development of Sewerage Systems in Cabanatuan and Clark	2	2011-2015
	Construction/Provision of Sewage Treatment and Disposal Facilities for ten principal cities and municipalities	1	2016-2025
Management of Flood and Sediment Disasters	Flood Mitigation for Pasac River Basin (Eastern Pinatubo Area)	3	2011-2015
	Flood Mitigation for Pampanga Delta	1	2011-2020
	Capacity Building on the Appropriate Dam Reservoir Operation against Flood	1	2011-2015
	Establishment of Community-Based Flood Forecasting and Warning System for Provinces of Pampanga, Tarlac and Nueva Ecija	1	2011-2015
	Flood Mitigation for Bacolor Municipality	1	2021-2025
Watershed Management	Strengthening of On-going Reforestation Efforts	7	2011-2025
Water-related Environmental Management	Improvement of Monitoring and Processing System for the Water Quality Data	1	2011-2015
	Capacity Development to Reduce Pollution Load	2	2011-2020
Water Resources Development, Allocation & Distribution	Enhancement of Monitoring of Groundwater and Surface Water	2	2011-2025
	Capacity Development on Water Allocation and Distribution	1	2011-2015
Total		41	

2.4 Proposed Institutional Setup for IWRM in Pampanga River Basin

2.4.1 Organization Setup

The River Basin Committee (RBC) shall be newly established under the existing Regional Development Council (RDC) Region III in order to lead the relevant government agencies and the private entities to the effective IWRM for Pampanga river basin. The RBC is composed of the Committee, the Secretariat and TWG. The roles and members of these components are as below:

- The Committee is at the top of the RBC having the roles of formulation of the policy and framework for IWRM Plan of Pampanga river basin and coordination/direction to the

under-mentioned TWG members for implementation of IWRM Plan. The Committee shall involve the relevant provincial governors and the representatives of the TWG, and NGOs.

- The NEDA Region III supports the Committee as the Secretariat.
- The TWG formulate the details of the IWRM Plan and monitors the project implementation relevant to IWRM. The members of the TWG are summoned from the relevant national government agencies/regional line agencies, NGOs and private firms, as required.

2.4.2 Legal Set up

Amendments of the existing regulations and/or laws and establishment of the new legal frameworks shall be made to attain the appropriate and effective IWRM for Pampanga river basin. The principal work items required to the legal setup are as below:

Table 5 Proposed Amendment and Establishment of Legal Setup Relevant to IWRM in Pampanga River Basin

Classification	Contents
Establishment of New Legal Basis for Regulation of Water Use Right	The new legal basis shall be set up to specify the seasonal variations of the allowable maximum limits of the water uses, and the minimum water supply security level for the water uses. A detailed implementation rule and regulation (IRR) shall be also prepared to clarify the rules, processes, compensation and all other necessary conditions for lease and transfer of the water right to enhance the more efficient water uses.
Amendments of Present Legal Setup for Overlapping Water Charge System	The Water Code prescribes that NWRB is entitled to collect the water fees and charges for the water permit, while the Local Government Code prescribes that the LGU is entitled to collect a share from the proceeds of water resources within its jurisdiction area. These overlapping provisions on the water charges in the Water Code and the Local Government Code shall be amended.
Establishment of New Legal Basis on Cost Allocation Rule for Multipurpose Dam Projects	The legal basis on cost allocation rule for multipurpose dam projects shall be newly established to achieve the rational and equitable water allocation for various water uses.
Establishment of New Legal Basis on Environmental River Flow	The legal basis on the minimum the environmental river flow shall be newly established in order to preserve the appropriate rivet ecosystem.
Establishment of New Legal Basis on River Basin Committee (RBC) for IWRM in Pampanga River Basin	The power and functions of the RBC and the necessary financial source for activities of RBC shall be appropriated by MOAs or Executive Order.

3. Environmental and Social Considerations on Projects of IWRM Plan for Pampanga River Basin

3.1 Screening and Scoping

The screening, scoping and selection of mitigation measures for the proposed and conceptual projects in the IWRM Plan for Pampanga river basin were made taking the following environmental components into account:

Table 6 Environmental Components Considered in IEE

Category	Environmental Components
Social Environment	(1) Involuntary resettlement, (2) Local economy such as employment & livelihood, etc., (3) Land use & utilization of local resources, (4) Regional severance, (5) Existing social infrastructure & services such as traffic/existing public facilities, (6) Social vulnerable groups such as the poor and ethnic minority, (7) Inequality between beneficiaries and project-affected people, (8) Cultural heritage, (9) Conflict of interests, (10) Water use right and common land use right, (11) Sanitation
Natural Environment	(12) Disaster (natural risk) and epidemics such as HIV, (13) Topography and geology, (14) Soil erosion, (15) Groundwater, (16) Flow regime of lake and river, (17) National park of equivalent area in terms of its ecological importance, (18) Coastal and sea area, (19) Flora and fauna, (20) Climate, (21) Landscape
Pollution	(22) Global warming, (23) Air pollution, (24) Water pollution, (25) Soil pollution, (26) Waste, (27) Noise and vibration, (28) Ground subsidence, (29) Offensive odor, (30) Bottom sediment, (31) Accident

As the results of the initial screening, the following five projects, which contain the potentials to cause the significant negative impacts, are identified:

Table 7 Projects Identified to have the Rating of A- and/or B-

Code No.	Name of Project and Possible Options
AI-P-01	Balintingon Reservoir Multipurpose Project (BRMP)
AI-P-02	Balog-Balog Multipurpose Project Phase II
MW-C-05*	Extended Bulacan Bulk Water Supply Project
FL-C-01*	Flood Mitigation for Pampanga Delta
IS-C-02*	Project for Recovery of Reliability of Water Supply in Angat-Umiray System

Note*: MW-C-05, MW-C-06, FL-C-01 and IS-C-02 contain several alternative options and it is preliminarily evaluated that significant adverse impacts are expected when the projects take the following options:

- MW-C-05 Option 1 for development of Bayabas storage dam, Option 2 for development of Balintingon storage dam and conveyance to AMRIS or Option 4 for development of Laiban storage dam
- MW-C-06: Option 1 for abstraction of residual groundwater at surrounding cities/municipalities, Option 2 for Direct abstraction of surface water of Pampanga River at Cong Dadong Dam or Option 3 for development of Gumain reservoir
- FL-C-01: Option 1 for a large scale river improvement or Option 2 for construction the flood retarding basin
- IS-C-02: Option 1 for development of Bayabas storage dam, Option 2 for development of Balintingon storage dam and conveyance to AMRIS or Option 4 for development of Laiban storage dam

The environmental components to be inflicted by the significant negative impacts and the proposed mitigation measures against the impacts are as listed below:

Table 8 Environmental Components inflicted by the Significant Negative Impacts and Mitigation Measures against the Impacts

Environmental Components	Details of Adverse Impacts	Projects (Code Nos.)	Timing of Occurrence of Impacts	Mitigation Measures
Involuntary resettlement	Involuntary resettlement caused by the installation of the infrastructures	AI-P-01, AI-P-02, MW-C-05(Opt.2,4), IS-C-02(Opt.2,4), FL-C-01(Opt.1)	Planning phases	- Selection of alternative project sites - Proper planning, implementation and monitoring of appropriate resettlement action plans.
Land use/ utilization of local resources	Land acquisition for the flood retarding basin (approx.16,000 ha)	FL-C-01(Opt.2)	Planning phase	- Proper planning, implementation and monitoring of compensation measures for the land owners
Social vulnerable groups	Involuntary resettlement of Indigenous Peoples (IPs).	AI-P-01, AI-P- 02, MW-C-05(Opt.2,4), IS-C-02(Opt.2,4)	Planning phases	- Enhancement of full participation of IPs in project cycles - Preparation, implementation and monitoring of the action plans to recover the livelihoods for the IPs affected

3.2 Important Notice on Implementation of the Projects

When the environmental and social consideration of the project, which consists of the IWRM Plan, is examined, the comments, suggestions and recommendations of the stakeholders have to be incorporated through stakeholder meetings. Moreover, the methodologies and procedures for organizing of the stakeholder meetings shall accord to the standards in the Philippines, and those of the donor, if the project is implemented through assistance from the donor.

4. Conclusions and Recommendations

4.1 Recommendations on the Proposed IWRM Plan for Pampanga River Basin

4.1.1 Guideline for Formulation of IWRM Plan

The member of NWRB formulated the “IWRM Plan Framework in the Philippines” in 2006 clarifying the concept and the direction of the IWRM Plan. Taking the “IWRM Plan Framework” in to account, the guideline on the methodologies and procedures for formulation of the IWRM Plan was prepared in

this study and used as the basic material for consensus buildings of the stakeholders on the procedures of the plan formulation. The guideline is also expected to be the references to formulation of IWRM Plans for other river basins.

The guideline prepared in the study is, however, likely to still contain an immature part, and it would be necessary to improve such immature part through actual implementation of the IWRM Plan and monitoring of the results of the implementation of the Plan.

4.1.2 Principal Visions of the IWRM Plan for Pampanga River Basin

The "Poverty Alleviation" and the "Economic Development" are adopted as the principal visions of the IWRM Plan for Pampanga river basin, and all development scenarios in the Plan shall be oriented to these principal visions. However, the following particular attentions shall be given to these principal visions:

(1) Poverty Alleviation

A particular attention shall be given to the ratio of the poverty thresholds in Nueva Ecija Province in the study area. The ratio in the Province is about 38%, which exceed the national average of 33%. The majority of the employees in the Province are engaged to the agriculture/forestry sector and one of the crucial issues on the poverty alleviation for the province shall be addressed to increment of the income of the employees in the sector.

(2) Economic Development

Pampanga river basin is the core industry area of the Region III in Philippines, and the manufacturing and the agriculture are the major industries in the Region, which produce the Gross Value Added of more than 50% in the Region. Accordingly, these industrial sectors shall take the principal roles for the "Economic Development" in Pampanga river basin, and thereby enhancement of the bulk water supply system for the manufacturing and the irrigation system for the agriculture shall be the important water-related works to promise the economic development in the study area.

4.1.3 Projects Proposed as the Components of IWRM Plan for Pampanga River Basin

The following special attentions shall be given in implementation of the projects proposed as the components of IWRM Plan for Pampanga river basin:

(1) Project Implementation Schedule

Of the proposed projects, those to be implemented in the Short-term shall be provided with the earlier budgetary arrangement as well as other necessary preparatory works for project implementation. As for the projects to be implemented in the Mid-term and the Long-term, however, the changes of social and natural environments relevant to the project implementation shall be carefully monitored and the reexamination may be required to the project implementation schedule as well as the contents of the projects in accordance with the results of monitoring.

(2) Project Investment Plan

The budgetary arrangement for the necessary investment cost of 70.1 billion pesos for the conceptual projects is newly required and the following particular attentions shall be given:

- The feasibility studies for many of the conceptual projects shall be carried out before project implementation in order to verify the project viability, decide the project implementation bodies and estimate the precise project investment cost.
- The investment cost shouldered by the corporation/private firm has to be fully recovered through collection of the water service charges. Such full cost recovery has been preliminarily verified based on the comparison between the necessary investment cost and the possible amount of water service charge. Nevertheless, the details on the full-cost recovery for development of the municipal water supply shall be reexamined before project implementation.

(3) Implementation of the Inter-sector Projects

The projects as the components of the IWRM Plan for Pampanga river basin involve the inter-sector projects, which are related to the plural water-sectors. The inter-sectors projects would need to be implemented jointly by the several government agencies and private firms under the umbrella of the under-mentioned River Basin Committee (RBC). At the same time, it is necessary to clarify the demarcations of each of the relevant agencies for the inter-sector projects based on the prevailing laws and regulations. The inter-sector projects and their principal issues in Pampanga river basin are as enumerated below:

- Water allocation/distribution for and flood control by multipurpose dam;
- Watershed management in cooperation with flood/sediment disaster management and water resources development/management;
- Coordination between the flood management and the fishery development;
- Flood management in cooperation with agricultural development; and
- Preservation of environmental river flow based on the adjustment between the necessary river flows for ecosystem and water intake for various water uses.

4.2 Application of the Results of the Study to the Future IWRM in Philippines

The results of study shall be applied to the actual IWRM immediately after completion of the study and sustainably developed through the continuous efforts by the relevant agencies. NWRB in particular as the leading counterpart agency for the study, is expected to accomplish the following missions:

(1) Support for Establishment of and Activities by River Basin Committee (RBC)

- To support preparation of the Minutes of Agreement (MOA) or Executive Order (EO), which appropriates the power and functions of the RBC and the financial source for activities of RBC;
- To monitor the outcomes of the activities by RBC (i.e., the results of implementation of the proposed IWRM plans); and
- To review and revise the proposed IWRM plans based on the results of the above monitoring.

(2) Missions as the Member of RBC

- To make capacity development on appraisal of water use right and adjustment of water allocation and distribution including capacity development on estimation of eligible water supply capacity and development of the basic database;
- To strengthen the monitoring system for usage of surface water and groundwater;
- To arbitrate the conflicts among the various water users, when the arbitration could not be made at the level of RBC; and
- To amend the present legal setup related to approval of water use right and water allocation/distribution.

(3) Development of Concept of IWRM as the Nationwide Movement

- To formulate the strategic plan for development of the concept of IWRM;
- To review and make the necessary revisions on the guideline for formulation of IWRM Plan proposed in the study; and
- To introduce the IWRM Plan to other river basins.

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Abbreviations and Acronyms

A&D	:	Alienable & Dispensable
ACC	:	Annual Allowable Cut
AD	:	Ancestral Domain
ADB	:	Asian Development Bank
AL	:	Ancestral Land
AMRIS	:	Angat Maasim River Irrigation System
AO	:	Administrative Order
APS	:	Automated Processing System
ARCDP	:	Agrarian Reform Communities Development Project
ARISPII	:	Agrarian Reform Infrastructure Support Project
ARWR	:	Annual Renewable Water Resources
AWAT	:	Angat Watershed Action Team
AWSOP	:	Angat Water Supply Optimization Project
BAS	:	Bureau of Agricultural Statistics
BBMP	:	Balog-Balog Multipurpose Project
BFAR	:	Bureau of Fisheries and Aquatic Resources
BOD	:	Biological Oxygen Demand
BOT	:	Built Operate Transfer
BRS	:	Bureau of Research and Standards
BSWM	:	Bureau of Soils and Water Management
BWSA	:	Barangay Water and Sanitation Association
CADT	:	Certification of Ancestral Domain Titles
CALT	:	Certification of Ancestral Land Titles
CARP	:	Comprehensive Agrarian Reform Program
CARP-IC	:	Comprehensive Agrarian Reform Program – Irrigation Component
CBFM	:	Community-Based Forest Management
CBFMA	:	Community Based Forest Management Agreement
CBO	:	Community Based Organization
CDA	:	Cooperative Development Authority
CDC	:	Clark Development Corporation
CDM	:	Clean Development Mechanism
CDO	:	Cease and Desist Orders
CDP	:	Capacity Development Program
CENRO	:	Community Environment and Natural Resources Office
CIGAR	:	Covered In-Ground Anaerobic Reactor
CIS	:	Communal Irrigation System
CITES	:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLIP	:	Central Luzon Irrigation Project
CLUP	:	Comprehensive Land Use Plan
CMIPP	:	Casecnan Multipurpose Irrigation & Power Project
CMMD	:	Coastal and Marine Management Division
CMR	:	Compliance Monitoring Report
CNC	:	Certificate of Non-Coverage
CPC	:	Certificate of Public Convenience
CRMP	:	Coastal Resource Management Program
CSEZ	:	Clark Special Economic Zone
CSO	:	Civil Society Organizations
CWA	:	Clean Water Act
CWC	:	Clark Water Corporation

DA	:	Department of Agriculture
DAO	:	Department Administrative Order
DAR	:	Department of Agrarian Reform
DBM	:	Department of Budget and Management
DCC	:	Disaster Coordinating Council
DD	:	Diversion Dam
DE	:	Department of Education
DECS	:	Department of Education, Culture and Sports
DENR	:	Department of Environment and Natural Resources
DEO	:	District Engineering Office
DILG	:	Department of Interior and Local Government
DO	:	Dissolved Oxygen
DOD	:	Department of Defense
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 Communication
DPWH	:	Department of Public Works and Highways
DTI	:	Department of Trade and Industry
ECA	:	Environmentally Critical Area
ECC	:	Environmental Compliance Certificate
ECOSAN	:	Ecological Sanitation
ECP	:	Environmentally Critical Projects
EDC	:	Energy Development Corporation
EIA	:	Environmental Impact Assessment
EIS	:	Environmental Impact Statement
EMB	:	Environmental Management Bureau
ENR	:	Environment and Natural Resource
EO	:	Executive Order
EPIRA	:	Electric Power Industry Reform Act
ERDB	:	Ecosystem Research and Development Bureau
ESWM	:	Ecological Solid Waste Management
ESWMP	:	Ecological Solid Waste Management Program
F.I.S.H.	:	Fisheries Resources Management for Improved and Sustainable Harvest
F/S	:	Feasibility Study
FBI	:	Field Based Investigation
FCSEC	:	Flood Control and Sabo Engineering Center
FFCM	:	Forest Fire Control and Management
FLUP	:	Forest Land Use Plan
FMB	:	Forest Management Bureau
FMP	:	Forest Management Program
FMS	:	Forest Management Service
FPIC	:	Free and Prior Informed Consent
FPLEP	:	Forest Protection and Law Enforcement Program
FRDD	:	Forest Resources Development Division
FUSA	:	Firmed Up Service Area
GA	:	Government Agency
GAA	:	General Appropriations Act
GDP	:	Gross Domestic Product

GFI	:	Government Financing Institution
GHG	:	Greenhouse Gas
GIS	:	Geographic Information System
GIS	:	Groundwater Irrigation System
GNP	:	Gross National Product
GOCC	:	Government Owned and Controlled Corporation
GRDP	:	Gross Regional Domestic Product
GTZ	:	German Technical Cooperation Agency
GVA	:	Gross Value Added
HBC	:	Hacienda Bio-Energy Corporation
HDI	:	Human Development Index
HMS	:	Hydrometric Station
HUDCC	:	Housing and Urban Development Coordination Council
IA	:	Irrigators' Association
IAFD	:	Integrated Agro-Forestry Development Program
IBRD	:	International bank for Reconstruction and Development
ICC	:	Indigenous Cultural Communities
ICC	:	Investment Coordination Committee
ICT	:	Information and Communications Technology
ICWE	:	Information Conference on Water and the Environment
IEC	:	Information, Education and Communication
IEE	:	Initial Environmental Evaluation
IEEC	:	Initial Environmental Evaluation Checklist
IEER	:	Initial Environmental Examination Report
IMO	:	Irrigation Management Office
IMT	:	Irrigation Management Transfer
IP	:	Indigenous People
IPCP	:	Industrial Pollution Control Program
IPO	:	Indigenous People's Organization
IPRA	:	Indigenous People's Rights Act
IRA	:	Internal Revenue Allotment
IRR	:	Implementing Rules and Regulations
ISF	:	Irrigation Service Fee
ISF	:	Integrated Social Forestry
ISP	:	Institutional Strengthening Program
IWMI	:	International Water Management Institute
IWRM	:	Integrated Water Resources Management
JBIC	:	Japan Bank for International Cooperation (presently merged to JICA)
JICA	:	Japan International Cooperation Agency
KMS	:	Knowledge Management System
KPI	:	Key Performance Indicators
LA	:	Line Agency
LGA	:	Local Government Agency
LGC	:	Local Government Code
LGU	:	Local Government Unit
LLDA	:	Laguna Lake Development Authority
LTRIS	:	Lower Talavera River Irrigation System
LWUA	:	Local Water Utilities Administration
M & E	:	Monitoring & Evaluation
M/P	:	Master Plan
MC	:	Memorandum Circular

MCWMC	:	Metro Clark Waste Management Corporation
MDFO	:	Municipal Development Fund Office
MDG	:	Millennium Development Goal
MFCDP	:	Major Flood Control and Drainage Project
MGB	:	Mines and Geo-sciences Bureau
MIS	:	Management Information System
MMDA	:	Metro Manila Development Authority
MPFD	:	Master Plan for Forestry Development
MRF	:	Materials Recovery Facilities
MTIP	:	Medium Term Investment Plan
MTPDP	:	Medium Term Philippine Development Plan
MWCI	:	Manila Water Company Inc.
MWLFI	:	Municipal Water Loan Financing Initiative
MWSI	:	Maynilad Water Service Incorporated
MWSS	:	Metropolitan Waterworks and Sewerage System
NAA	:	Non-Attainment Area
NAMRIA	:	National Mapping and Resource Information Authority
NAPC	:	National Anti-Poverty Commission
NAPOCOR/NPC	:	National Power Corporation
NCIP	:	National Commission on Indigenous People
NCR	:	National Capital Region
NDCC	:	National Disaster Coordination Council
NECA	:	Non-Environmentally Critical Area
NECP	:	Non-Environmentally Critical Projects
NEDA	:	National Economic Development Authority
NEPC	:	National Environmental Protection Council
NEPIS	:	Nueva Ecija Pump Irrigation System
NGA	:	National Government Agency
NGO	:	Non-government Organization
NHRC	:	National Hydraulic Research Center
NIA	:	National Irrigation Administration
NIPAS	:	National Integrated Protected Area System
NIS	:	National Irrigation System
NPAA	:	Network of Protected Area for Agriculture
NPC	:	National Power Corporation
NPCC	:	National Pollution Control Commission
NRW	:	Non-Revenue Water
NSCB	:	National Statistical Coordination Board
NSO	:	National Statistics Office
NWRB	:	National Water Resources Board
NWRC	:	National Water Resources Council
O&M	:	Operations and Maintenance
OCD	:	Office of Civil Defense
ODA	:	Official Development Assistance
OPAPP	:	Office of the Presidential Adviser on the Peace Process
OPMBCS	:	Operational Plan for the Manila Bay Coastal Strategy
P3W	:	President's Priority Program on Water
PA	:	Protected Areas
PACBRMP	:	Protected Area Community- based Resource Management Program
PAGASA	:	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAMB	:	Protected Area Management Board

PAMP	:	Protected Area Management Program
PAWB	:	Protected Areas and Wildlife Bureau
PAWCZMS	:	Protected Area, Wildlife and Coastal Zone Management Services
PAWD	:	Philippine Association of Water Districts
PBRIS	:	Pampanga-Bongabon River Irrigation System
PCB	:	Polychlorinated biphenyl
PCPT	:	Per Capita Poverty Threshold
PD	:	Presidential Degree
PDDP-IC	:	Pampanga Delta Development Project –Irrigation Component
PDR	:	Project Description Report
PDRIS	:	Pampanga Delta River Irrigation System
PEIS	:	Programmatic Environmental Impact Statement
PEISS	:	Philippine Environmental Impact Statement System
PEMAPS	:	Project Environmental Monitoring and Aucit Prioritization Scheme
PEMSEA	:	Partnership in Environmental Management for the Seas of South East Asia
PENRIS	:	Penaranda River Irrigation System
PENRO	:	Provincial Environment and Natural Resources Office
PEPP	:	Philippine Environmental Partnership Program
PFPDP	:	Private Forest Plantation Development Program
PHDR	:	Philippine Human Development Report
PhilBIO	:	Philippine Bio-Sciences Company, Inc
PHILRICE	:	Philippine Rice Research Institute
PHIVOLCS	:	Philippine Institute of Volcanology and Seismology
PIDP	:	Participatory Irrigation Development Project
PIMO	:	Provincial Irrigation Management Office
PIS	:	Pump Irrigation System
PMO	:	Program Management Office/Project Management Office
PMO-RWS	:	Project Management Office for Rural Water Supply
PNSDW	:	Philippine National Standards for Drinking Water
PO	:	People’s Organization
POP	:	Persistent Organic Pollutant
PPDO	:	Provincial Planning and Development Office
PPFP	:	Provincial Physical Framework Plan
PRB	:	Principal River Basin
PRBRP	:	Pampanga River Basin Rehabilitation Program
PRIS	:	Pampanga River Irrigation System
PSP	:	Private Sector Participation
PW4SP	:	Provincial Water Supply Sector, Sewerage and Sanitation Plan
PWA	:	Philippine Waterworks Association
PWAT	:	Pantabangan Watershed Action Team
PWRF	:	Philippine Water Revolving Fund
PWSSR	:	Philippine Water Supply Sector Roadmap
PWSU	:	Provincial Water and Sanitation Unit
R&D	:	Research & Development
RA	:	Republic Act
RBC	:	River Basin Committee
RBCO	:	River Basin Control Office
RBO	:	River Basin Organization
RCBFMO	:	Regional Community Based Forest Management Office
RDC	:	Regional Development Council
RDCC	:	Regional Disaster Coordinating Committee

RENRO	:	Regional Environment and Natural Resources Office
RIES	:	Revised Industrial Eco-watch
RIO	:	Regional Irrigation Office
RIS	:	River Irrigation System
RLA	:	Regional Line Agency
RO	:	Regional Office
RPFP	:	Regional Physical Framework Plan
RWDC	:	Rural Waterworks Development Corporation
RWSA	:	Rural Water and Sanitation Association
SAFDZ	:	Strategic Agriculture and Fisheries Development Zone
SALT	:	Sloping Agricultural Technology
SCAD	:	Subic-Clark Alliance for Development
SDC	:	Super Diversion Canal
SEZ	:	Special Economic Zone
SFR	:	Small Farm Reservoir
SLF	:	Sanitary Land Fill
SMORIS	:	San Miguel-O'donel River Irrigation System
SMR	:	Self-Monitoring Reports
SPM	:	Strategic Planning and Management
SRIP	:	Small Reservoir Irrigation Project
SSIP	:	Small Scale Independent Provider
STP	:	Sewerage Treatment Plants
STW	:	Shallow Tube-well
SWIP/SWIMP	:	Small Water Impounding Project
SWIS	:	Small Water Impounding System
SWMA	:	Solid Waste Management Act
TARIS	:	Tarlac River Irrigation System
TASMORIS	:	Tarlac-San Miguel-O'donel River Irrigation System
TDS	:	Total Dissolved Solids
TGIS	:	Tarlac Groundwater Irrigation System
TGISRP	:	Tarlac Groundwater System Reactivation Project
TRIS	:	Talavera River Irrigation System
TSP	:	Total Suspended Particulate
TSS	:	Total Suspended Solids
TWG	:	Technical Working Group
UDP	:	Upland Development Program
UN	:	United Nations
UNFCC	:	United Nations Framework Convention on Climate Change
UPRIIS	:	Upper Pampanga River Integrated Irrigation System
USGS	:	The U.S. Geological Survey
WASCO	:	Water Supply Coordinating Office
WB	:	World Bank
WD	:	Water District
WFR	:	Watershed Forest Reserve
WHO	:	World Health Organization
WM	:	Watershed Management
WQ	:	Water Quality
WQMA	:	Water Quality Management Area
WQMP	:	Water Quality Monitoring Program
WRAP	:	Water Resources Authority of the Philippines
WRC	:	Water Regulatory Commission

WRI	:	World Resources Institute
WSP	:	Water Service Provider
WSSPMO	:	Water Supply and Sanitation Program Management Office
WSSWP	:	Water, Sanitation & Solid Waste Program

Measurement Units

(Length)

mm	: millimeter(s)
cm	: centimeter(s)
m	: meter(s)
km	: kilometer(s)

(Area)

mm^2	: square millimeter(s)
cm^2	: square centimeter(s)
m^2	: square meter(s)
km^2	: square kilometer(s)
ha	: hectare(s)

(Weight)

g, gr	: gram(s)
kg	: kilogram(s)
ton	: ton(s)

(Others)

mw	: megawatt

(Time)

s, sec	: second(s)
min	: minute(s)
h, hr	: hour(s)
d, dy	: day(s)
y, yr	: year(s)

(Volume)

cm^3	: cubic centimeter(s)
m^3	: cubic meter(s)
l, ltr	: liter(s)
mcm	: million cubic meter(s)
mld	: million liters per day

(Speed/Velocity)

cm/s	: centimeter per second
m/s	: meter per second
km/h	: kilometer per hour

1. Introduction

1.1 Objectives of the Study

The objectives of "The Study on Integrated Water Resources Management for Poverty Alleviation and Economic Development in Pampanga River Basin" (hereinafter referred to as "the Study") as agreed upon between the JICA and the NWRB in November 2008 are as follows:

(1) To formulate a plan for the Integrated Water Resources Management (hereinafter referred to as "IWRM") for the Pampanga river basin in coordination with other concerned organizations; and

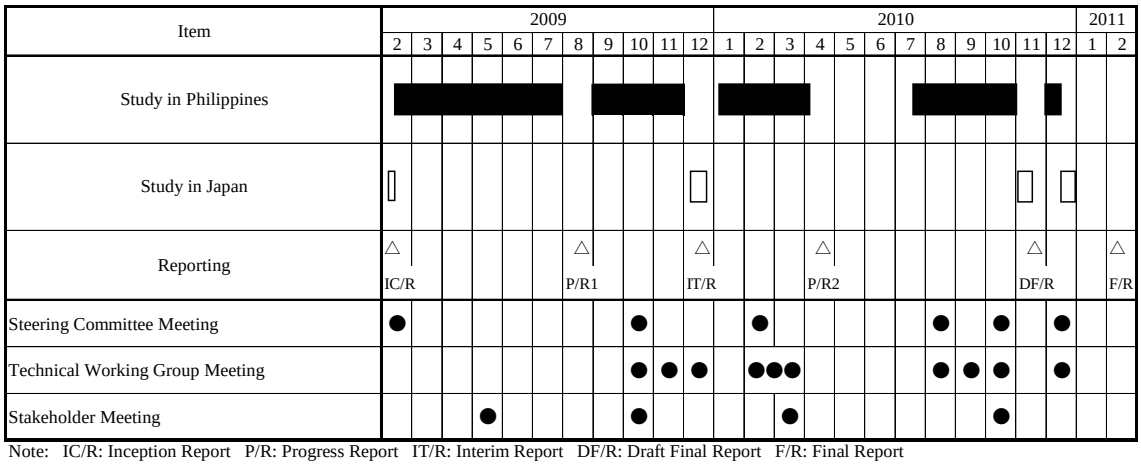
(2) To transfer relevant skills and technologies on IWRM to personnel of NWRB as well as other concerned organizations.

1.2 Extent of the Study Area

The study area is the entire 10,434 km^2 catchment area of Pampanga river basin, which situates within the administrative jurisdiction of eleven (11) provinces and 90 cities/municipalities. A substantial part of the study area (about 95%) is, however, within the boundary of four (4) provinces: Nueva Ecija, Tarlac, Pampanga and Bulacan (refer to the General Map).

1.3 Study Schedule

The study was carried out for a period of 25 months from February 2009 until February 2011. During the study period, several official meetings, including the Steering Committee (SC) meetings, the Technical Working Group (TWG) meetings and the stakeholder meetings, were occasionally held to appraise the progress of the study, as shown in Figure 1.3.1.



Note: IC/R: Inception Report P/R: Progress Report IT/R: Interim Report DF/R: Draft Final Report F/R: Final Report

Figure 1.3.1 Study Schedule

1.4 Justification of the Project Proposed in the Study

The study area contains complex and interrelated issues inherent in the various water sectors such as: (a) water allocation and distribution for irrigation, domestic use, hydropower generation and other water uses; (b) management of flood and sediment disasters; (c) conservation and improvement of water quality and other water-related environments; and (d) watershed management.

In order to cope with the issues, the relevant government and non-government agencies had implemented a variety of projects on water resources management and development. Many of the issues are, however, still unattended without giving any fundamental solution. Moreover, the completed and/or proposed projects were not always based on adequate coordination with all the water-related sectors, and, at the same time, the requirements of the stakeholders have not been well reflected.

Hence, the IWRM Plan for the study area was examined in the Study, stressing the following four different principles: (1) the integrated and holistic approach crossing multi-water sectors; (2) the adaptable response to future dynamic changes of socio-economic and natural conditions brought by climate change and other factors; (3) the involvement of stakeholders at every stage and step of plan formulation and implementation of water-related projects; and (4) the broader focus points such as fairness, economical effect, efficiency and sustainability of the water-related projects. Hence, the Study was to undertake the clarification of definite water-related issues inherent in the study area in order to propose the IWRM Plan to cope with those issues.

1.5 Implementation Structure for the Study

The arrangement of organizations for implementation of the Study was made, as described in the following subsections.

1.5.1 Counterpart Agency

The NWRB acted as the Philippine counterpart agency for the Study to facilitate its implementation. It had assigned twenty-one (21) counterpart personnel, who worked together with the Study Team.

1.5.2 Steering Committee

The Steering Committee was set up with representatives from eighteen (18) government agencies as members under the initiative of NWRB. It had provided guidance on the smooth implementation of the Study, and coordinated with the relevant government and non-government organizations. All of the reports for the Study have been presented to and discussed with the Steering Committee at every stage of the Study.

1.5.3 Technical Working Group

The Technical Working Group (TWG) was set up with twenty-five (25) agencies as members under the initiative of NWRB. It had provided technical support services to the above Steering Committee.

1.6 Composition of the Final Report

The Final Report of the Study consists of: (a) Volume I, Summary; (b) Volume II, Main Report; and (c) Volume III and IV, Supporting Reports. The contents of each volume are as shown below.

Table 1.6.1 Composition of the Final Report

Volume No.	Title	Contents
Volume I	Summary	The summary of all study results.
Volume II	Main Report	All of the study results.
Volume III	Supporting Reports	The detailed results of the study in each of the following sectors to support the Main Report: ・ Topography and Meteorology ・ Socio-Economy ・ Agricultural, Irrigation and Fishery Development ・ Municipal Water Supply, Sanitation and Sewerage System Management ・ Flood and Sediment Disaster Management ・ Water-Related Environmental Management ・ Watershed Management ・ Water Resources Development and Management
Volume IV		・ Socio-Environmental Consideration ・ Guidelines for Formulation of IWRM Plan ・ Formulation of IWRM Plan for Pampanga River Basin ・ Plans for Legal and Institutional Framework ・ Water-Related Data Management Appendix: Minutes and Discussion Records on SC, TWG and Stakeholder Meetings
Supplementary Material (Digital file only)		・ Databook ・ Training Material & Manual

2. Present Natural Conditions of the Study Area

2.1 Topographic Conditions

An alluvial plain with ground elevation of less than 200m and slope of less than 3% spreads over the lower and middle reaches of Pampanga river basin, covering about 65% of the study area. It forms a part of the Central Luzon Plain. The lower part of the plain, in particular, has an extremely low ground elevation of less than 10m above mean sea level. It is called the Pampanga Delta, which accounts for about 15% of the study area.

Hilly/low-mountain ranges with the elevation of 200-800m enclose the above alluvial plain and form part of the Sierra Madre Mountains. These hilly/low-mountain ranges take about 30% of the entire study area.

There exist the mountain areas of more than 800m above mean sea level in elevation. They are mainly located in the Pinatubo Mountains and the north-east boundary, and share about 5% of the study area.

Mt. Pinatubo erupted in 1991, and the top of the mountain was blown off, making the height of the mountain about 500m lower than before. A significant volume of lahar was also produced by the eruption and deposited widely around the mountains.

2.2 Rivers

The study area is largely divided into three river systems, namely; (1) Pampanga main river system, (2) Angat river system; and (3) Pasac river system. Of these river systems, the Pampanga main river system has the largest catchment area of 7,978 km^2 and the longest channel length of 265 km. The river originates in the Caraballo Mountains north of the study area, and flows into Pantabangan storage dam. The upstream stretch of the river above the dam is often called Pantabangan River. After passing the dam, the river further flows southward meeting with several tributaries and finally empties into the Manila Bay. Among the major tributaries of the Pampanga main stream are Coronell River, Peñaranda River, and Rio Chico (River). Of these tributaries, Rio Chico has the largest catchment area of 2,895 km^2, and it joins the main stream nearby Mt. Arayat and/or Candaba Swamp, which has the maximum inundation area of about 330 km^2 in the rainy season.

The Angat river system originates in the Sierra Madre Mountains and flows into Angat storage dam meandering through a narrow valley. In the lower reaches from the dam, the river flows westward and finally empties into the Manila Bay through Labangan Floodway. There is a small connecting channel with Pampanga River, which is called as Bagbag River. The total length of the main stream of Angat River is 153 km and the total catchment area is about 1,085 km^2.

The Pasac river system includes various river channels running on the eastern slope of Mt. Pinatubo, such as Abacan--San Fernando River, Pasig-Potrero River and Porac-Gumain River. All of the rivers originate in Mt. Pinatubo and flow into the Manila Bay. The total catchment area of the river system is about 1,371 km^2. In the lower reaches, the river system is connected with Pampanga Main River by Bebe-San Esteban Cutoff Channel. The morphologies of Pasac River have been much affected by the eruption of Mt. Pinatubo in 1991; river alignments have changed due to the mudflow produced by the eruption, and serious sediment deposition in the river channel is still in progress.

2.3 Meteorology

A substantial part of the study area except the eastern mountainous region belongs to the climate area of Type I classified by PAGASA, which is characterized by the pronounced dry season from November to April and wet season during the rest of the year. The maximum rainfall depth is usually recorded in the period from June to September. On the other hand, the eastern mountainous regions belong to Type III, which is characterized by no very pronounced rainy season.

The long-term average annual precipitation in the study area is estimated at about 2,155 mm/year, and about 83% of the annual precipitation concentrates in the rainy season from May to October.

Table 2.3.1 Variations of Precipitation in the Entire Study Area

(unit: mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
31.8	24.1	29.0	46.1	180.4	267.5	363.8	409.7	331.6	230.5	155.5	84.9	2155.0
1.5%	1.1%	1.3%	2.1%	8.4%	12.4%	16.9%	19.0%	15.4%	10.7%	7.2%	3.9%	100.0%

Source: JICA Study Team

Data for the meteorological indices other than the above precipitations were collected from the representative synoptic gauging stations at the Central Luzon State University (CLSU), Muñoz City, Nueva Ecija Province, which is located in the study area. The average monthly variations are as listed below.

Table 2.3.2 Monthly Variation of Climatic Parameters at CLSU-Muñoz

Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Air Temperature (℃)	25.9	26.1	27.0	28.7	29.4	28.6	27.9	27.5	27.5	27.5	27.4	26.3	27.5
Relative Humidity (%)	76.4	77.6	76.3	74.9	76.2	81.3	84.2	87.0	86.0	82.7	77.8	75.5	79.7
Wind Speed (m/s)	3.2	3.1	2.7	2.5	2.1	2.2	1.8	2.0	1.9	2.0	2.7	3.0	2.4
Sunshine Duration (hrs)	7.9	8.7	8.9	9.3	7.6	6.4	5.3	4.7	5.1	6.2	6.8	7.0	7.0
Pan Evaporation (mm/month)	168	169	203	213	192	147	135	119	120	129	135	153	1,879

Source: JICA Study Team based on PAGASA data

There is no significant change in air temperature throughout the year. The hottest month is May with mean air temperature of 29.4 degrees Celsius. On the other hand, January is the coldest with mean air temperature of 25.9 degrees Celsius. The difference between the hottest month and the coldest month is only about 3.5 degrees Celsius.

2.4 Hydrology

The annual average discharges observed at the representative hydrological gauging stations in the study area are as listed below.

Table 2.4.1 Annual Average Runoff Discharge in the Study Area

Code No. of Gauging Station*	Name of River Basin	Catchment Area (km^2)	1951-1973			1974-2007		
			Discharge (m^3/s)	Specific Discharge ($m^3/s/ha$)	Runoff Ratio	Discharge (m^3/s)	Specific Discharge ($m^3/s/ha$)	Runoff Ratio
343	Pampanga	6,315	237.0	3.8	0.57	229.3	3.6	0.56
334	Pampanga	2,455	141.8	5.8	0.85	69.1	2.8	0.41
345	Rio Chico	1,604	52.9	3.3	0.54	71.4	4.5	0.73
3998	Angat	546	60.8	11.1	0.80	58.7	10.7	0.77

*: Named by BRS-DPWH

Pantabangan storage dam in Pampanga river basin started operation in 1974, causing a significant change in the flow regime. As listed above, the specific discharge in Pampanga river basin after the commencement of dam operation in 1974 is somehow lower than that before the commencement. This is presumably because of the impact of abstraction for irrigation water in the basin, which became available upon the start of operation of Pantabangan storage dam. The specific discharge for Angat storage dam catchment is much higher than that in the other catchments in Pampanga river basin. This is due to the much higher precipitation volume in the Angat storage dam catchment.

There are twenty (20) hydrological gauging stations, which record the average runoff ratios in the study area. According to the discharge records at these gauging stations, during the period from 1974 to 2007, runoff rate ranges from 0.4 to 0.9, and they tend to decrease with the size of the catchment area and reaches about 0.5 to 0.6 when the catchment area is large.

2.5 Geology

The Philippines is situated in and along the Circum-Pacific Volcanic-Earthquake Belt characterized by earthquakes and volcanic activities, some of which are destructive. General geological structure

trends north to north north-west faulted by the Philippines Fault System and its splay faults stretches particularly along the Southern Sierra Madre Mountains crossing over the Nueva Ecija and Bulacan provinces. Faults in Nueva Ecija named "Dingalan Fault" are supposed to be active faults, and faults distributed in Bulacan are supposed to be probable active faults.

The oldest rocks at the substratum composed of amphibolite, mica schist, phyllites, etc., are distributed along the eastern highland of the study area and considered to be older than the Cretaceous. Sedimentary rocks composed of marine wackes (sandstone) and flysch (shale) intercalated by basalt, andesite flow, and pyroclastics from the age of Cretaceous period to Tertiary-Miocene epoch are widely distributed in the eastern mountain area. Oligocene sedimentary rocks are intruded by quarts diorite. Upper-Miocene sedimentary rocks are overlain by pyroclastics and tuffaceous sedimentary rocks. These rocks are not basically aquiclude, which is not expected to be used for groundwater exploitation excluding caves/cavities of limestone and lava flow. The location and scale of caves/cavities is not clear at this moment.

Alluvium (R) which consists of unconsolidated clay, sand and gravel is widely distributed in the Central Luzon Plain at a thickness of about 199m based on the existing drilling results. It is considered as a good aquifer, especially the sand and gravel layers, which can be widely utilized for domestic water supply and others.

Quaternary pyroclastics (QVP) is overlaid by Alluvium. The possibility of groundwater extraction by an ultra-deep well depends on the depth of the pyroclastics.

2.6 Hydrogeology

A substantial part of the alluvial plains in the study area have been estimated to show high permeability and contain the aquifers, which have a rather high productivity of groundwater. About 5,585km^2 or 53% of the study area is expected to have high productivity of groundwater.

There are the flood plains along the narrow valleys in the hilly and/or low mountain area. These flood plains would also contain highly productive aquifers of groundwater. The deposits in the flood plains are composed of sand, gravel and clay, and they are expected to be moderate to high permeability. About 224km^2 or 2.1% of the study area belong to the flood plains containing the rather high productivity of groundwater.

The hilly and/or mountainous regions other than the above alluvial plains and flood plains have low permeability and hardly produce adequate groundwater. Only the loose crack area and/or limestone area may contain the possible local aquifer. About 4,725km^2 or 43% of the study area belong to the hilly/mountainous regions containing the rather low productivity of groundwater.

2.7 Water Quality

2.7.1 Surface Water Quality

DENR defines the classes of surface water quality according to the applicable usage, as shown in Table 2.7.1. In accordance with this classification, DENR evaluated that the water quality at upstream of Pampanga River belongs to Class A, and a majority of the other river channels in the study area are Class B while none is Class D.

Table 2.7.1 Water Usage and Classification of Fresh Surface Waters

Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection to meet the Philippine National Standards for Drinking Water (PNSDW)
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment to meet the PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (e.g., bathing, swimming, skin diving, etc.)
Class C	Fishery Water, Recreational Water Class II, or Water Supply Class I – Intended for propagation and growth of fish & other aquatic resources, boating, manufacturing processes after treatment
Class D	Industrial Water Supply Class I – Intended for agriculture, irrigation, livestock watering, etc.

Source: DENR

Based on the above DENR classifications, river surface water in the study area is evaluated to be rather clean, and this general evaluation was preliminarily accepted in the present study judging from the results of the field reconnaissance and the results of the recent water quality monitoring.

However, particular attention should be paid to Abacan River and San Fernando River, the tributaries of Pasac River. Abacan River flows through Angeles City, which is the largest urban center in the study area. The JICA Study Team recognized that the river gives an offensive odor in the dry season; therefore, it could be hardly classified even as Class D. Likewise, San Fernando River, which flows through the second largest city in the study area, shows that BOD is far beyond the limit of Class A and could not be classified even to the water usage of Class D. This could be attributed to the effluent from San Fernando City to the river.

2.7.2 Groundwater Quality

The groundwater is the primary source for potable water supply in the study area. Hence, the present groundwater quality has been preliminarily evaluated against the Philippine National Standards for Drinking Water (PNSDW) by the Department of Health (DOH).

The results of bacteriological analysis on coliform and the metal analysis on toxic materials contained in the groundwater were collected from several sampling points albeit very few. According to the analyses, no impermissible toxic material such as arsenic, cadmium, and mercury were detected. As for the result of bacteriological analysis, impermissible coliform was detected in the raw groundwater at a few wells in Angeles City. Nevertheless, the treated groundwater contains no impermissible coliform. The results of the interview-survey further assured that no fatal disease has originated from the groundwater source in the study area.

In addition to the results of the above bacteriological and metal analyses, those for physical and chemical analyses on groundwater quality in 2005 to 2008 were collected from 180 sampling points in 21 water districts in and around the study area, and summarized as below.

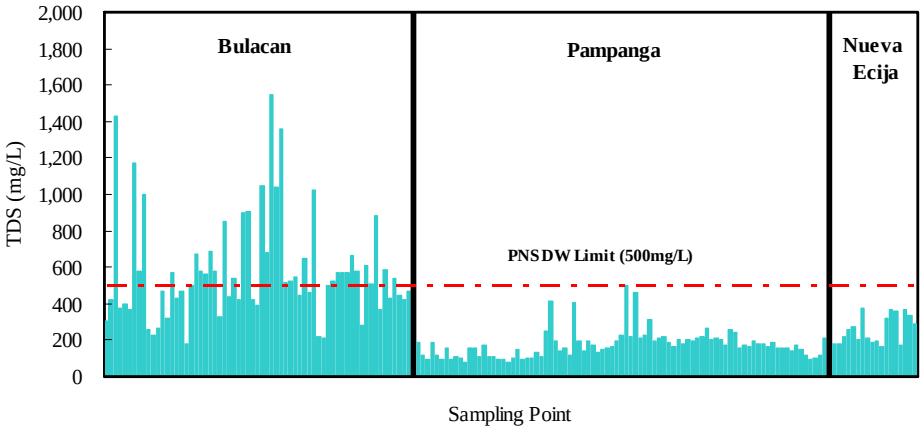
Table 2.7.2 Results of Water Quality Test for Groundwater Managed by Water Districts in and around the Study Area

Description	Bulacan	Pampanga	Nueva Ecija	Total
1. Number of Total Sampling Points	71	87	22	180
2. Number of Sampling Points above PNSDW Limit				
(1) Turbidity	2	0	0	2
(2) True Color	4	0	0	4
(3) pH	8	1	0	8
(4) Hardness	3	0	2	3
(5) Total Dissolved Solids (TDS)	35	0	0	35
(6) Chloride	15	0	0	15
(7) Iron	1	1	0	1
(8) Manganese	0	9	1	0

Source: Water Districts

As shown in Table 2.7.2, the groundwater at a substantial number of sampling points in the Province of Bulacan (35 points out of 73 points) shows high values of TDS and Chloride, which exceed the PNSDW Limits. Moreover, seven samples (or about 10% of the whole samples) show an extremely high TDS of more than 1,000mg/liter, which is double of the PNSDW Limits (refer to Figure 2.7.1).

Both TDS and Chloride could be the indicators on the mixture degree of saltwater intrusion. Judging from the said extraordinary values of TDS and Chloride, the groundwater in a part of the Province of Bulacan could hardly qualify as the source of potable water.

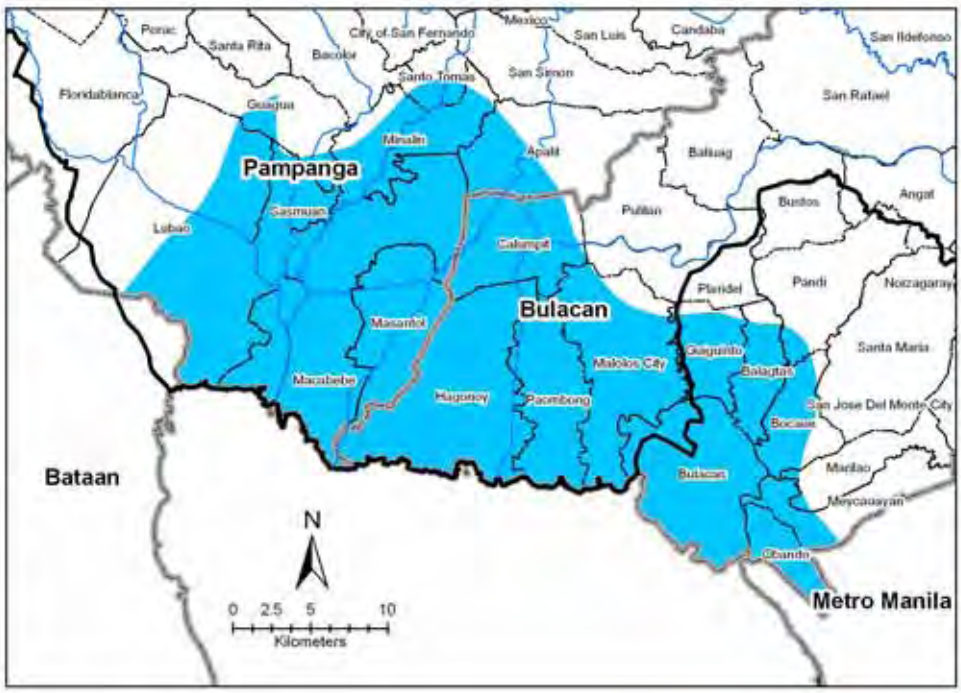


Source: Water Districts

Figure 2.7.1 TDS of Groundwater in Bulacan, Pampanga and Nueva Ecija Provinces

Saline water intrusion to the groundwater in general occurs in the shoreline areas. The NWRC (formerly, NWRB) had estimated the possible extent of saltwater encroached area as shown in Figure 2.7.2 based on the results of groundwater quality tests made before 1982, the analysis on the resistivity formation of aquifers, and other available relevant data. Based on the figure, the saltwater encroached area spreads over the coastal belt at about 20 to 30km in width.

In addition to the TDS and Chloride, the pH values of groundwater also exceed the PNSDW Limits at about 11% of the sampling points in the Province of Bulacan. Nevertheless, the excess of pH values is not significant as compared with those of the aforesaid TDS, and such excessive Ph value leads to a little unpalatable water but not fatal disease. A little concern is further given to the impermissible concentration of Manganese detected at nine (9) sampling wells in the Province of Pampanga. However, the sample wells, which contain the impermissible concentration, are located within a few water districts only, and reduction in concentration of Manganese could be made through proper treatment.



Source: NWRB

Figure 2.7.2 Possible Extent of Saltwater Encroached Area Estimated by NWRC in 1982

2.7.3 Coastal/Marine Water Quality

In 2008, the DENR-EMB Region III began monitoring the quality of coastal waters near the mouth of Manila Bay, which is the outlet of Pampanga River. This is in support of the initiative to rehabilitate Manila Bay. Six (6) stations are being monitored in Pampanga Delta, specifically along the fishpond areas in the towns of Masantol, Macabebe and Sasmuan. The data sets are, however, still inadequate for purposes of analysis.

Nevertheless, available reports from water quality assessments done in adjoining coastal areas of Manila Bay, including Navotas, Metro Manila and Cavite, confirm the risks to human health posed by high fecal and total coliform load, and other toxic contaminants contributed by domestic, agricultural and industrial wastes from areas draining into Manila Bay. While it is yet uncertain how much Pampanga river basin contributes in terms of total load, pollutants in the coastal environment are constantly being remobilized.

2.8 Ecologically Sensitive Area

Republic Act No. 7586, titled the National Integrated Protected Areas System (NIPAS) Act, prescribes the eight categories of protected areas, namely; (1) strict nature reserve; (1) natural park; (3) natural monument; (4) wildlife sanctuary; (5) protected landscapes and seascapes; (6) resource reserve; (7) natural biotic areas; and (8) other categories, as established by law, conventions or international agreements in which the Philippine Government is a signatory. In accordance with this Act, the following areas in and around the study area are designated as protected areas established under the NIPAS.

Table 2.8.1 Protected Areas in and around the Study Area under NIPAS

Protected Area	Area(ha)
1. National Park (NP)s	
(1) Minalungao NP	2,018.00
(2) Biak-na-Bato NP	658.85
(3) Mt. Arayat NP	3,715.23
2. Watershed Forest Reserves	
(1) Angat Watershed Forest Reserve District	55,709.10
(2) Angat Watershed and Forest Range	6,600.00
(3) Talavera Watershed Reservation	37,156.00
(4) Pantabangan-Carrangan Watershed Reservation	84,500.00
(5) Doña Remedios/General Tino Watershed	20,760.00
Total	211,117.18

Source: Statistics on Philippine Protected Areas and Wildlife Resources, PAWB, 2004

In addition to the above protected area designated under NIPAS, particular attention should be paid to Candaba Swamp and the mangrove forest in the study area. Among them, Candaba Swamp is one of the Ramsar candidate sites, extending over 33,000 ha in the middle stream of Pampanga river basin. The swamp and Manila Bay are also nominated as Important Bird Area designated by Bird Life International.

As for mangrove forests, there existed the mangrove area of 1,276 ha around Manila Bay, of which 1,007 ha extended in the study area in 1994. However, the Environmental Resource Validation by Manila Bay Environmental Atlas identified that the said extent of mangrove area was reduced to 414.15 ha, which includes 230 ha in the study area in 2005, as listed below. Thus, mangrove areas are declining significantly in Manila Bay due to the conversion of land use.

Table 2.8.2 Existing Mangroves in the Study Area

Province	In the year of 1994 (ha)	In the Year of 2005 (ha)
Bulacan	259	10
Pampanga	748	220
Total	1,007	230

Source: Manila Bay Area Environmental Atlas, DENR, 2007

2.9 Wildlife (Fauna)

Pursuant to the Department of Environment and Natural Resources (DENR) Administrative Order No. 2004-15, the National List of Threatened Fauna was prepared aiming to determine species of wild birds, mammals and reptiles, which shall be declared as priority concern for protection and conservation. According to the red list, one (1) species of mammal and seven (7) species of birds are listed for Pampanga river basin, as shown below.

Table 2.9.1 Species Listed in Red List for Conservation in and around the Study Area

Taxonomy	Scientific Name	Common Name	Conservation Status	Distribution Area
Mammals	*Acerodon jubatus*	Golden-crowned fruit bat	EN	Tarlac
Birds	*Ptilinopus marchei*	Flame-breasted fruit dove	VU	Aurora
	Ptilinopus merrilli	Cream-bellied fruit dove	VU	Nueva Ecija
	Erythrura viridifacies	Green-faced parrotfinch	VU	Bulacan
	Grus antigone	Sarus crane	CR	Candaba swamp and Nueva Ecija
	Prinoturus luconensis	Green-headed racket-tailed parrot	VU	Mt. Arayat and Pampanga
	Tringa guttifer	Nordmann's greenshank	EN	Bulacan
	Zoothera cinerea	Ashy thrush	VU	Bulacan

Note: Conservation Status: CR (Critically Endangered), EN (Endangered), VU(Vulnerable). Species under Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are categorized as CR, while in Appendix II of CITES, as EN.

Source: 2004 Statistics on Philippines Protected Areas and Wildlife Resources, Protected Areas and Wildlife Bureau (PAWB)

It is herein noted that more than 10,000 waterfowls migrate to the study area in almost every year, and the Candaba Swamp, which is the largest swamp in the study area having the maximum water impounding area of about 210 km^2, has been identified as an important habitat for waterfowls. Moreover, the waterfowls in the study area include the rare species classified as Vulnerable and Endangered under the IUCN Red List, e.g., Philippine Duck (*Anas luzonica*) and Black-faced Spoonbill (*Platalea minor*), which were observed in Candaba Swamp and Pantabangan Dam.

2.10 Water-Related Disasters in the Study Area

2.10.1 Flood

The Regional Disaster Coordinating Committee (RDCC) for Region III had recorded the recent flood damages from 2003 to 2006 in the provinces of Bulacan, Pampanga and Nueva Ecija, which lie centered in the study area, as shown in Table 2.10.1. According to the flood damage records, these provinces had suffered from extensive flood damage, which include 30 to 750 thousand population affected by floods every year. In 2004, in particular, three large flood damages occurred.

Table 2.10.1 Recently Recorded Major Flood Damage in Pampanga, Bulacan and Nueva Ecija

Time of Flood	Typhoon	Affected Population	Number of Casualties		Number of Houses Damaged	
			Dead	Injured	Totally	Partially
Jul. 2003	Harurot	163,309	5			
Aug. 2004	Marce	757,070	14	1	120	1,200
Nov. 2004	Violeta	9,562	2			
Nov. 2004	Winnie	537,058	16	2	602	1,409
Nov. 2004	Toyong	324,498	8	2	94	162
Sep. 2005	Labuyo	43,631				
Jul. 2006	Glenda	30,831				
Oct. 2006	Milenyo	34,045	1	0	274	1,610

Source: RDCC-Region III

The recent largest flood damage was caused by Typhoon Marce in August 2004. The remote sensing analysis by Dartmouth Flood Observatory shows that the flood area by Typhoon Marce spreads over 1,151 km^2 or about 11% of the study area, which encompasses Pampanga Delta, a substantial part along the midstream of Pampanga River and its tributary Rio Chico.

As stated above, large flood damage occurs in almost every year in the study area, and the most serious damage is in Pampanga Delta. The principal cause of such frequent and large-scale flood damage could be attributed to the extremely small river flow capacity.

The channel flow capacities of the downstream and midstream sections of Pampanga River were preliminarily estimated, as listed in Table 2.10.2, based on the results of the previous relevant study in 1982. According to the results of estimation, the flow capacity of the whole section of Pampanga River from Masantol to Cabiao (the stretch of about 14 km to 54 km upstream from the river mouth) is evaluated to hardly cope with even the 5-year return period flood.

Table 2.10.2 River Channel Flow Capacity and Probable Peak Runoff Discharge

(unit: m^3/s)

River	Stretch	Channel Flow Capacity	Probable Peak Flood Runoff Discharge	
			5-year return period	10-year return period
Pampanga	River Mouth – Masantol	4,300 (500)*	2,654	3,517
	Masantol – Sulipan	2,200	2,654	3,517
	Sulipan – Arayat	1,800	2,349	2,731
	Arayat – Cabiao	2,000	2,424	3,071
	Cabiao - San Isidro	2,500	2,408	3,051
Angat	Calumpit - Expressway Bridge	900	737	854
San Fernando	Sasmuan - San Fernando	200	272	363

Note: *: The channel flow capacity was increased from 500 to 4,300 m^3/s through the PPDP-Phase I in 1993.
Source: Feasibility Study Report on the Pampanga Delta Development Project, JICA, 1982

The widening of river channel, together with the construction of embankment was made for the river stretch of 14km in length from the river mouth to Masantol through Pampanga Delta Development Project (hereinafter referred to as "PDDP") Phase I in 1993. As a result of this project, the channel flow capacity of the section from the river mouth to Masantol had increased from 500 to 4,300m^3/s, which could cope with the probable flood of 20-year return period. The PDDP was originally scheduled to continue as Phase II in order to increase the channel flow capacity for the further upstream sections, but Phase II is being held as a plan examined due to the extremely large scale of house relocation required.

According to the results of field reconnaissance, fish ponds are expanding in Pampanga Delta, in particular, and such expansion of some fish ponds would narrow the river channel width, which accelerates the reduction of channel flow capacity and induces a more frequent occurrence of flood. Moreover, the recent remarkable progress of land subsidence could also aggravate the flooding conditions.

2.10.2 Sediment Disaster

Mt. Pinatubo, which is located in the southwestern part of the study area, erupted in 1991, and produced an extremely large volume of lahar runoff, which flowed down as mudflow to the rivers in the eastern Pinatubo areas such as Sacobia-Bamban River (the tributary of Pampanga River) and the tributaries of Porac River, namely; Abacan River, Pasig-Potrero River and Gumain River.

The runoff volume of lahar immediately after the eruption was estimated at about 1,650 MCM, and since then the annual runoff volume of more than 100 MCM continued for three years from 1992 to 1994. On the other hand, PHILVOLCS predicted that such la arge volume of lahar runoff would rapidly subside, and the Study Team had confirmed that the lahar runoff had substantially subsided through the field reconnaissance and interview-survey with the relevant organizations.

Although the runoff of lahar had subsided, the lahar of about 900 MCM still accumulates in the upper reaches of the river basin, and sediment continues to run-off from the accumulated volume. As the result, the current sediment runoff volume into the river channel is estimated at about four times of those before the eruption of Mt. Pinatubo. The annual specific yield of sediment before the eruption of Mt. Pinatubo was 17 m^3/ha/year, while the present yield is 62 m^3/ha/year in Pasig-Potrero river basin. Likewise, Porac-Gumain had the annual specific yield of 14m^3/ha/year before the eruption, while it is 56 m^3/ha/year at present. These present larger sediment runoff is estimated to continue for more than 100 years and a substantial part of them would accumulate in the river channel, causing

reduction of the channel flow capacity unless certain countermeasures are taken, such as river dredging to remove the sediment and reforestation to reduce the sediment runoff.

In addition to the above problems of sediment runoff, another important issue concerns the drainage of San Fernando River, which functions as the principal drainage channel for San Fernando City. The large volume of mudflow from Mt. Pinatubo blocked the waterway from San Fernando River to Pasig-Potrero River. As the result, floodwaters flowing into San Fernando River are hardly drained, which induces the frequent and serious flood damage in San Fernando City. In order to cope with this drainage problem, an alternative route called "the Pilot Channel" was newly excavated to drain the floodwater of San Fernando River into Manila Bay. Nevertheless, the flow capacity of the Pilot Channel could cope with only the probable flood runoff discharge of less than 2-year return period.

2.10.3 Drought

The frequent and serious shortage of water currently occurs in Angat-Umiray system. The Angat storage dam was constructed in 1967, and its operation started in 1968. In 2000, the Umiray-Angat transbasin tunnel was completed, and additional water is then supplied from Umiray River to Angat storage dam. The Angat-Umiray system is currently used as the water source for the municipal water demand of 46 m^3/s in Metro Manila and irrigation water demand of 19.2 m^3/s (estimated by the Study Team) in Angat-Massim River Irrigation System (AMRIS).

However, the additional water supply from Umiray River could not adequately cover the dynamic increment of municipal water demand in Metro Manila. The potential supply capacity of Angat-Umiray system is evaluated to hardly cope with the relevant water allocation of 93 m^3/s (reduced to 78 m^3/s when 15 m^3/s conditionally allocated to MWSS is subtracted) in case of a drought year of more than 5-year return period.

According to the dam operation record, the water level of the Angat storage dam dropped below 180m above mean sea level, the lowest value of the rule curve, in 16 years during 40 years (1968-2007), which required NIA to completely cut back its granted water use volumes for irrigation water use in AMRIS. This water shortage has happened more frequently since the additional water use right of 15 m^3/s were conditionally allocated to MWSS in 1988.

2.10.4 Land Subsidence

The low-lying Pampanga Delta in the study area in particular is subject to chronic flood damage, and one of the major causes of the flood damage could be attributed to the current rapid progress of land subsidence. The JICA Study in 2002 reported that the evidence of land subsidence in Pampanga Delta could be seen at Orani Harbor in Bataan Province, which is located in the northwestern part of Manila Bay. The dock and market in the harbor was never flooded at the time of its construction; however, they are currently flooded with the maximum inundation depth of about 1m every year during Spring High Tides. The said JICA Study also gives other evidence like the ground floor level of several old buildings in Guagua and Sasmuan municipalities in Pampanga Province, which had sunk by 2 to 3m over several decades.

The actual extent of land subsidence was examined in the above JICA Study in 2002, as well as the study by Rodolf and Siringan, University of the Philippines in 2003. By referring to these studies, it is preliminarily presumed that land subsidence is occurring, at least, over the coastal area in Pampanga Province from the shoreline to about 40 km inland (refer to Figure 2.10.1). The coastal area in Bulacan Province could be also affected by land subsidence judging from the similar geological settings and the excessive abstraction of groundwater to those in Pampanga Province, although no relevant previous study has confirmed it yet.

The annual average rate of the land subsidence in the coastal area in Pampanga Province is preliminarily presumed, referring to the above two studies, to be in the range of 0.5 cm/year from inland to 8 cm/year at the coastal side.

The area of the subject land subsidence in Pampanga Province is a broad tidal-river delta complex formed by the sediment runoff from Pampanga river basin, and its underlying alluvium is composed of consolidated silt or clay and poorly cemented sand and gravel. This geological setting tends to cause

land compaction once dewatering of aquifer is made by the abstraction of groundwater. At the same time, the present abstraction volume of groundwater in the subject area far exceeds the estimated groundwater potential in some places. The geological setting and the excessive abstraction of groundwater could be the principal causes of the present land subsidence.

The land elevation lowered by land subsidence is hardly recovered once it occurs, and control of the present excessive abstraction of groundwater is the only solution to deter further land subsidence. However, the present lack of monitoring system for land elevation in the coastal area would make identifying the precise progressive rate of the land subsidence difficult, which leads to difficulties in estimating the proper abstraction volume of groundwater. From this point of view, the periodical leveling survey for the benchmarks together with monitoring of abstraction of groundwater would be required to estimate the proper abstraction volume of groundwater.

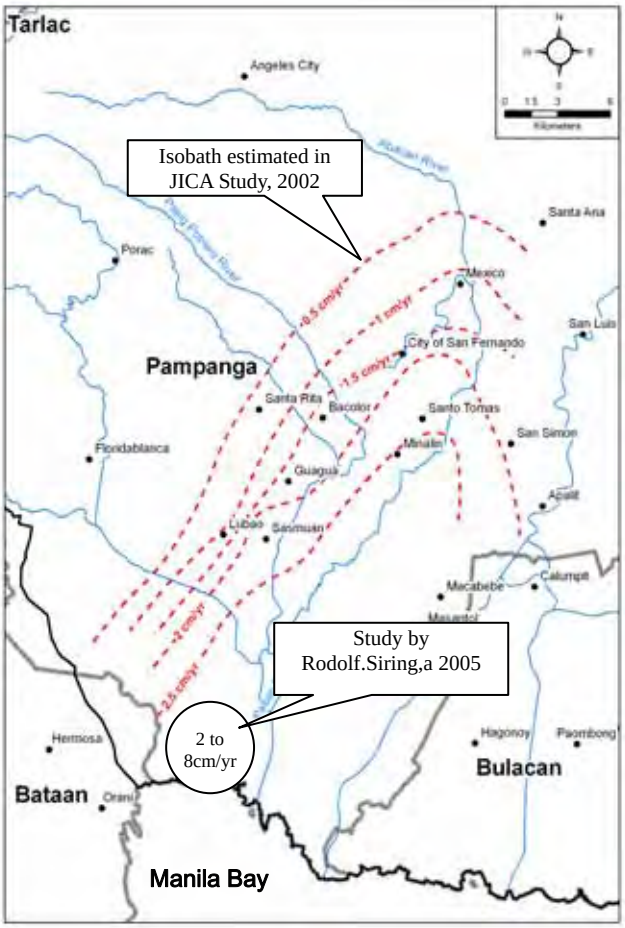


Figure 2.10.1 Annual Average Rate of Land Subsidence Estimated in the Previous Studies

3. Present Socio-Economic Conditions of the Study Area

3.1 Demographic Characteristics

The population in the study area is estimated to have increased from about 3.0 million in 1980 to 5.8 million in 2007 as shown in Table 3.1.1. The population in 2007 corresponds to about 59.2% of the total in Region III and/or 6.5% of the national total. The population growth from 1980 to 2007 is 2.40%, which is slightly higher than the national average of 2.35%.

Table 3.1.1 Estimated Population and Annual Average Population Growth in the Study Area

Province	Population					Population Growth 1980-2007
	1980	1990	1995	2000	2007	
Bulacan	594,920	769,921	908,081	1,072,923	1,299,400	2.94%
Nueva Ecija	990,542	1,222,034	1,402,016	1,549,715	1,733,849	2.10%
Pampanga	1,159,123	1,503,152	1,602,261	1,839,706	2,180,084	2.37%
Tarlac	260,839	322,431	345,794	396,042	472,676	2.23%
Others	28,922	40,365	43,744	51,150	70,148	3.34%
Whole Study Area	3,034,346	3,857,903	4,301,897	4,909,536	5,756,156	2.40%

Source: Population Census in 1980, 1990, 1995, 2000, and 2007 by NSCB (for Basic Population Data)

Among the major four (4) provinces in the study area, Bulacan currently has the intensive urbanization in the south-eastern part of the Province, which faces Metro Manila, in particular. Due to such intensive urbanization, the province recorded the highest growth of 2.94% from 1980 to 2007 among the four provinces, while Nueva Ecija had the lowest growth of 2.1%.

The population density of the study area in 2007 is 552 persons/km^2, which is more than double of the national average of 258 persons/km^2 (refer to Table 3.1.2). Among the major four provinces in the study area, Pampanga Province has the highest average population density of 1,078 persons/km^2 followed by 643 persons/km^2 in Bulacan Province in 2007, 567 persons/km^2 in Tarlac and 346 persons/km^2 in Nueva Ecija.

Table 3.1.2 Estimated Population Density in the Study Area

Province	Area (km^2)	Population Density (persons/km^2)				
		1980	1990	1995	2000	2007
Bulacan	2,021	294	381	449	531	643
Nueva Ecija	5,013	198	244	280	309	346
Pampanga	2,022	573	743	792	910	1,078
Tarlac	834	313	387	415	475	567
Whole Study Area	10,434	291	370	412	471	552

Source: (1) Population Census in 1980, 1990, 1995, 2000, and 2007 by NSCB (for Basic Population Data)
(2) JICA Study Team (for Overlapping Ratio of study area with Cities/Municipalities)

3.2 Gross Regional Domestic Product

Due to the inadequate census on the Gross Value Added (hereinafter referred to as GVA) in each of the industrial origin at the municipal and/or provincial level, the general view on the current regional domestic product of the study area was accessed from the economic census at the regional level (i.e., the census of Region III where the study area is located).

Region III recorded the GRDP of 501 billion pesos in 2007, which takes 7.5% of the GNP and ranks third next to NCR and Region IV among the 17 regions in the country. These three regions in a higher rank of GRDP are tied together with the North and South super-highways and produce 56.1% of GNP in total. Thus, the regions form the core economic block in Philippines, and Region III plays a part of the important economic activities in Philippines.

Among the industrial sectors in Region III, the Agriculture Sector showed the highest share of GVA to the national total (10% of the national total) in 2007 followed by 8.3% in the Industrial Sector and 6.4% in the Service Sector (refer to Table 3.2.1). This 10% of the Agriculture Sector is ranked 2nd among all regions in Philippines next to Region IV.

Table 3.2.1 Share of Gross Value Added of Region III to National Total in 2007

(unit: billion pesos/year)

Description	Agricultural Sector	Industrial Sector	Service Sector	Total
Gross Value Added in Region III	93,539	175,857	231,959	501,356
Gross Value Added in the whole Country	936,415	2,107,287	3,604,542	6,648,245
Share of Gross Value Added of Region III	**10.0%**	**8.3%**	**6.4%**	**7.5%**

Source : "Gross Regional Domestic Product" by National Statistical Coordination Board, 2005-2007"

As described above, Region III contributes to the GNP of the Philippines especially in the Agriculture Sector. It is further noted that Region III is the largest irrigated paddy-producing district taking the share of about 22% of the national total. Moreover, Nueva Ecija, Tarlac, Pampanga and Bulacan provinces, the substantial part of which are within in the study area, are ranked as the 1st, 5th, 9th and 14th largest irrigated paddy-producing provinces among 80 provinces in the whole country. These four provinces produced the irrigated paddy of 2.4 million metric ton in total which corresponds to about 19% of the country total. Judging from the irrigated-paddy production, the sustainable water supply for the paddy irrigation in the study area is deemed to be one of the important issues not only for the regional economy but also the national economy.

The annual average growth rate of the GRDP in Region III from 1995 to 2007 was about 10% (refer to Table 3.2.2). The highest growth rate of GVA was recorded in the subsector of "Transport, Communication & Storage" (14.3%) followed by the subsector of "Electricity/Water" (13.8%). The subsector of "Manufacturing", which currently takes the largest share of GRDP in Region III, also recorded the annual growth rate of 9.6%. In contrast, the sector of "Agriculture/Fishery" confines its growth rate below 8%. The degradation of the annual growth rate of the GVA in the sector of "Agriculture/Fishery" is the nationwide general tendency, which could be attributed to the lower productivity per head of worker as compared with the sectors of "Industry and Services." Nevertheless, the Agriculture/Fishery is still one of the key industries and currently takes in the largest number of employees in Region III. Moreover, as described above, promotion of the sector is indispensable to accord to one of the national policy for increase of the food self sufficiency rate.

Table 3.2.2 Annual Average Growth Rate of Gross Value Added in Industrial Sectors of Region III from 1995 to 2007

Sector	Subsector	Gross Value Added (in million pesos)		Annual Ave. Growth Rate 1995-2007
		In 1995	In 2007	
Agricultural Sector	(1) Agriculture and Fishery	38,532	93,435	7.7%
	(2) Forestry	0	104	-
Industrial Sector	(3) Mining and Quarrying	1,248	639	-5.4%
	(4) Manufacturing	39,226	118,107	9.6%
	(5) Construction	14,002	33,774	7.6%
	(6) Electricity and Water	4,922	23,338	13.8%
Service Sector	(7) Transport, Comm., Storage	7,904	39,306	14.3%
	(8) Trade	21,339	72,669	10.8%
	(9) Finance	2,354	9,112	11.9%
	(10) O. Dwellings & Real Estate	11,749	33,627	9.2%
	(11) Private Services	10,939	48,504	13.2%
	(12) Government Services	7,724	28,742	11.6%
Regional Total (GRDP)		159,939	501,356	10.0%

Note: The current price as of 2008

Source : "Gross Regional Domestic Product" by National Statistical Coordination Board

The number of employees in Region III is about 3.4 million, which makes up about 35% of the total population in the region. The largest number of employees in the region belongs to agriculture/forestry and wholesale/retail. Both of the occupations receive about 22% of the total employees in the region as listed below.

Table 3.2.3 Number of Employees according to Occupation

Occupation	Number of Employees (thousand)	Share to Total
Agriculture and Forestry	745	21.90%
Wholesale and Retail	743	21.90%
Manufacturing	416	12.20%
Social Service Activities	382	11.20%
Transport, Storage and Communication	375	11.00%
Construction	252	7.40%
Others	478	14.10%
Total	3,396	100.00%

Source: "2008 Philippines Statistical Yearbook" by National Statistical Coordination Board

The GVA per head of employee was estimated based on the above GVA and the number of employees in each industrial sector. The highest GVA per head of employee is 255 thousand pesos/employee in the Industrial Sector followed by 122 thousand pesos/employee in the Service Sector and 116 thousand pesos/employee in the Agriculture Sector as listed below.

Table 3.2.4 Gross Value Added per Head of Employee

Sector	Gross Value Added (million pesos)	Number of Employees in Each Industrial Sector (thousand)	Gross Value Added per Head of Employee (pesos/person)
Agriculture Sector	93,539	804	116,342
Industrial Sector	175,858	690	254,867
Service Sector	231,960	1,902	121,956
Total	501,357	3,396	147,632

Source: "2008 Philippines Statistical Yearbook" by National Statistical Coordination Board

3.3 Income and Poverty Statistics

The annual incomes in Region III for the recent decade from 1997 to 2006 are in a range of 1.05 to 1.14 times of the national average as shown in Table 3.3.1. At the same time, the annual income in Region III is the third highest value next to NCR and Region VI-A among the 17 regions in the Philippines. Thus, Region III is rather wealthy as compared with the other regions.

Table 3.3.1 Annual Average Family Income in Region III

Region	1997	2000	2003	2006
Average Annual Income (pesos/year/family)	133,130	151,449	160,000	197,640
Ratio to the National Average	108%	105%	108%	114%

Source: "2008 Philippines Statistical Yearbook" by National Statistical Coordination Board

NSCB estimates the "Per Capita Poverty Threshold" (hereinafter referred to as PCPT), which is the minimum income necessary to enhance an adequate standard of living, by provinces in the Philippines. The national average PCPT is 15,057 pesos/head/year, and about 33% of the population in the country is regarded as indigents whose annual incomes are below the average PCPT. On the other hand, the indigents in the major four provinces of Bulacan, Nueva Ecija, Pampanga and Tarlac in the study area form about 20% of the total population as listed below.

Table 3.3.2 Annual Per Capita Poverty Threshold and Incidences of Population for Whole Country and Four Provinces Overlapped with Study Area

Objective Area	2003			2006		
	Per Capita Poverty Line (pesos/head/year)	Poor Population	Poverty Incidence (%)	Per Capita Poverty Threshold (pesos/head/year)	Poor Population	Poverty Incidence (%)
1 National Total	12,309	23,836,104	30.0	15,057	27,616,888	32.9
2. Provinces in Region III	14,378	1,535,784	17 5	17,298	1,914,590	20 7
3. Major Provinces in Study Area	14,629	1,289,078	17.5	17,446	1,584,003	20.3
(1) Bulacan	15,027	307,762	12.3	17,768	358,012	13.4
(2) Nueva Ecija	14,394	484,106	27.1	17,830	662,742	37.7
(3) Pampanga	15,148	289,106	14.7	17,243	234,820	10.8
(4) Tarlac	13,866	208,104	18.4	16,463	328,428	27.6

* Annual Per Capita Poverty Threshold = The minimum annual income per person to meet the basic food and non-food requirement

** Poor Population = The population, whose annual income is less than the per capita poverty threshold.

*** Poverty Incidence = The proportion of poor population to the total population.

Source: "2008 Philippines Statistical Yearbook" by National Statistical Coordination Board

As stated above, the average ratio of the poor population in the study area is far lower than the national average. However, particular attention should be given to the ratio of Nueva Ecija Province, which is far higher than those in the other three provinces and exceeds even the national average. According to the "Socio Economic Profile of Nueva Ecija Province, Series of 2005," a majority of the employees are engaged in the Agriculture Sector (47% in the Agriculture Sector, 40% in the Service Sector, and 13% in the Industry Sector). Accordingly, one of the crucial issues for poverty alleviation in Nueva Ecija Province should be addressed to the increment of income of employees engaged in the Agriculture Sector.

3.4 Land Cover

The agricultural area widely extends in the central part of the study area as shown in Annex-F 3.4.1. The mountain area is characterized by forest land and/or brush land. The built-up area is in general scattered. However, around the San Fernando and Angeles areas is a continuous built-up area. The share of each category of land cover in the study area is summarized in Table 3.4.1

Table 3.4.1 Land Cover Category in the Study Area

Land Cover Category		Area (km^2)	
Forest		1,875.4	(18.0%)
Brush Land		2,533.9	(24.3%)
Cultivated Area	PaddyField	3,972.5	(38.1%)
	OtherCultivatedArea	706.7	(6.8%)
Populated Area	Built-upArea	268.0	(2.6%)
	Settlement	70.1	(0.7%)
Wetland	Swamp	57.1	(0.5%)
	Fishpond	490.5	(4.7%)
Water Body		149.3	(1.4%)
Others	Others(Natural)	293.5	(2.8%)
	Others(Artificial)	17.5	(0.2%)
Total		10,434.4	(100.0%)

Source: JICA Study Team

3.5 Water Use

The present water demand and the water volume granted as water use right by NWRB have been estimated, as shown in Table 3.5.1. It should be noted that the category of municipal water demand includes the following types of water use: domestic, municipal, recreational and other purposes. The commercial and light industrial water demand, which may be provided by public water providers and may not be granted as industrial purpose in the water permit issued by NWRB, is also included in the category of domestic water demand.

Table 3.5.1 Summary of Granted Water Quantity as Water Use Right and Present Annual Average Water Demand in the Study Area

(unit: m^3/s)

Category of Water Demand Estimation	Type of Water Use defined by Water Code	Estimated Present Water Demand (Annual average)	Granted Water Quantity
Municipal	Domestic Municipal Recreation Other purposes	7.429	9.506
Municipal by MWSS	Municipal	46.236*	46.236
Industrial	Industrial	1.265*	1.265
Irrigation	Irrigation	Maximum 241.028 Average 113.356 Minimum 22.508	316.529
Power Generation	Power generation	103.000*	103.000
Fisheries (Brackish water)	Fisheries	17.900	0.000
Fisheries (Fresh water)	Fisheries	6.400	0.028
Livestock	Livestock	0.290	0.019
Total excl. power generation and fisheries (brackish water)		174.976	373.583
Total		295.876	476.583

Note *: It is assumed that the present demand is the same as the granted water quantity.
Source: JICA Study Team

The following could be noted from the above table:

(1) Estimated annual average water demand for irrigation is about 40% of the granted water quantity. The granted water permit shows only the maximum quantity which may be abstracted. The actual pattern of irrigation water demand throughout a year should be considered when water supply-demand balance is examined.

(2) The estimated water demand for fisheries is much larger than the currently granted water quantity.

3.6 Water Tariff

The water tariff is broadly divided into the following “Irrigation Service Fee” (herein referred to as ISF) and the “Water Tariff for Municipal/Industrial Use.”

(1) ISF: NIA sets up the irrigation service fee (ISF) based on the concept that NIA delivers the right volume of water at the right time to every farm at least twice a year, and the farmers shall pay ISF for NIA’s services in the delivery of water to the farms.” The rate of ISF as of 2008 is in the range of 1,000 to 1,750 pesos/ha/year.

(2) Water Tariff for Municipal/Industrial Use: The water districts under the jurisdiction of LWUA form the majority of water service providers (WSPs) for municipal/industrial use in the study area, and their water tariff is as listed in Table 3.6.1. LWUA undertakes the governmental financing to the water districts by loan, and the water districts are obligated to pay back the loan with some interest by using the water charges collected from the end users based on their water tariff.

Table 3.6.1 Water Tariff for Municipal/Industrial Water Service for Water Districts under Jurisdiction of LWUA

Province	Number of Samples	Service Conn'n Fee (pesos)	Basic Water Charge* (pesos)	Additional Charge (pesos/m^3)				
				11~ 20m^3	21~ 30m^3	31~ 40m^3	41~ 50m^3	>51m^3
I. Water Tariff in and around Study Area								
Bulakan	22	10,090	173	19	21	24	26	29
N. Ecija	18	3,207	192	20	22	23	25	27
Pampanga	12	9,526	148	16	18	19	21	23
Tarlac	2	11,208	174	19	21	23	25	27
Total	54	7,729	174	19	20	22	25	27
II The National Average Water Tariff as of 2008								
	-	-	167	19	21	23	25	26

Note: *: The minimum rate for the water use of less than 10m^3.
- : Data is not available
Source: "Philippine Water Districts Directory", LWUA

The collection ratio of ISFs varies depending on the irrigation system and the year. The collection rates as of 2008 are in the range of 10.2% to 67.1%. According to officials of NIA, the current rate regulation was set in 1975 (34 years ago), and since then, it has never been revised. The rate systems are generally set to recover operation and maintenance cost including salaries and wages of staff and laborers. However, even the salaries and wages are hardly recovered by the water tariff at present.

As compared with the above collection ratios of ISF, those of the water tariff for municipal/industrial water supply service are deemed to be better. The collection ratios by the WSPs for municipal/industrial water supply service under the jurisdiction of NWRB are in the range of 50 to 90%, and several WSPs could achieve the highest ratio of 90%. The customers for the municipal/industrial water supply services are required to pay their water charges at the beginning of the month for their consumption in the last month, and disconnection of the water supply service is executed to the customers whose payments are delayed for more than two months. This penalty is likely to boost the collection ratio of the water tariff.

3.7 Water-Related Disease

The pollution of surface water as well as groundwater could cause a variety of contagious diseases. Those diseases could outbreak through several routes such as (a) drinking of and/or contact with polluted water; (b) infection by mosquito and other vectors which breed in and around the water, and (c) infection by parasites (such as schistosome) which inhabit the water. From these points of view, the water-related diseases are categorized into four (4) groups as shown below.

Table 3.7.1 Typical Cases of Water-related Disease

Cause of Disease	Typical Case of Disease
Drinking of Polluted Water	Cholera、Typhoid、Paratyphoid, Hepatitis (Type A and E), Dysentery , Diarrhea*
Contact with Polluted Water	Scabies, conjunctivitis, typhus, trachoma
Infection by Vector	Malaria, Dengue, Yellow Fever, Filariasis
Infection by Parasite	Schistosomiasis

Note *: Diarrhea is due to the drinking of polluted water which contains the parasite.
Source: JICA Study Team

According to the statistical data from NSCB, the whole country and Region III recorded the water-related diseases as all-year average from 1995 to 2002, as shown in Table 3.7.2. Among the diseases, Malaria is the most prevalent in the whole country taking the disease ratio of 83.6 to 100,000 population, and Dengue Fever and Typhoid/Paratyphoid follow. On the other hand, the highest disease ratio in Region III is from Dengue Fever (disease ratio of 18.4 to 100,000) followed by Typhoid/Paratyphoid and Malaria. Particular attention is given to Schistosomiasis, which still has a rather high disease ratio in the whole country (12.5 to 100,000) but almost expelled in Region III.

It is herein noted that diarrhea is more prevalent than Malaria and Dengue Fever in the whole country, as well as Region III. However, diarrhea is caused not only by drinking of the polluted water but

also by other non-water-related factors such as eating/drinking of too much food, spoiled food, and poisonous materials. Under the circumstances, it is virtually difficult to know the disease rate of diarrhea caused by polluted water, and diarrhea is not counted as a water-related disease.

Table 3.7.2 Number of Water-Related Diseases in the Philippines and Region III (Five-Year Average for 1995 to 1998 and 2002)

Area	Cause of Disease	Number of	Rate to Total Number of Water-Related Diseases	Rate per 100,000 Persons
Whole Country	Malaria	59,218	57.6%	83.6
	Dengue Fever	19,408	18.9%	26.3
	Typhoid/Paratyphoid Fever	14,744	14.3%	20.8
	Schistosomiasis	8,845	8.6%	12.5
	Cholera	565	0.5%	0.8
	Total	102,780	100.0%	143.9
Region III	Dengue Fever	1,346	52.6%	18.4
	Typhoid/Paratyphoid Fever	633	24.8%	9.1
	Malaria	542	21.2%	8.2
	Cholera	34	1.3%	0.5
	Schistosomiasis	2	0.1%	0.0
	Total	2,557	100.0%	36.2

Source: 2006 Compendium of Philippines Environmental Statistics, NSCB

As listed above, the disease ratios of all cases in Region III are far lower than those in the whole country. Most of the present drinking water in Region III is from the groundwater, and judging from the lower disease ratio of Typhoid/Paratyphoid Fever in the region than the country average, the groundwater in the region is currently controlled under a rather good hygienic condition. Likewise, the lower disease ratio of Malaria, Dengue Fever and Schistosomiasis in the region suggests that the surface water has not seriously deteriorated.

3.8 Indigenous Peoples

In the Study Area, there are 133,312 Indigenous Peoples (IPs) which is composed of five groups of tribes, as summarized below. The Aeta tribe accounts for 34.2% of the total population of IPs in the study area, followed by group of Ibaloi, Kalanguya and Kankanaey tribes.

Table 3.8.1 Population of Indigenous Peoples distributed in and around the Study Area as of 2006

Province / Tribe	Aurora		Bulacan		Nueva Ecija		Pampanga		Tarlac		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Aeta	112	0.8	0	0.0	1,032	1.9	18,920	100.0	25,503	66.2	45,567	34.2
Abelling	0	0.0	0	0.0	0	0.0	0	0.0	13,032	33.8	13,032	9.8
Dumagat/ Remontado	5049	34.4	6861	100.0	10,701	19.7	0	0.0	0	0.0	22,611	17.0
Ibaoloi/ Kalanguya/ Kankanaey	0	0.0	0	0.0	42,585	78.4	0	0.0	0	0.0	42,585	31.9
Ilongot/ Bugkalot	9517	64.8	0	0.0	0	0.0	0	0.0	0	0.0	9,517	7.1
Total	14,678	100.0	6,861	100.0	54,318	100.0	18,920	100.0	38,535	100.0	133,312	100.0

Note:
Relevant municipalities in Aurora Province: Baler, Casiguran, Dilasag, Dinalungan, Dinagalan, Dipaculao, Maria Aurora, San Luis
Relevant municipalities in Bulacan Province: Dona Remedios de Trinidad, Norzarway and San Jose Del Monte
Relevant municipalities in Nueva Ecija Province: Carranglan, Lupao, Pantabangan, Rizal, San Jose City, Science City of Muños, Bongabon, Cabanatuan City, Gabaldon, Laur, Licab, Palayan City, Gen.Tino
Relevant municipalities in Pampanga Province: Angeles, Floridablanca, Mabalacat, Polac, City of San Fernando
Relevant municipalities in Tarlac Province: Bamban, Camiling, Capas, Mayantoc, San Clemente, San Jose, Tarac City
Source: NCIP Regional Office III

Republic Act No. 8371, known as the Indigenous Peoples Rights Act, prescribes the fundamental rights of indigenous peoples in the country and prescribes that the ownership and possession of IPs to their ancestral domains shall be recognized and protected. Also, the act institutionalized the National Commission of Indigenous People (NCIP), which is responsible for the formulation and

implementation of policies as well as issuance of Certification of Ancestral Domain/Land Titles (CADT/CALT). CADT refers to a title recognizing the rights of possession and ownership of IPs over the identified area, while CALT refers to a title recognizing the right of utilization of the identified lands by the members of IPs. There are four (4) CADTs in and around the study area, as shown in the following table.

Table 3.8.2 Status of Ancestral Land Delineation and Titling in and around the Study Area as of March 9, 2010

Location	Claimant Tribe	Area (ha)
Areas where the CADTs/CALTs have been issued	Dumgat, Aeta, Kalanguya, Aeta, Kalanguya-Ikalahan	277,465.85
Areas where the survey for e Ancestral Land Titles have been completed	Dumgat	13,883.20
Areas where the survey for Ancestral Land Titles is in progress	Aeta, Bugkalot	66,718.00
Areas where the social preparation for Ancestral Land is in progress	Dumagat	67,283.00
Total		425,350.05

Note*: NCIP is in charge of implementation of the profile survey for the area.

Source: NCIP

3.9 Historical and Religious Sites

In the study area, there is no archeological and/or historical site designated as World Heritage listed area by UNESCO. However, there exist other significant historical sites and landmarks in the study area as summarized below.

Table 3.9.1 Historical sites and Landmarks in the Study Area

Province	Municipality/City	Historical Site/Landmark
Bulacan	Malolos	Barasoain Church
	Baliuag	Baliuag Church
	Paombong	Paombong Church
	Plaridel	Quingua Church
	San Rafael	San Rafael Church
	Calumpit	St.John the Baptist Church
	Sub-total	6 sites
Nueva Ecija	Carranglan	Dalton Pass
	Cabanatuan	McArthur Statue
	Cabanatuan	Pangatian Shrine
	Guimba	Triala House
	Penaranda	Church of Peneranda
	Gapan	Tabacalero of San Isidro
	Sub-total	6 sites
Pampanga	Angeles city	Church of Sto Rosario
	Bacolor	Church of Bacolor
	San Fernando	Church of San Fernando
	Mabalacal	Marcos Village
	Sub-total	4 sites
Tarlac	Capas	Capas National Shrine
	Capas	Death March Monument
	Tarlac	Tarlac Cathedral
	Sub-total	3 sites
Total		19 sites

Source: Manila Bay Area Environmental Atlas, PAWB- DENR,2007

4. Present Practices for Water-Related Development and Conservation in the Study Area

4.1 Water Resource Development Facilities

There exist the two (2) large storage dams in the study area, namely; Angat storage dam and Pantabangan storage dam. Both of them are accompanied with trans-basin water transfer schemes. The fundamental features of the existing storage dams are summarized in the following table. The location maps of Angat storage dam and Pantabangan storage dam are presented in Annex-F 4.1.1 and 4.1.2, respectively.

Table 4.1.1 Fundamental Features of Existing Storage Dams

Storage Dam	Item	Description
Angat	Completion year*1	September, 1967 (start of construction in 1961)
	Purpose*1	Municipal, Irrigation water supply, Hydropower, Flood control
	Dam type*1	Earth and rock fill dam
	Dam height*1	131m
	Effective storage*1,*4	894MCM (696MCM for Municipal, Irrigation water supply, Hydropower)
	Drainage area*2	546km^2
	Re-regulation dam*1	Ipo dam, Bustos dam
	Trans-basin*1,*2,*3	Umiray-Angat trans-basin (operation started on June, 2000) (A=130km^2) (Two intakes with catchment area of 31km^2 not yet completed).
Pantabangan	Completion year*5	November, 1973 (release started in February 1974)
	Purpose*5	Irrigation water supply, Hydropower generation, Flood control
	Dam type*5	Zoned earth-fill dam
	Dam height*5	107m
	Effective storage*5	2,775MCM (total volume: 3,000MCM, deal volume: 225MCM) (1,757MCM for Irrigation water supply, Hydropower)
	Drainage area*2	937km^2 (incl. catchment of Aurora trans-basin and Masiway dam)
	Re-regulation dam*5	Masiway dam
	Trans-basin*2,*5	1) Aurora trans-basin (A=68km^2) 2)Casecnan trans-basin (operation started in December 2001) (A=570km^2)

Source: *1: NWRB/JICA, Dams in the Philippines
*2: GIS data prepared by JICA Study Team
*3: ADB, MWSS: Umiray-Angat Transbasin study
*4: Data provided by NPC and analyzed by JICA Study Team
*5: NIA, Pantabangan Dam, Briefing Kit

4.2 Agriculture/Irrigation and Fishery Development

4.2.1 Irrigation

The development strategies for the agriculture sector in the Medium-Term Philippine Development Plan for 2004-2010 (MTPDP 2004-2010) are anchored on two primary goals: (1) to expand the agricultural production base; and (2) to increase productivity. Self-sufficiency in rice production is considered, in particular, as a key component of the agriculture productivity goal. Succeeding MTPDP, the Updated Central Luzon Regional Physical Framework Plan for 2005-2030 (RPFP 2005-2030) was formulated in 2006. This RPFP gives priority to the development of new irrigation systems and the rehabilitation of existing systems in order to expand the coverage to agricultural production areas and increase their efficiency.

In accordance with the above policies, the irrigation systems of about 240,000 ha have been developed in the study area, as listed below.

Table 4.2.1 Types of Irrigation System in the Study Area

	Administrative Agency	Service Area	(Share)
National Irrigation System (NIS)	Constructed and operated by NIA	177,616 ha*1	(72%)
- River Irrigation System (RIS)			
- Pump Irrigation System (PIS)			
- Groundwater Irrigation System (GIS)			
- Small Reservoir Irrigation Project (SRIP)			
Communal Irrigation System (CIS)	Constructed by NIA and turned over to IA	53,884 ha*1	(22%)
- Communal Irrigation System (CIS)			
- Pump Irrigation System (PIS)			
Small Scale Irrigation and Water Harvesting	BSWM	1,826 ha*2	(1%)
- Diversion Dam (DD)			
- Small Water Impounding Project (SWIP)			
- Small Farm Reservoir (SFR)			
- Shallow Tubewell (STW)			
Private Irrigation System		12,770 ha*3	(5%)
Total		246,096 ha	(100%)

Source : *1; NIA, *2; BSWM, *3; RPFP, 2005-2030 (including out of Study area)

The National Irrigation System (NIS), which has the service area of more than 1,000 ha in general, has been set-up and is operated and maintained by NIA. There are eight (8) NISs in the Study area with the total service area of around 178,000 ha including those of groundwater systems, as shown in Table 4.2.2. Locations and schematic flow diagrams of the NISs are as shown in Annex-F 4.2.1 and 4.2.2, respectively. Of these NISs, the Upper Pampanga River Integrated Irrigation System (UPRIIS) is the largest in the study area and also in the entire country. It has a total service area of 119,000 ha covering the province of Nueva Ecija and some areas in Bulacan and Tarlac.

Table 4.2.2 Summary of National Irrigation Systems (NIS) in the Study Area

Name of System	Service Area (ha)	Water Source
Angat-Maasim RIS (AMRIS)	31,485	Angat R., Massim R.
Porac-Gumain RIS	4,004	Porac R., Gumain R.
Tarlac-San Miguel-O'Donnel RIS (TASMORIS)	5,301	Tarlac R., San Miguel R., O'Donnel R.
Pampanga Delta RIS (PDRIS)	11,920	Pampanga R.
Upper Pampanga River Integrated Irrigation System (UPRIIS)	119,411	Pampanga R., Talavera R.
Aulo SRIP	810	Aulo R.
Nueva Ecija Pump IS	1,313	Groundwater
Tarlac Groundwater Irrigation System (TGIS)	3,372	Groundwater
Total	177,616	

Source: NIA

Communal irrigation systems (CISs), most of which have the service area of less than 1,000 ha, are constructed and turned over by NIA to organized groups of farmer-beneficiaries called "Irrigators' Association" (IA). The locations of CISs are shown in Annex-F 4.2.3. The construction cost of CISs are borne by NIA and later amortized by the beneficiaries after turnover. Some CISs are privately owned and operated. There are one hundred eighty-six (186) functional CISs with 37,100 ha of service area. However, ninety-five (95) systems with the total service area of 16,830 ha are non-functional.

There are also various small-scale irrigation systems under the Bureau of Soils and Water Management (BSWM) of the Department of Agriculture (DA). The locations of the small-scale irrigation systems are shown in Annex-F 4.2.4. These systems are developed to increase cropping intensity and production by providing small-scale irrigation and rainwater harvesting infrastructure utilizing small local catchments or shallow groundwater.

The on-going and proposed national irrigation projects to be implemented until 2018 are listed in the NIA-COPLAN 2009-2018, i.e., the Indicative Irrigation Development Program for 2010-2019 and BSWM as shown in Tables 4.2.3 and 4.2.4, respectively. In addition to the proposed projects in the NIA-COPLAN, the updated Central Luzon Regional Physical Framework Plan (RPFP) further

envisions development of the Balintingon Multipurpose Project, for which the feasibility study was carried out in 1983 and reviewed and updated at the pre-feasibility level in 2006. This project was proposed to irrigate new areas of 14,900 ha of its own service area and to divert water to the AMRIS area.

Table 4.2.3 Summary of On-going National Irrigation Projects

Name of Project	Province Covered	Schedule	
		Start	End
Balog-Balog Multipurpose Project Phase I	Tarlac	1999	2011
Rehabilitation of AMRIS	Bulacan	2009	2010
Along-along Creek Irrigation Project (In UPRIIS Div. 3)	Nueva Ecija	2010	2019
Comprehensive Agrarian Reform Program, Irrigation Component, Project II	Nationwide	1993	-
Repair, Rehabilitation of existing Groundwater Irrigation Systems, Establishment of Groundwater Pump Project	Nationwide	-	-
Repair, Rehabilitation, Restoration & Preventive Maintenance of existing National & Communal Irrigation Facilities	Nationwide	-	-
Balikatan Sagip Patubig Program (BSPP)	Nationwide	2010 -	2019
Repair, Rehabilitation, Restoration & Preventive Maintenance of Existing National & Communal Irrigation Facilities (RRENIS/CIS)	Nationwide	2010 -	2019
Restoration/Rehabilitation of Existing NIA-Assisted Irrigation Systems (PRE-NIA-AIS)	Nationwide	2010 -	2019
Participatory Irrigation Development Project (PIDP)	Nationwide	2010 -	2019
Rehabilitation of Small Water Impounding Projects/Diversion Dam	Nationwide	2009-	2011
Upper Tabuating SRIP	Nueva Ecija	2010-	2010-

Source : NIA-COPLAN 2009-2018: Indicative Irrigation Development Program, 2010-2019 and BSWM

Table 4.2.4 Summary of Proposed National Irrigation Projects

Name of Projects	Province Covered	Service Area (ha)	Expected Funding
Participatory Irrigation Development Project	Nationwide	26,791	GAA / IBRD
Procurement of Pumps, Drilling Rigs & Related Equipment	Nationwide	3,900	GAA / Spanish Loan
Balog-balog Multipurpose Project Phase II	Tarlac	34,410	GAA / ODA
Sector Loan on Rehabilitation of Irrigation Facilities	Nationwide		GAA / JICA
Casecnan Multipurpose Power & Irrigation Project, Irrigation Component, Phase II	Nueva Ecija / Bulacan	61,000	GAA / ODA
Irrigation Water Resources Augmentation Pump Establishment Project	Nationwide	2,361	-
Appropriate Irrigation Technologies for Enhanced Agricultural Production	Include. Regions III	4,000	GAA / ODA
Central Luzon Groundwater Irrigation Systems Reactivation Project	Nueva Ecija	5,000	-
Gumain Reservoir Project	Pampanga	16,750	-

Source : NIA-COPLAN, 2009-2018 and Indicative Irrigation Development Program, 2010-2019

Note : GAA: General Appropriations Act; IBRD: International Bank for Reconstruction and Development

The location map of the projected national irrigation projects including the Balintingon project is given in Annex- .2.5 while their schematic flow diagrams are in Annex-F 4.2.6.

In addition to the above NISs, the new construction or rehabilitation of existing CISs will be implemented under the nationwide programs, although the concrete development plan for individual CISs is not available. The proposed projects to be implemented by BSWM are summarized in Table 4.2.5.

Table 4.2.5 Summary of Proposed Small-Scale Irrigation Systems under BSWM

	No.	Service Area (ha)
Diversion Dam (DD)	18	1959
Small Water Impounding Project (SWIP)	24	1,635
Small Farmers Reservoir (SFR)	4	112
Total	46	2,706

Source : Estimated by the Study Team based on the BSWM database

4.2.2 Fishery

Fishery activities in the study area consist mainly of inland municipal and commercial fishing and aquaculture, while marine fishery is also prevailing in a part of Bulacan and Pampanga as well as Zambales and Bataan in Central Luzon. Aquaculture has the largest share (92%) of the region's fish production, as shown in Table 4.2.6.

Table 4.2.6 Fish Production by Province in 2008

(unit: ton)

Provinces	Commercial Fisheries	Municipal Fisheries		Aquaculture	Total
		Inland	Marine		
Bulacan	978	1,261	2,722	46,808	51,769
Nueva Ecija	0	1,783	0	7,022	8,805
Pampanga	0	9,327	2,237	143,917	155,481
Tarlac	0	398	0	6,141	6,538
Total (4 Provinces)	978	12,768	4,959	203,889	222,593
(Share)	(0.4%)	(5.8%)	(2.2%)	(91.6%)	(100%)
Region III Total	8,980	13,243	29,222	223,481	274,926
Country Total	1,226,205	181,678	1,151,309	2,407,698	4,966,889

Source: Bureau of Fisheries & Aquatic Resources

Fishes caught in Pampanga river basin especially in the Pampanga delta are a mixture of freshwater species and those tolerant of saltwater. Major species such as tilapia and tiger shrimp can tolerate varying concentrations of saltwater up to the strength of seawater. Major fish culture is aquaculture in fishponds, in which major fishes are Tilapia and Milkfish. Region III, mostly in the Pampanga delta, is ranked as the highest producer in the country in terms of aquaculture of Tilapia and Milkfish both in brackish and freshwater in fishponds.

In 1992 after the Mt. Pinatubo eruption, fishery production declined drastically especially in the Province of Pampanga due to the loss of flow and damage of fishponds. However, in these years, the production of aquaculture is remarkably increased especially in the Pampanga delta, while fish harvest is stable in the other provinces for the last five years.

Most of the fish ponds lie in the Pampanga delta, taking fresh or brackish water directly from the rivers or creeks. In addition, certain numbers of fish ponds are also operated within the service area of the NIA irrigation systems. NIA does not issue permits for fishery in the canals, while fishponds are allowed. Reportedly, fishpond owners pay an Irrigation Service Fee (ISF), double or more amounts compared to paddy farming, through an agreement between NIA and the fishpond owners/farmers. Fishery operation is about 4-8 months and its water requirement is around five times of that for paddy.

4.3 Municipal Water Supply, Sanitation and Sewerage

4.3.1 Municipal Water Supply

Immediately after the Millennium Development Goals (MDGs) was released through the UNDP Millennium Summit held in September 2000, the Government of the Philippines had resolved to adopt the MDGs and tightly integrated them into the Medium-Term Philippine Development Plan for 2004-2010 (MTPDP 2004-2010), thus allowing government strategies, policies and action plans to simultaneously address national and MDG targets.

The MDGs focused on the eight targets, and one of them was stressed to the access to safe drinking water in any water supply service level. In line with this policy, the MDGs for Central Luzon

targeted to increase the population rate, which could access safe water drinking and sanitary toilet facilities, from about 79% in 1990 to 90% in 2015.

Recently, the Philippine Water Supply Sector Roadmap has been issued by NEDA. It describes the framework, vision, goals, strategies and program needed to achieve the desired outcomes for the development of the water supply sector. The vision in the Philippine Water Supply Sector Roadmap is "Access to safe, adequate and sustainable water supply for all," which targets the objectively verifiable indicators with 100% access coverage and sustaining utility operation by 2025. There are four outcomes: 1) Strengthened Institutions in 2025; 2) Developed Capacities in 2025; 3) Strategic Alliances Built in 2025; and 4) Adequate Infrastructure Provision.

There are three water service levels called level 3, level 2 and level 1 system in the study area. The Level 3 system is the piped household connection provided by the Water Districts (WDs), LGUs and other private water providers. Level 2 and Level 1 are the piped communal faucets, and point source systems, respectively.

The provincial health offices and other relevant agencies have undertaken a sample survey on the population who could access the water supply service level. The existing water service level ratios for each city and municipality in the study area were estimated based on the information from the aforesaid relevant agencies. The estimated ratio of water supply service level by province is summarized in the following table. The condition for each municipality/city is shown in Annex-F 4.3.1 and 4.3.2.

Table 4.3.1 Present Coverage Ratio of the Water Supply Service System in the Study Area

Province	Water Supply Service Level			Safe Water Access	
	Level 3	Level 2	Level 1	Safe	Unsafe
Bulacan	57%	0%	43%	89%	11%
Nueva Ecija	34%	6%	60%	85%	15%
Pampanga	45%	5%	50%	76%	24%
Tarlac	32%	0%	68%	80%	20%
Total	45%	3%	52%	83%	17%

Note: Inside the study area only.
Source: PHO in Bulacan, Nueva Ecija, Pampanga and Tarlac (arranged by JICA Study Team)

About 45% of the population in the basin has the Level 3 water system, 3% have Level 2 water system, and 52% have Level 1 water system. The basin average ratio with access to safe water is 83%. This means that 17% have water supply of any water service level that are not within the permissible water quality under the Philippine National Standards for drinking water which is also patterned after the World Health Organization (WHO) standards. The groundwater is the major water source in the study area. Based on the NSO 2000 Census of population and housing, about 98% are using groundwater as their water source in the basin. About 2% in the study area have access to the use of surface water such as small springs and rivers as point source for domestic water supply and also for drinking by boiling the water and or with the aid of simple household sand filtration equipment.

4.3.2 Water Supply Service from the Study Area to MWSS Service Areas

MWSS is serving the municipal water supply for Metro Manila and a part of the provinces of Rizal and Cavite through its water service providers, Manila Water Company, Inc (MWCI) and Maynilad Water Services Inc. (MWSI). MWSS's service areas are located out of Pampanga river basin, while their present major water source is the Angat-Umiray system located in the river basin, which stores the runoff discharge of Angat River and Umiray River.

The allocation of water in Angat-Umiray system is complicated. The water use permits have been historically granted to several water users. However, the actual allocation is currently based on the resolutions issued from time to time. The latest water allocation from the Angat-Umray System to the municipal water supply service area by MWSS is 46m^3/s, which include the 20.1 m^3/s from Angat storage dam, 10.9m^3/s from Umiray and 15m^3/s from unutilized irrigation water (conditionally allocated).

The supply of 46m^3/s from the Angat-Umiray system to the service area of MWSS has been frequently unstable. There is water use conflict between the MWSS and NIA in the Angat-Umiray system due to limited supply. Both MWSS and NIA have agreed to look for additional water sources to stabilize the water supply from the Angat-Umiray system. According to MWSS[19)], the following water sources are under investigation:

- Proposed Balintingon storage dam in Balintingon multi-purpose project and conveyance to AMRIS area: Pre- F/S completed in 2006;
- Direct abstraction of surface water of Pampanga river at around Apalit and conveyance by pumps to AMRIS area: under investigation; and
- Candaba River: (details unknown)

In addition to the above potential water sources, NIA, NWRB and the World Bank had in 1994 proposed Bayabas and Maasim storage dams, which are located near to Angat dam site, to supplement the water supply capacity of the Angat-Umiray system. The additional water source for the Angat-Umiray system could be further conceived through the on-going rehabilitation works of the existing damaged diversion tunnel for the Umiray-Angat trans-basin system and the construction of the two additional diversion intakes, which could result in about 20% increase from the current inflow.

The above supplementary water supply sources are the utmost efforts to guarantee the present water supply of 46m^3/s allocated to the Angat-Umiray system, and it would be virtually difficult to secure any further water allocation of more than 46m^3/s for the existing MWSS service area. From this viewpoint, MWSS has projected several new water sources, almost all of which are located out of the study area except the Sumag diversion project to utilize the remaining intakes on Umiray River, in order to meet the incremental domestic water demand in Metro Manila and other MWSS service areas. Considering the current unstable water supply condition in the Angat-Umiray system, the water requirement of MWSS from the system should not exceed 46m^3/s even after the completion of the Sumag project.

In addition to the above water resource development plan, MWSS projects to expand its service area to the Province of Bulacan. A part of the coastal area of Bulacan currently suffers from salinity intrusion to the groundwater and lowering of the groundwater level, which causes difficulty in using the groundwater as the source of drinking water. In order to cope with this problem, MWSS has agreed with the provincial government of Bulacan to supply bulk water to the existing water districts. The project would deliver the treated bulk water of 2.7m^3/s to the priority cities and municipalities of Bulacan. According to MWSS[19)], the objective cities/municipalities for the bulk water supply project are as follows.

Table 4.3.2 Objective Service Area of Bulacan Bulk Water Supply Project

Classification	Objective Area
Out of the Study Area	• San Jose Del Monte (Raw water of 50MLD is currently supplied from MWSS.) • Meycauayan, Marilao and Obando (Areas supplied with treated water under MWSI) • Balagtas and Bocaue (Other areas to be served)
Within the Study Area	• Sta. Maria, Guiguito, Malolos, Bulacan, Calumpit (Other areas to be served)

Source: MWSS

The water source of the 2.7m^3/s is not yet known. However, as per NWRB Resolution No. 015-0816 issued on August 18, 2006, the 1.9m^3/s out of 2.7m^3/s is to be allocated to the Bulacan Government from the Angat-Umiray system. The newly developed water source at the Sumag Intake could be utilized for the remaining 0.8 m^3/s, based on MOU among MWSS, LWUA and the Bulacan Government in 1992.

4.3.3 Sanitation

The existing sanitary conditions for each city and municipality in the study area were evaluated based on the environmental report from the PHO. There are two types of toilets, namely; (a) the sanitary toilet in the form of flush toilet with septic tank; and (b) the unsanitary toilet without septic tanks,

which disposes human waste without passing through a septic tank so that leachate percolates directly into the ground or water bodies.

The estimated ratio of population with sanitary toilets is given in Table 4.3.3 (refer to Annex-F 4.3.3 regarding the condition in each municipality/city). Unsanitary toilets have a significant impact on water quality. Referring to Table 4.3.3, the ratio of unsafe water is complemented by the ratio of unsanitary toilet.

Table 4.3.3 Safe Water Ratio Relative to Sanitation Facilities

Province	2008 Safe Water Ratio		2008 Sanitation Facilities	
	Safe	Unsafe	Sanitary	Unsanitary
Bulacan	89%	11%	91%	9%
Nueva Ecija	85%	15%	86%	14%
Pampanga	76%	24%	88%	12%
Tarlac	80%	20%	85%	15%
Total	83%	17%	88%	12%

Note: Inside the study area only.
Source: PHOs, JICA Study Team

4.3.4 Sewerage

In addition to the above MDGs, the Clean Water Act was enacted in 2004, and its Section 8 titled "Domestic Sewage Collection, Treatment and Disposal" prescribes the following requirements:

- Within five (5) years following the affectivity of this Act, the agencies, which vests in the entities to provide water supply and sewerage facilities and/or concessionaires in Metro Manila and other highly urbanized cities, shall connect the existing sewage lines in all subdivisions, condominiums, commercial centers, hotels, sports and recreational facilities, hospitals, market places, public buildings, industrial complexes and other similar establishments including households to available sewerage system. This connection works shall be made through coordination with the LGUs.
- The said connection shall be subject to sewerage services charge/fee in accordance with existing rules or regulations unless the sources had already utilized their own sewerage system.
- All sources of sewage and waste water shall comply with the requirements herein. In the areas not considered as the highly urbanized centers (HUCs), the DPWH in coordination with the Department, DOH and other concerned agencies, shall employ septic tank or combined sewerage-septic management system.

The sewerage system located in the Clark Special Economic Zone (CSEZ) in Mabalacat Municipality, Province of Pampanga, is the sole existing complete system in the study area. The sewerage system has two separate subsystems for storm drainage and sewage. The present sewage effluent is being treated in the biological wastewater treatment plant (WWTP) with a capacity of 8,023m^3/day to accommodate the effluent of about 16,280 population and receive the effluent from a number of industrial, commercial and institutional houses/buildings within the CSEZ. The Clark Water Corporation (CWC) is the main provider for both water supply and sewerage systems. CWC is charging sewerage tariff at 40% of the domestic water bill. The present WWTP is proposed to be expanded by year 2010 to cater the effluent of 13,500 m^3/d and by 2012 to 33,000 m^3/d.

In the province of Nueva Ecija, Cabanatuan City has a complete feasibility study and engineering design for the construction of the urban sewerage, sanitation and drainage system to serve about 33,200 people. The designed combine sewerage system is composed of drainage/sewer lines, lift stations, and waste water treatment plant with a capacity of 6,630 m^3/d dry weather flow for STP 1 and 1,541 m^3/d dry weather flow for STP 2. The proposed biological treatment plant includes anaerobic lagoon and chemical disinfection. At present, the combined drainage and sewer lines are already constructed but the WWTP has not been done yet due to lack of funds.

The rest of the municipalities and cities in the study area have no sewerage system and the effluent is discharge directly into the nearest stream.

It has been reported that the present sludge disposal system is unmonitored and the desludgers are mostly disposing the untreated sludge anywhere such as open dumpsite and rivers.

4.4 Hydropower Generation

The total peak power demand in the Philippines reached 8,993MW in 2007, while the present total install capacity in the country is 15,937MW. Thus, the present install capacity is apparently adequate for the peak power demand. However, about 50% of the install capacity relies on oil and coal energy, most of which are supplied through importation. Accordingly, energy self-sufficiency for power generation is hardly achieved. In order to improve the power supply condition in the Philippines, the Department of Energy (DOE) set the following two targets: (1) to reach the energy self-sufficiency level of 60% by 2010; and (2) to introduce competitive and reasonable processes for power generation.

The Luzon Grid where the study area is located has the install capacity of 12,172MW, which corresponds to about 73% of the country total. Of the said install capacity, about 2,210MW or 18% is by the hydropower plant. To achieve the target of energy self-sufficiency, DOE presumes the necessity to increase a cumulative install capacity by hydropower in Luzon Grid from 2,210MW in 2005 to 2,510MW by the year 2014.

There currently exits three hydropower plants in the study area (refer to Annex-F 4.4.1), namely; (1) Angat hydropower plant with an install capacity of 246MW, which is placed at Angat storage dam; (2) Pantabangan-Massiway hydropower plant with an install capacity of 112MW placed at the downstream of Pantabangan Dam and Massiway Dam; and (3) Casecnan with an install capacity of 160MW placed at the outlet of Casecnan trans-basin tunnel connecting with Pantabangan dam reservoir. The total install capacity of these three hydropower plants is 458MW, which is about 20% of the total install capacity by hydropower plants in the Luzon Grid.

Of the said existing three hydropower plants, Angat hydropower plant is the most important to contribute to the peak power demand in Metro Manila in particular, because the plant is located near to the demand area and possesses the largest install capacity. In the Luzon Grid, peak demand usually occurs during day time, and Angat hydropower plant tends to release a large volume of the discharge during daytime and little during nighttime in the summer season in particular to cover the peak power demand. Such peak power generation requires a large fluctuation of discharges released from the dam reservoir throughout a day. Bustos Dam is located downstream of the Angat storage dam functioning as the after-bay to re-regulate the discharge released from Angat storage dam and supply the constant discharge to the irrigation area of AMRIS. Due to the large fluctuation of the discharge released from Angat storage dam, however, difficulties in re-regulating the discharge often occur, which leads to the difficulties in supplying the water to AMRIS from Bustos Dam.

In addition to the above existing hydropower plants, there are proposed installations of hydropower plant in the following proposed multi-purpose water resources development projects:

- Balintingon Reservoir Multipurpose Project: Installed Capacity = 30MW, Expected Generated Power = 119.6GWh/year; and
- Balog-Balog Multipurpose Project: Installed Capacity = 43.5MW, Expected Generated Power = 103.12GWh/year

After completion of the projects, it is expected that the installed capacity of 73.5MW will be added to the Luzon Grid.

4.5 Mitigation for Flood and Sediment Disasters

4.5.1 Existing Works

Most of the existing flood mitigation structures were founded in the 1970s (refer to Annex-F 4.5.1). The Pantabangan storage dam was constructed in the upper reaches of Pampanga river basin in 1973 with the flood control capacity of 330MCM. Immediately, after the dam construction, several

levees/river dikes had been constructed along the Pampanga mainstream. Of those levees/dikes, the Arayat-Apalit-Masantol Setback Levee has the longest length of 40km. However, the Levee protects only the right bank of Pampanga River against the flood, and the more serious flood overflow tends to rush into the left bank area where Candaba Municipality covering the Candaba Swamp and other two municipalities of San Luis and Simonn are located. Moreover, other river dikes/levees principally aim at protecting the river bank erosion and/or fix the river alignment and hardly contribute to the increment of river channel flow capacity. As the result, most of the downstream and midstream sections of Pampanga River have small channel flow capacities which could not cope with even the probable flood runoff discharge of 5-year return period.

In order to increase such small channel flow capacity, the Pampanga Delta Development Project (PDDP) was launched in 1982 and the PDDP Phase I was implemented in 1992 to 2002. The Project was completed at a reduced scale due to the budgetary constraints and difficulty of land acquisition of the Philippine government. The target river channel improvement length was 14.2km while the completed length was only 13.9km. Further work on the PDDP is being held as a plan examined.

Sediment prevention works had been also constructed in the eastern area of Mt. Pinatubo in the 1990s and 2000s in order to cope with the large volume of sediment runoff caused by the eruption of Mt. Pinatubo. Among the major projects for sediment prevention and management are: (a) Pinatubo Hazard Urgent Mitigation Project (PHUMP) Phase I for Sacobia-Bamban River (a tributary of Pampanga River); (b) Construction of Mega Dike and Transverse Dike for Pasig-Potrero River (a tributary of Pasac River); and (c) PHUMP Phase II for Pasig-Potrero River and San Fernando River.

In addition to the above structural approaches, the non-structural approaches by the flood forecasting and warning system have been also adopted in the study area. Among the existing flood forecasting and warning systems are: (1) the basin-wide flood forecasting and warning system for Pampanga completed in 1981 (refer to Annex-F 4.5.2); (2) the flood forecasting and warning system for effective reservoir operation of Pantabangan and Angat storage dams established in 1994; and (3) the community-based flood forecasting and warning system for Bulacan Province established in 2005.

4.5.2 On-going and Proposed Works

The on-going and proposed structural works for flood and sediment disaster prevention and management are as listed below (refer to Annex-F 4.5.3).

Table 4.5.1 On-going and Proposed Major Structural Flood Mitigation Projects

Name and Status of Project	Target River Basin	Status	Principal Purpose of Project	Families to be Relocated	Project Cost (billion pesos)
PHUMP Phase III /1	Pasac	On-going (2005-2010)	Flood mitigation for Pasac Delta	40 to 80	4.70
PHUMP Phase IV/2	Pasac	Proposed	Flood mitigation for San Fernando River and its connecting channels	100	3.30
PDDP FC Phase II /3	Pampanga	Proposed	Flood mitigation for Pampanga Delta	6,700	8.80
PDDP FC Phase III /4	Pampanga	Proposed	Flood Mitigation for South Candaba Swamp area	Unknown	Unknown
Maintenance/Rehabilitation Works/5	Pampanga	Proposed (2008-2014)	River channel maintenance and rehabilitation	Nil	0.20

Source: /1: Pinatubo Hazard Urgent Mitigation Project, Phase II, Monitoring and Planning of Flood Control Works on the Pasac-Delta (including Porac-Gumain River) and Third River Channel, 2002
/2: Pampanga Delta Development Project (Flood Control Component, Review Study for Phase II, 2003
/3: Feasibility Report on the Pampanga Delta Development Project, 1982
/4: DPWH Region III

The above structural works are broadly classified into the following three groups: (a) Pinatubo Hazard Urgent Mitigation Project (PHUMP), Phase III and Phase IV, which aim at coping with the flood and sediment disasters in the eastern area of Mt. Pinatubo; (b) Pampanga Delta Development Project (PDDP), Phase II and Phase III, which aim at coping with the frequent flood overflow of Pampanga

River; and (c) maintenance and rehabilitation works for the existing flood and sediment prevention and management structures. It is herein noted that the proposed PDDP Phase II and III in item (b) are indefinitely differed as described above.

In addition to the above structural works, there are two principal non-structural works for flood and sediment disaster prevention and management which are now in progress or proposed in the study area. One is the on-going project for upgrading of the aforesaid flood forecasting and warning system in Pampanga river basin and for dam reservoir operation of the Angat and Pantabangan storage dams (refer to Annex-F 4.5.2). Another is PHUMP Phase III, Part 2, which is proposed as a continuation of the aforesaid PHUMP Phase III, in order to mitigate the flood and sediment runoff in Porac river basin. This project includes several sub-project components such as those for watershed management, land use management, flood management by FFW and institutional management.

4.6 Watershed Management

Community-based forest management (CBFM) was formulated in 1995 by virtue of Executive Order 263 and eventually adopted as the national strategy to ensure the sustainable development of the country's forest resources pursuant to EO 318 of 2004. The CBFM takes the principles of social equity, sustainability and community participation in forest management and biodiversity conservation. CBFM now integrates and unifies all people-oriented forestry programs. It is currently envisioned that 9 million ha of forestland, i.e., 30% of the country's total land area, will be placed under CBFM by 2020.

The CBFM strategy led to the streamlining of the Revised Philippine Master Plan for Forestry Development (PMPFD) in 2003 and the formulation of the Green Philippines Program (GPP) in 2006. The PMPFD aims to reconcile forestry objectives with those for land, water resources, indigenous peoples and local environmental governance. The GPP, on the other hand, focuses on collaborative partnerships with the private sector in order to generate sufficient funding and support towards rapid reforestation and reversal of further loss of forest cover. The GPP targets the greening of four (4) thematic areas, namely; (a) protected areas; (b) mangrove and coastal areas; (c) agro-forestry; and (d) urban parks, green campuses and subdivisions.

Consistent with the framework of PMPFD and GPP, the DENR Region III and its field offices, namely; the Forest Management Service (FMS), the Protected Area, Wildlife and Coastal Management Division (PAWCZMD), the Provincial ENR offices and their respective Community ENR offices implement the watershed management projects in the basin. The DENR works closely with other government agencies such as the NIA, the NPC and the LGUs and coordinates the private sector's participation in forestry development and conservation initiatives.

The on-going watershed management programs and projects by these agencies are described in Annex-T 4.6.1.

4.7 Water-Related Environmental Management

The protection of water-related environment is laid down in the following national and regional imperatives:

- Maintaining good public health, ecological integrity and economic viability as embodied in the Philippine Agenda 21, the country's blueprint for sustainable development
- Enhancing water quality management, environmental compliance, solid waste management and pollution control, according to the DENR-EMB's priority thrusts and consistent with the mandates of the Clean Water Act (RA 9275), the Philippine EIS System (PD 1586), and the Ecological Solid Waste Management Act (RA 9003).
- Restoring the ecological integrity of Manila Bay in accordance with the Operational Plan for the Manila Bay Coastal Strategy (OPMBCS).

The Supreme Court in 2008 issued a continuing *mandamus* for the urgent cleanup of Manila Bay based on the OPMBCS. Specifically, the mandamus calls for a concerted effort among government agencies to: (i) reduce by 50% the water pollution discharges from all sources by 2015; (ii) implement

integrated solid waste management programs in all LGUs by 2007; (iii) achieve ecologically sound and sustainable aquaculture fisheries production by 2015; and (iv) protect aquifers from contamination and saltwater intrusion by increasing the coverage of water supply distribution by 50% by 2015.

The DENR Environment Management Bureau (EMB) III spearheads the initiatives and programs meant to improve and safeguard water quality in the region. These programs are implemented in partnership with other public agencies, private businesses, academe, civil society groups, the LGUs and international development institutions.

The on-going Capacity Development Project on Water Quality Management funded by JICA is meant to strengthen the capabilities of the DENR-EMB national and regional offices to implement priority actions mandated under the Clean Water Act. It also aims to strengthen capacity of the WQMA Governing Boards, industries, commercial entities, LGUs, and other stakeholders for achieving the water quality goals identified in the WQMA Action Plans. The Project began in 2007 and is now in its second phase. Under this project, the Marilao-Meycauayan-Obando river system in Bulacan was selected as the pilot area for designating WQMA and formulating WQMA Action Plan for Region III. This pilot WQMA will serve as a model for designating WQMAs and formulating and implementing corresponding action plans in Pampanga river basin and in other river systems within the region.

The on-going programs and projects on the water-related environmental management in the basin are described in Annex-T 4.7.1.

5. Present Institutional Setup for IWRM

5.1 National and Local Sector Policies, Planning and Implementation

Key national government agencies are responsible for sector policy, planning, implementing and monitoring of national projects, and regulatory functions specific to their jurisdiction. Part of the roles and authorities of the national government agencies were transferred to the local governments based on the Local Government Code of 1991 (LGC-1991). Local governments at all administrative levels retain responsibilities of public utilities for policy, planning, and regulatory functions specific to their jurisdictions, through the respective local government units (LGUs).

Those mandates and responsibilities are severely fragmented, spread across different government tiers and various national government agencies. Fragmentation might be partly induced by the three policies of privatization, decentralization and rationalization.

Allocation of sector roles of the national government and local governments are defined in SEC. 17, CHAPTER I of LGC-1991, the National Government Appropriations Act and other special laws. The basic public services and facilities vested in the LGUs are defined for Barangay, Municipality, Province and City, respectively, in LGC-1991. The LGUs are grouped into seventeen (17) regions and are also subdivided into 81 provinces, 136 cities, 1,495 municipalities and 42,008 barangays as of December 31, 2008.

The public works and infrastructure projects and other facilities, programs and services funded by the National Government Appropriation Act, other special laws, pertinent executive orders, and those wholly or partially funded from foreign sources, are not covered under SEC. 17, with some exceptions. However, the sector roles of the national government and local governments have not been unified, and those vary depending on the sector policy and prevailing conditions.

The institutions and organizations in the Philippines established by laws (Republic Act and Presidential Decree) are sustainable, but those established by Executive Orders and Administrative Orders tend to be abolished or not functioning after the change of administration. However, the creation of new republic laws has been difficult since 1996.

5.2 Institutional Framework for the Study Area

There are no specific institutional and legal arrangements in the study area with respect to water-related sector planning and implementation, and IWRM. The legal framework for policy, planning, approval, implementation of water-related projects, and the regulatory framework of water resources management are basically the same as those of the national government. The power and attributes of local government, inter-government relationship, local legislation, organization structure and staffing, local taxation and fiscal matters, local fiscal administration including budgeting, and share of local government units in the national wealth are enumerated in the LGC.

The local governments have not initiated yet further specific and/or own arrangements for the management of water-related sector.

5.3 NWRB as Apex Regulatory Body

The overall responsibility for coordination of water resources development and management is vested in the National Water Resources Board (NWRB). The jurisdictional powers, functions and duties of NWRB include: (1) to formulate policies and guidelines on water resources development and management; (2) to effect cross-sector and inter-department coordination of water resources development activities; (3) to grant or issue water permits and certificates of public convenience and necessity; (4) to advise NEDA on matters relating to water resources development plans, programs and projects; and (5) to exercise jurisdiction over disputes concerning water allocation and utilization.

5.4 Water Resources Planning and IWRM

The Medium-Term Philippine Development Plan (MTPDP-2004-2010) adopted the Integrated Water Resources Management (IWRM) through the river basin approach as the general strategy for water

resources management. In this regard, the creation of river basin organizations or any appropriate authority was identified as a specific strategy to manage water resources.

The NWRB is tasked with collating, coordinating and updating the framework plans for water resources and for NEDA to integrate the plans for water resources development and management into national strategies and policies. The framework plan is not a water resources basin development plan to manage water rights allocation quantitatively. The NWRB does not have the authority to determine the priority of the projects for implementation of a specific river basin water resources master plan. Neither a national government agency nor a local government has authority to determine and implement such an IWRM Plan which involves multiple provinces and multiple water sectors in a river basin.

Bills for the WRAP (Water Resources Authority of the Philippines) by DENR and the Water Regulatory Commission (WRC) by NEDA intended to strengthen the country's economic regulatory framework (regulation of water service providers) but the underlying principles are divergent. The Presidential Task Force on Water Resources Management and Development sought to create the Water Resources Authority of the Philippines (WRAP) as a new entity to take over the functions, powers and responsibilities of NWRB, in addition to new and broad powers and functions to develop a comprehensive water resources management strategy responding to the Water Crisis Act in 1995. NEDA proposed the creation of a Water Regulatory Commission (WRC) as an independent economic regulatory body to separate the economic regulation from the resource management (regulation of water utilization including issue of water permit and enforcement of laws). Both bills pended in the period 1997-2002 due to insufficient consultation done with the different stakeholders regarding the two bills.

5.5 Planning of Provincial Governments and Integrated Area Development

Planning of the provincial government is well executed by the provincial planning and development office (PPDO) under LGC-1991. Integrated area development approach has been well deployed for integration and prioritization of inter-provincial and inter-municipal development projects under the Regional Development Council (RDC) of Region III. RDC is the policy coordination and decision-making body in a region. The functions of RDC are the formulation of development plans and investment programs, project monitoring, and budgeting and investment programming.

5.6 River Basin Organization

The River Basin Organizations (RBOs) in the Philippines and two practices in Australia and Japan are classified into five types for clarification of the existing and planned RBOs in the Philippines.

Table 5.6.1 Types of River Basin Organization in Philippines and Other Countries

Type	Philippines		Other Counties
	Existing	Studied/Planned	
1. Statutory body for integrated area development and management of all infrastructures	LLDA (1966/amended 1975)	Ifugao-Isabela River Basin Development Authority(House Bill)	
2. Statutary body for policy making, planning, coordinating all inter-agency activities	Bicol River Basin Council (1973), Implementation by Bicol River Basin Management Office, EO No. 359 (2004)		
3. Statutory coordination body for advocating IWRM and monitoring watershed environment	Bohol IWRM Board (2008), PCEEM-Davao Inc. (2002)	Agusan River Basin Authority	
4. National agency for water resources management for the specified basin			Murray-Darling Basin Authority, Australia (2008)
5. National agency for construction and O&M of the facilities in the specified basin			Japan Water Agency (2003)

Source: JICA Study Team

6. Problems and Issues on IWRM in Pampanga River Basin

6.1 General

A variety of approaches for water resources development and management are being made in Pampanga river basin and they contain issues/problems in the sectors such as the water allocation/distribution, the flood/sediment disaster management, the watershed management and the water-related environmental management. It was further confirmed that some of the issues/problems are not latent in a single sector but they extend over several sectors. The problems and issues finally confirmed are as described hereinafter.

6.2 Agriculture/Irrigation and Fishery

6.2.1 Water Shortage in Existing Irrigation Systems

In many paddy fields including existing irrigation systems in both national and communal irrigation, water shortage is observed. The principal causes of the water shortage could be (1) recent climate change; (2) limited water resource development; (3) insufficient maintenance and deterioration of irrigation facilities; (4) lack of small scale irrigation; and (5) degradation of watershed.

6.2.2 Delay of Large-Scale Irrigation Development Projects

Implementation of all of the major large scale projects proposed in the study area has been suspended or delayed mainly due to the insufficient budgetary arrangement despite the rapid escalation of prices of construction materials.

6.2.3 Water Shortage in AMRIS

The priority of water distribution from Angat-Umiray system is given to the municipal water use in Metro Manila, and hence the irrigation operation in the AMRIS, which also relies on Angat storage dam as the water source, has been facing chronic water shortage. Moreover, the peak hydropower generation operated at Angat storage dam makes it more difficult to effectively utilize fully the water from the Angat storage dam for AMRIS.

6.2.4 Low Irrigation Efficiency

Low irrigation efficiency as the issues of the irrigation water management is caused by various reasons such as (1) deterioration of canals and related facilities; (2) insufficient water control facilities; and (3) high water conveyance loss in the unlined canal. The low irrigation efficiency is also caused by lack of proper water management activities both by the farmers and the related agencies.

6.2.5 Other Problems and Issues

In addition to the above issues and problems, the following items are pointed out in the stakeholder meetings:

(1) Deterioration of Water Quality

Two major issues/problems are identified in connection with the fishpond operation, which is extensively made in Pampanga Delta. One is the water pollution in the fishpond areas due to contamination by effluents and garbage flowing into the fishponds. Another is pollution load given by fishponds causing water pollution in Manila Bay.

(2) Depletion of Groundwater

Depletion of groundwater is reported causing saltwater intrusion in pump irrigation systems in Pampanga and Bulacan provinces

(3) Flood Damage to Irrigation System and Fishpond

Frequent flood damage and poor drainage in the irrigation area causes the low and unstable agricultural production, especially in lower Pampanga and its tributaries. Flood damage in the fishpond area has been also reported in the stakeholder meetings.

6.3 Municipal Water Supply, Sanitation and Sewerage

6.3.1 Inadequate Water Supply Source

The present groundwater as the source for municipal water supply tends to run dry and its quality is being deteriorated due to the unregulated/excessive extraction of groundwater and the unrepaired pipe leakages and the illegal pipe connections.

6.3.2 Unsafe Water Supply

About 17% of the households in the study area hardly take safe quality groundwater for drinking due to the impurities such as: (1) leachate of human waste from the unsanitary toilets; (2) bacteria as the result of poor operation and maintenance of water source/distribution system; (3) sand and other solids due to improper well development; and (4) intolerable salinity.

6.3.3 Increasing Pollution Load in Water Bodies

The problem on the increase of pollution load in the water bodies has been identified as the result of insufficient water pollution load reduction facilities in the study area. The present sewage from household septic tanks flows directly to the water bodies. On the other hand, there exists no municipal wastewater treatment plant in the study area except for the area of Clark. Moreover, the present sludge disposal system is reportedly unmonitored and most of the desludgers are disposing untreated sludge anywhere such as open dumpsite and rivers. According to the results of analysis on the water pollution load made in the study, the following ten cities/municipalities are likely to be the high pollution load contributors: Angeles, San Fernando, Malolos, Tarlac, Cabanatuan and the municipalities of Hagonoy, Baliwag, Calumpit, Mabalacat and Guagua.

6.4 Flood and Sediment Disaster Management

The study area which contains 30 to 750 thousand of population has been suffering from extensive flood damage every year, and the most serious occur on the delta of Pampanga River and the eastern Pinatubo area (i.e., Pasac river basin). Under the present flood damage conditions, the principal problems and issues hampering flood and sediment disaster management are as described in the following subsections.

6.4.1 Insufficient Structural Capacity for Flood Mitigation

One of the principal causes of the frequent and large-scale flood damage in the study area could be attributed to the extremely small river flow capacity. According to the preliminary estimation made in the previous relevant study on PDDP FC in 1982, the flow capacity of most sections of Pampanga River could hardly cope with even the 5-year return period flood.

The massive siltation at the waterways was also identified as another major issue for Pasac river system in particular. There still remains a volume of about 900MCM in the upper reaches of the river basin, produced by the eruption of Mt. Pinatubo in 1991. Such large deposits of lahar cause the large sediment runoff into the downstream river stretches. The current sediment runoff volume into the river channel is estimated at about four times of those before the eruption of Mt. Pinatubo. A substantial part of the present larger sediment runoff would accumulate in the river channel causing reduction of the channel flow capacity.

6.4.2 Increment of Flood Damage Potential

Flood damage in Pampanga river basin is being further aggravated due to complex factors, such as:

- Increase of surface runoff-discharge inflicted by the expansion of built-up area and the poor watershed management;
- Increase of assets/properties in flood hazard areas caused by the unplanned and/or rapid urban expansion;
- Encroachment of illegal settlers into the waterways;

- Unregulated quarrying in the river channels; and
- Climate change.

6.4.3 Inadequate Information and Knowledge on Flood Mitigation

The following issues have been pointed out in the stakeholder meetings:

- Inadequate real-time information on the flood forecasting and warning for the residents during flood time;
- Inadequate information on the flood hazard area;
- Risk of untimely release of dam water during flood time; and
- Garbage disposal into the water ways.

6.5 Watershed Management

The extent of the area, which is classified as forestland[1] in the study area, is about 3,595.5 km^2 or 34.5% of the entire catchment. On the other hand, the actual forest cover is only about 1,875.4 km^2 or 17.9% of the entire catchment referring to the satellite images in 2005 (refer to Annex-F 6.5.1).

6.5.1 Watershed Degradation

(1) Poverty and Lack of Livelihood Opportunities

The lack of income-earning opportunities in the lowlands continues to drive migrants into the uplands in search of livelihood. This spawns a rise in destructive activities in forestlands, such as timber poaching and unsustainable harvesting of forest resources, encroachment and illegal land use, and destructive cultivation practices.

(2) Absence of Harmonized Protected Area Plans

There does not exist any adequate, comprehensive and updated management plan for the National Integrated Protected Areas System (NIPAS) in the study area. The absence of a harmonized plan leads to illegal and conflicting land uses, along with the consequent habitat destruction and bio-diversity loss in these sensitive areas. Another significant problem concerns the violation of the condition of free prior and informed consent (FPIC), which is required before any project or undertaking within the ancestral domains of the indigenous communities.

(3) Inadequate Information and Decision Support System

There is no single office that takes responsibility over regular collection and updating of information about the state of forest and its resources, which causes difficulties in preparing the appropriate management plans for forest and its resources. Moreover, there is low appreciation for watershed conservation and protection and the implications on environmental, social and economic costs.

6.5.2 Weak Reforestation

(1) Inadequate Tenure Security

Inadequate tenure security leaves substantial parts of the forestlands as “open access” areas and therefore susceptible to encroachment and further degradation. Moreover, the constant shift in forest policies often leads to cancellation of some CBFM agreements, thus undermining efforts to improve tenure security. In some cases, inaccurate surveys and overlapping claims have resulted in resource use conflicts among tenure holders.

(2) Poor Performance of Reforestation Projects

The performance of past and on-going reforestation projects in the basin is below targets.

[1] The classified forestlands are placed in upland areas with the ground slope of more than 18%, which remains as the untitled public domains and in the hands of the State.

(3) Inadequate Institutional Capability

In spite of grappling by DENR, the organized communities end up not adequately equipped with technical and management skills to undertake forest protection and development in their tenured areas due to constraint of funding, manpower and logistics,. The constraints also affect the effectiveness and competence of the LGUs to undertake devolved watershed functions.

(4) Lack of Incentive for Private Participation and Investment in Forestry Development

The policy of total log ban and the slowdown of wood-based industries is said to be responsible for poor accomplishment among private forest concessionaires and the lack of interest by private investors to actively participate in forestry development.

6.5.3 Poor Institutional Coordination Mechanisms

(1) Conflicting/Overlapping Mandates

Conflict arises due to unclear and overlapping mandate over watershed areas and hinders cooperation between the DENR and the LGUS. There is a need to strengthen coordination mechanisms as well as clear delineation of authority at the lowest planning level.

(2) Inadequate Devolution

On one hand, LGUs want full devolution of forest management functions over integrated social forestry (ISF) and small watershed areas devolved to them under the Local Government Code. On the other hand, DENR cites that LGUs do not have sufficient means and technical capability, much less the willingness to undertake the devolved functions.

(3) Political Interference

The watershed activities in the basin often take a backseat in favor of political projects, which largely hinders implementation of the forestry and environmental conservation projects.

6.6 Water-Related Environmental Management

6.6.1 Inadequate Water Quality Data Management

There is a pressing need to rationalize the DENR's water quality monitoring system and develop complete inventory of pollution generators in the basin in order to generate sufficient reliable data. All hazardous waste generators also need to be inventoried, including hospitals and electronic manufacturing industries. Moreover, it is required to upgrade the office facility for DENR-EMB Region III, manpower capability and data storage system to facilitate systematic data retrieval and decisions on water quality management.

6.6.2 Contamination of Surface, Ground and Coastal Waters

The contamination of water resources in Pampanga river basin could be due to: (a) inadequate sewerage treatment and sanitation facilities; (b) pollution from industrial, agricultural and aquaculture wastes; (c) poor solid waste management; (d) over-extraction of groundwater; (e) siltation of rivers; and (f) illegal settlements along river easements.

6.7 Water Resources Development, Allocation and Distribution

6.7.1 Sustainable Water Source for Municipal Water Supply

The water source of municipal water supply in Pampanga river basin currently relies on groundwater source. However, among seventy-six (76) municipalities/cities inside the study area, twenty (20) municipalities/cities currently suffer from the chronic shortage of available supply volume of groundwater. The number of municipalities/cities which suffer from shortage of groundwater would increase to thirty (30) in 2025 (refer to Annex-F 6.7.1 and F 6.7.2).

In some water districts (WDs) in Bulacan Province in particular, the deterioration of water quality has already exceeded the tolerable level for drinking purpose due to salt-water intrusion. In order to cope

with this issue, it would be necessary to undertake the periodical monitoring on the groundwater level and convert the groundwater source to another source, such as surface water source.

6.7.2 Securing Necessary Water Sources for Expansion of Large Irrigation System

In order to support regional economic growth and job opportunity, expansion of irrigation area in Pampanga river basin is one of the fundamental strategies in the agriculture sector, and development of the following three (3) water resources for expansion of the large-scale irrigation systems are being projected: (1) Balintingon Reservoir Multipurpose Project (BRMP) for irrigation area of 14,900ha; (2) Balog-Balog Multipurpose Project Phase II for the irrigation area of 39,150ha; and (3) Gumain Reservoir Project for the irrigation area of 16,750ha. All of the projected water resources are for the exclusive use of irrigation. However, as for Gumain storage dam which has been projected as one of the irrigation dams, this issue shall be re-studied considering the possibility of supplying water for a part of the future municipal water use in Pampanga as well as the effect of the Mt. Pinatubo eruption on the proposed dam site.

6.7.3 Inadequate Reliability of Water Supply in Angat-Umiray System

The present reliability of water supply in Angat-Umiray system is inadequate both for irrigation and municipal water supply. The main causes of the problems and issues have been identified as shown below, based on analysis of the related documents and the hearing survey from the concerned agencies as well as the water balance study.

- Increase of water allocation for municipal water use without adequate water resources development;
- Existence of water use permits without proper amendment and/or modification by issuing resolutions;
- Unclear definition used in resolutions such as “unutilized irrigation water”;
- Water use permit which does not represent actual water demand for irrigation water use;
- Unregulated Peak Hydropower Generation; and
- Enforcement of operation rule, which is not approved due to the unclear responsibilities contained therein.

6.7.4 Expected Increase of Conflict among Water Users, especially between Municipal and Irrigation Water Users

Increase of conflict among water users, especially between municipal and irrigation water users are easily expected. Necessity of more surface water both for municipal and irrigation water supply in future is expected. In Pampanga river basin, a large amount of water use permits for irrigation water use has already been granted to NIA. If one needs to develop new water resources with storage dams, the existing water use permits should be adjusted considering the actual water use for irrigation. Otherwise, there would be almost no room for issuing additional water use permits in many cases. Uncertainty on water resources due to possible climate change in future may also cause the increase of the conflicts.

6.8 Institution

Eleven strategic issues have been defined for five key IWRM functions based on the problem-cause and objective-analyses done through a series of joint steering committee meetings with the technical working group, the technical working group meetings, the stakeholder consultations, the focus group discussions and the counterpart meetings.

6.8.1 Issue-1: Strengthen Water Rights Regulation Capacity

The NWRB resolution concerning the reservoir operation and draught coordination of the Angat dam resulted in increase of total water quantity of the water permit without supplementing new water sources. If the present institution is kept unchanged the water supply security level (reliability) inside the basin will decrease, and it will result in increasing the risk of regional socio-economic loss.

In order to attain a more rational and equitable water permit system, it is required to specify the seasonal variations of the allowable maximum limits of the water uses, and the minimum water supply security level for the water uses. At the same time, monitoring on the actual water uses and enforcement for the proper water uses shall be strengthened.

6.8.2 Issue-2: Enhance Efficient Water Use and Re-allocation of Water Rights

A detailed implementation rule and regulation (IRR) shall be prepared to clarify the rules, processes, compensation and all other necessary conditions for lease and transfer of the water right so as to enhance more efficient water uses.

6.8.3 Issue-3: Modify Overlapping Water Charge System

The Water Code prescribes that NWRB is entitled to collect water fees and charges for the water permit, while the Local Government Code prescribes that the LGU is entitled to collect a share from the proceeds of water resources within its jurisdiction area. It is required to unify the overlapping provisions on the water charges in the Water Code and the Local Government Code.

6.8.4 Issue-4: Achieve Sustainability of Groundwater

In order to enhance effective groundwater management, it is required to establish the extensive groundwater monitoring system and to arrange the institutional setup, which is effective to prevent the excessive groundwater abstraction.

6.8.5 Issue-5: Introduce Specific Law to Enhance Multipurpose Dam Projects

It is required to establish the legal basis on the allocation rule of cost and reservoir volume for multipurpose dams. Such allocation rule would be effective to achieve the rational and equitable water allocation for irrigation/municipal water use and hydropower generation during a drought.

6.8.6 Issue-6: Enforce to Maintain Environmental Flow

The environmental river flow is a major determinant of the ecosystem health, while the significance of the environmental flow is hardly comprehended and complied with among water users. In order to offset such unfavorable conditions, a legal arrangement would be required to preserve the minimum environmental river flow.

6.8.7 Issue-7: Strengthen Water Quality Monitoring and Management

The quality of surface water and groundwater is being deteriorated, while the present management to monitor and enforce water quality control is not effective. In order to cope with this issue, the institutional arrangement is necessary to specify the responsibilities of the water users and to empower the execution capacity of NGAs and LGUs for water quality management including the monitoring system.

6.8.8 Issue-8: Manage and Mitigate the Risk from Water-Related Disasters

There is no legal basis to define the responsibility to mitigate risks from floods of each of the water users concerned. Establishment of the flood control basin plan for the whole river basin or the concerned river stretch would provide a clue to resolve the issue.

6.8.9 Issue-9: Improve Watershed and Forest Management

The functions and territories of watershed management are not well defined among DENR, and other related national/local government agencies. Funds for implementation, maintenance and monitoring are also limited. Necessity of institutional strengthening has been reported but detailed and concrete problems and causes about the weak capacity have not been clarified well.

6.8.10 Issue-10: Set up Authority to Implement Pampanga River Basin IWRM

The National Water Resources Board (NWRB) recommended that a river basin organization should be organized in line with the preparation of the Study, and both the NWRB and JICA agreed that the creation of the river basin organization will be to the best interest of the Study (Minute of Meetings on the Study, March 2008). The IWRM Plan concept was accepted as part of the Medium-Term

Philippine Development Plan for 2004-2010 during the Central Luzon Water Summit, but creation of RBO or another organizational structure is not part of their plan. Overlapping of the existing authority with an RBO, which has been not welcomed by NEDA Region III, is a specific issue in the Philippines. The RBOs in the Philippines also tends to be weak at operation, maintenance and management of river facilities and monitoring systems.

It is required to clarify the institutional and legal arrangements including the river basin organization (RBO) in the Pampanga River Basin to implement and practice the IWRM Plan.

Allocation of the function of operation and management of river structures is not well defined between the national government and local governments in the Philippines, and this underlines the basic issue on the function of RBOs.

6.8.11 Issue-11: Strengthen Execution and Financial Capacity for Sustainability

It is necessary to clarify the responsibilities for the operation and maintenance of river facilities in the basin. It is also indispensable to strengthen the financial capacity of both LGUs and the line agencies to achieve a sustainable IWRM from the regional interests.

7. Guideline on the Formulation of IWRM Plan

7.1 Objective of the Guideline

The Guideline is prepared in order to provide definite procedures and methodologies for the formulation of the IWRM Plan for Pampanga river basin, and to be used as a material for consensus building on the proposed IWRM Plan. At the same time, a substantial part of the guideline shall be useful as reference and/or standards for the formulation of the IWRM Plan for other river basins.

7.2 Basic Concept of IWRM Adopted in the Guideline

IWRM should be an approach to promote the coordinated development and management of water resources and maximize the resultant economic and social welfare without compromising the sustainability of vital ecosystem. The process of IWRM shall move forward like a spiral with several different stages starting from the initial primitive stage toward the mature stages, as shown in Figure 7.2.1.

Each of the stages in the process of IWRM shall cover the sequence of the four (4) steps of: (a) assessment of existing conditions; (b) planning; (c) project implementation; and (d) monitoring on the results of project implementation. Moreover, the accountability to and synergy with the stakeholders has to be assured through involvement of them at every steps of the IWRM. The present stage of IWRM in Pampanga river basin is the initial spiral stage, and of the above four steps, the present study supports those of items (a) and (b). The follow-up activities after the present study are indispensable to complete an initial spiral stage of the process of the IWRM.

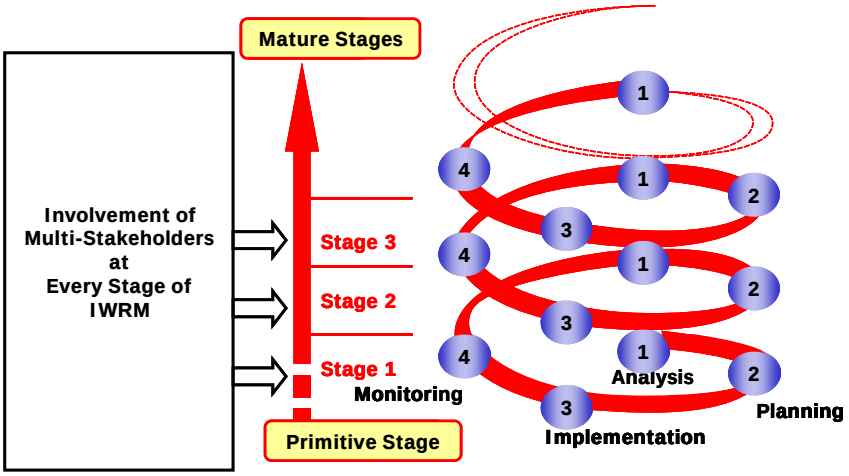


Figure 7.2.1 Process of IWRM

7.3 Planning Procedures for Formulation of IWRM Plan

As described above, this Guideline is to furnish the definite procedures and methodologies for the formulation of the IWRM Plan for Pampanga river basin. The procedures together with the methodologies for plan formulation are as summarized in the following subsections.

7.3.1 Step 1: Assessment (Identification of the Problems and Issues on IWRM)

Assessment on the principal problems and issues on the IWRM in Pampanga river basin shall be made as the basic approach to formulation of the IWRM Plan. The problems and issues are latent in the various aspects, such as: (a) the water resources development, allocation and distribution for the irrigation, the municipal water and other various water demands; (b) the flood and sediment disaster management; (c) the watershed management; and (d) other water-related environmental management. Moreover, some of the problems and issues are not limited to a single sector but they extend across several sectors causing the inter-sector conflicts.

7.3.2 Step 2: Setting of the Planning Framework

The planning frameworks shall be set as the preconditions for formulation of the IWRM Plan. The principal items of the planning frameworks are as follows:

- Target completion year of the entire plan;
- Socioeconomic frames by the target year;
- Visions, objectives and sector goals of IWRM Plan for Pampanga river basin; and
- Ceilings of Project Investment Cost.

7.3.3 Step 3: Selection of Potential Projects for IWRM in Pampanga River Basin

Various government agencies and non-government entities currently implement and/or propose the projects which could cope with the aforesaid issues and/or problems on IWRM and make a contribution to the visions, objectives and sector goals for the IWRM Plan. These on-going and proposed projects shall be identified as the components of the IWRM Plan.

In addition, the conceptual projects, which are essentially required to solve the issues and/or problems but currently neither implemented nor proposed, shall also be further proposed as the components of the IWRM Plan.

7.3.4 Step 4: Preliminary Study on Alternative Approaches to the Specific Issues

Some of the projects selected as the potential components of the IWRM Plan in the above Step 3 may contain several alternative approaches to cope with their own specific issues. The optimum plan among the alternative approaches should be ideally determined before finalizing of the IWRM Plan.

However, a feasibility study shall be required to determine the optimum plan. On the other hand, the IWRM Plan should involve numerous projects to attain a variety of water-related development scenarios, and therefore, the feasibility study would be hardly carried out, in detail, for each of the individual projects. From this point of view, the IWRM Plan shall take the following fundamental rules into account:

- The feasibility study shall be included as a part of the project and undertaken before the commencement of physical project works;
- The outline of the project features together with the project investment cost required shall be provisionally assumed taking the conceptual alternative approaches into account; and
- The pre-feasibility study on the project(s) may be carried out to estimate the most-likely optimum plan, when the project is judged to prominently influence the entire IWRM Plan and, at the same time, the basic information for the pre-feasibility study are available.

7.3.5 Step 5: Grouping of the Projects

The projects selected as the IWRM Plan in the above Step 3 shall be divided into Group-A and Group-B in order to facilitate the programming of the project development scenarios metioned below and the project implementation schedule/the project investment program. The projects in Group-A have to be implemented in accordance with the basic social and natural requirements regardless of the amount of project cost. The following projects shall be classified into Group-A:

- The projects for basic human needs like the municipal water supply projects, which are indispensable to secure human life;
- The projects, which are indispensable for preservation of the irreversible natural environments and/or resources; and
- The projects for rehabilitation and/or maintenance of the existing water resources management facilities, which are indispensable for sustainment of the inherent design capacity of the facilities.

All projects not included into Group-A are to be classified into Group-B, and the typical projects in Group-B are as enumerated below:

- The projects for economic development, which could enhance the growth of the regional economy and/or improvement of the livelihood in the region;
- The projects for mitigation of flood and sediment disasters, which could contribute to better public welfare and growth of the regional economy; and
- The ad hoc projects which could support and/or strengthen the annual regular projects classified into Group-A

The projects classified into Group-B could be implemented with the budget during the optional period, and the phased implementation schedule for them shall be determined based on the following two (2) factors into account:

- The priority order of projects, which could be determined taking the results of inter-sector project evaluation; and
- The ceilings of investment cost for each of the short-term, mid-term and long-term projects.

7.3.6 Step 6: Setting of Development Scenarios and Phased Implementation Schedule for Projects in Group-A

The target development scenario for the projects in Group-A shall be set as the prerequisite for the phased project implementation schedule. That is, the development scenario shall be firstly delineated and then, the phased implementation schedule shall be programmed in order to attain the development scenarios.

7.3.7 Step 7: Evaluating and Prioritizing of the Projects in Group-B

The projects classified into Group-B in the above Step 5 shall be evaluated in order to prioritize them. The evaluation is made to the inter-sector projects, which extend over the various water-related sectors. The evaluation is made from the viewpoints of six (6) categories, namely; (a) Viability of the Project; (b) Enhanced Livelihood; (c) Improved Quality of Life; (d) Decentralized Development; (e) Sustained Ecosystem; and (f) Empowered People. Each of the categories for evaluation would have further four (4) to five (5) criterions for evaluation as listed in Table 7.3.1, and the total number of criterions for evaluation would reach 25 items. Such a rather large number of criterions would be advantageous for the well-balanced evaluation of a wide range of projects in the various water-related sectors.

Each of the above criterions for evaluation would have three (3) ranks of scores. The projects which may be expected to attain high performance in the criterion, would take the score of 3, while those which would attain lower performance would take scores of 2 or 1.

(1) Score 3: Achievement of the criterion for evaluation has been already verified and/or it has been programmed as one of the primary purposes of the project.

(2) Score 2: The project is judged to make a certain indirect contribution to the criterion for evaluation, although achievement of the criterion is not the primary purpose of the project and/or it has been clearly verified yet.

(3) Score 1: The project is judged to hardly satisfy the criterion and/or make any contribution to the criterion.

Table 7.3.1 Categories and Criterions for the Evaluation of Projects

Category	Criterion for Evaluation
1. Viability of the Project	1.1 Economic viability
	1.2 Technical viability
	1.3 Financial affordability
	1.4 Impacts to natural and social environments
	1.5 Adaptability to climate change
2. Enhanced Livelihood	2.1 Creation of new job opportunities in the Region
	2.2 Increase of income level in the Region
	2.3 Improvement of livelihood for vulnerable group*
	2.4 Reduction of income gaps in urban and rural areas
3. Improved Quality of Life	3.1 Increase of access to safe drinking water
	3.2 Increase of per-capita municipal water supply volume
	3.3 Improvement of sanitary and health conditions
	3.4 Mitigation of flood risks and hazards
4. Decentralized Development	4.1 Development of regional economic development centers
	4.2 Increase of regional productivity in e agriculture, fishery, forestry, industry and service sectors
	4.3 Creation of favorable circumstances for private investment in the Region
	4.4 Enhancement of social equity in the Region
5. Sustained Ecosystem	5.1 Enhancement of sustainable monitoring on the ecosystem
	5.2 Protection of ecologically vulnerable areas
	5.3 Promotion of vegetation in the watersheds
	5.4 Reduction of potential pollution loads
6. Empowered People	6.1 Promotion of stakeholder participation in project planning and execution
	6.2 Improvement/transfer of knowledge and skills
	6.3 Promotion of community-based activities
	6.4 Empowerment of vulnerable group*

Note *: Vulnerable group includes the poor, indigenous people, women-headed households, out-of-school youths, handicapped and the elderly.

7.3.8 Step 8: Development Schedules and Phased Implementation Schedule for Projects in Group-B

The phased implementation schedule for projects in Group-B shall be programmed in accordance with the priority order of the projects as evaluated in the above Step 7 and the ceilings of project investment cost for each of the short-term, mid-term and long-term. Then, the phased development scenarios shall be delineated as the results of the phased implementation schedule. However, when the development scenarios proposed by the priority order of projects are hardly accepted by the stakeholders, the priority order shall be reexamined and a certain modification of the phased implementation schedule as well as development scenarios shall be made.

7.3.9 Step 9: Formulate the IWRM Plan for Pampanga River Basin

The implementation schedules, investment programs and development scenarios of the projects shall be finalized by integrating the outputs given in the above Step 6 and Step 8. The following items shall be clarified:

- The phased project implementation programs in the short-term (2011-2015), mid-term (2016-2020) and long term (2021 2025);
- The expected eligible financial source for the projects;
- The implementation bodies for the projects;
- The sectors, which the projects would belong, such as (a) agriculture/irrigation and fishery development; (b) municipal water supply, sanitation and sewerage; (c) flood and sediment disaster management; (d) watershed management; and (e) water-related environment management.

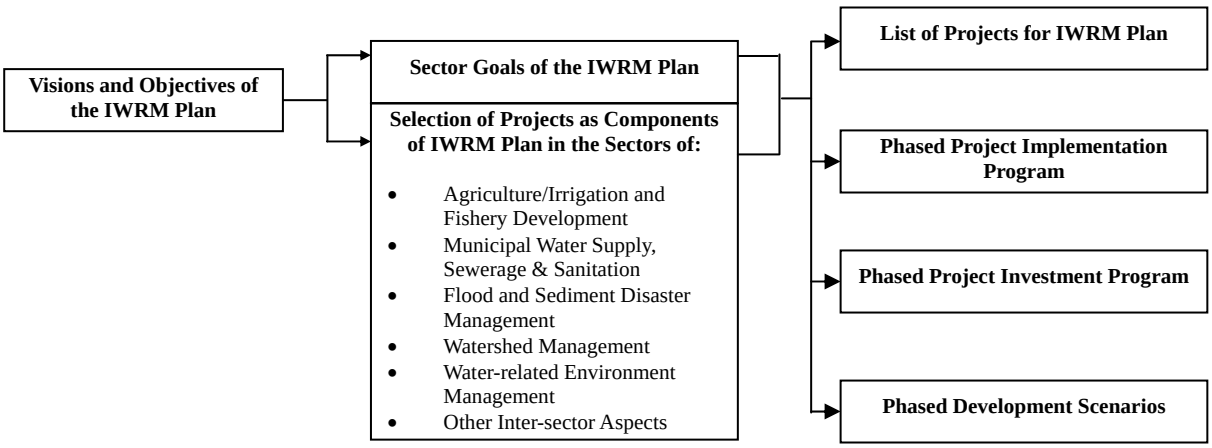


Figure 7.3.1 Image of Output of the IWRM Plan for Pampanga River Basin

7.4 Formulation of Institutional Setup Plan for IWRM of Pampanga River Basin

The optimum institutional setup plan, which would be required to execute the aforesaid spiral processes of IWRM for assessment, formulation, implementation and monitoring of the projects, shall be proposed taking the following two (2) aspects into account:

(1) To manage and/or coordinate key issues in water resources in the river basin such as reasonable allocation and regulation of water rights, upstream and downstream issues in flood control, watershed management, water quality management, sustainable groundwater management, etc.; and

(2) To establish the River Basin Organization (RBO) for Pampanga river basin as the implementing body for the proposed IWRM Plan in terms of equitable and sustainable development, environmental conservation, and operation and maintenance of the river facilities and the monitoring system in the river basin.

The former would be related to the improvement of the Water Code and capacity strengthening of NWRB as an apex body for water right and water resources management. The latter would be related to capacity strengthening of sector agencies such as DENR (watershed, forest management, water-quality management), DPWH (flood control and water-related natural disasters), NIA (irrigation water management) and LGUs (watershed, forest management, water quality management, flood control and water-related natural disasters, communal irrigation, groundwater management). The purpose, function, role and responsibility of the stakeholders as well as the financial sustainability and the regional policy should be clarified to validate the RBO.

7.5 Stakeholders related to the IWRM Plan for Pampanga River Basin

The priority stakeholders shall be selected and divided into the different hierarchy-groups as shown in Table 7.5.1. Decision-making on consensus in the present study is basically under the responsibility of the core stakeholders which consists of the members of the steering committee and the technical working group. On the other hand, the meeting with the other stakeholders aims at deliberating the results of the study and the hearing of opinions from the stakeholders according to the agenda approved by the Steering Committee and the Technical Working Group.

Table 7.5.1 Hierarchies and Functions of Stakeholders

Hierarchy/Expected Members	Function
1. Core stakeholders • Steering Committee members • Technical Working Group members	• To make the final decisions on consensus. • To bring forward the problems and needs for IWRM. • To propose the draft plan on IWRM.
2. Stakeholders (representatives at entire basin level) • Related governmental organizations • Related organizations (water users association, fisherman's association, water supply company, power supply company, etc.) • Representatives of local level stakeholders • Representatives of association of indigenous people, woman's association, and religious association, etc. • Representatives of LGUs in Metro Manila • Representatives of LGUs related to water transmission to reservoirs in the basin • NGO • Academes • Others, if necessary	• To bring forward the problems and needs of IWRM. • To propose the draft plan on IWRM.
3 Other stakeholders • Other stakeholders who are not included in the stakeholders of the above items 1 to 2.	• To disclose information through the internet, etc.

7.6 Schedule for Planning Procedures

As described above, the process of IWRM should move forward like a spiral with the different four stages. The present stage for the IWRM in Pampanga river basin is the initial spiral stage, and "assessment of existing conditions" and "planning" are being undertaken for a 2-year period, as shown in Figure 7.6.1.

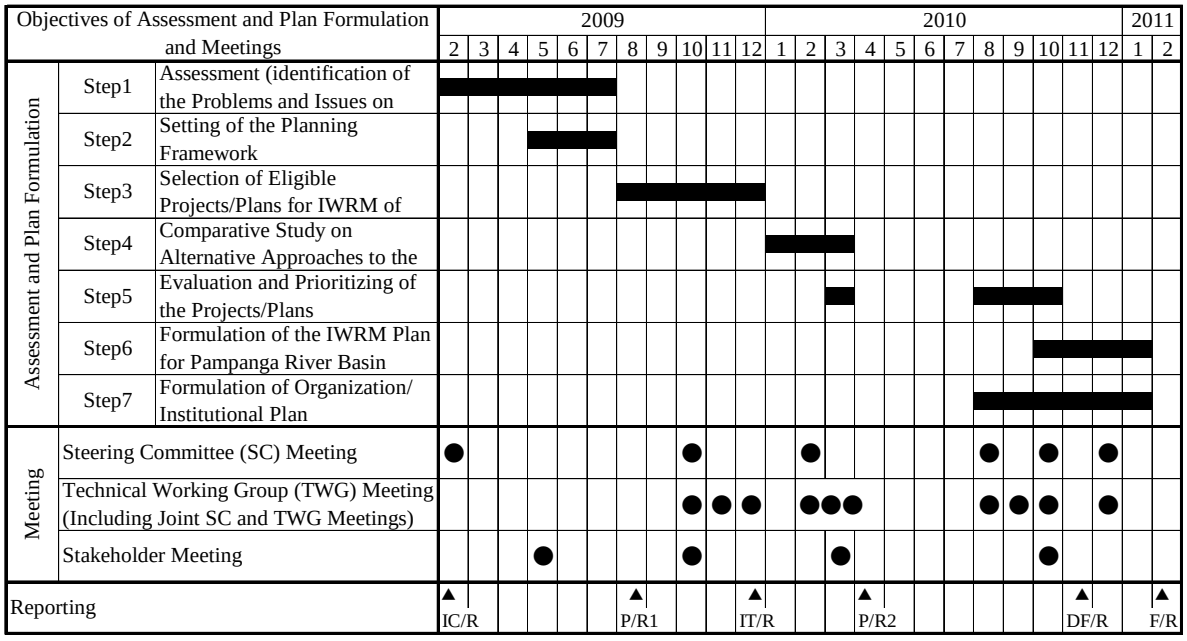


Figure 7.6.1 Schedule for Planning Procedures

8. Setting of Planning Framework

8.1 Target Year and Socio-Economic Frame

The target year of the proposed IWRM Plan for Pampanga river basin and the socio-economic frame until the target year is set forth as described below.

8.1.1 Target Year

The target year of the IWRM Plan under this planning stage had been set at 2025 as agreed in the "Minutes of Meeting on Implementation Agreement for the Study". On the premises of the target year 2025, the project implementation period is divided into the following three (3) terms: (a) Short-term for the period from 2011 to 2015; (b) Mid-term for the period from 2016 to 2020; and (c) Long-term for the period from 2021 to 2025.

8.1.2 Socio-economic Frame

The future population growth and gross regional domestic product (GRDP) for the period from 2011 to 2025 are projected referring to the information from the National Statistics Coordination Board (NSCB). The average annual growth of population and GRDP in the study area is projected as below:

(1) Population Growth: 1.86%/year for 2011-2015, 1.66%/year for 2016-2020 and 1.46%/year for 2021-2025.

(2) Growth of GRDP: 8.2%/year for the agriculture, fishery & forestry sector, 9.0% for the industry sector, and 10.2%/year for the service sector.

8.2 Visions, Objectives and Sector Goals of IWRM for the Study Area

Referring to the national/regional development policies mentioned below, "Poverty Alleviation" and "Economic Development" are adopted as the principal visions of the IWRM Plan for Pampanga river basin.

(1) "Medium-Term Philippine Development Plan for 2004-2010" (MTPDP 2004-2010) prepared by the National Economic and Development Authority in 2004;

(2) "Regional Physical Framework Plan for 2005-2030 for Central Luzon" (RPFP 2005-2030), by the Regional Land Use Committee/Regional Development Council, NEDA, in 2006; and

(3) "Integrated Water Resources Management (IWRM) Plan Framework" prepared by the Steering Committee composed of the NWRB Board members and the Multi-sector Task Force in the Philippines in 2006.

"Poverty Alleviation" is oriented to the betterment of livelihood/increase of income for the poverty thresholds and at the same time, it aims at securing the basic human needs such as safe drinking water and safe living conditions against flood and other water-related disasters. Moreover, the approaches to "Poverty Alleviation" shall not be made by sacrifice of the vital ecosystem. Likewise, "Economic Development" is oriented to not only development of the regional economy but also preserving and/or recovery of the ecosystem in Pampanga river basin.

The average ratio of poverty thresholds in the study area as of 2006 is about 20%, which is lower than the national average of about 33%. However, particular attention shall be given to the ratio of the poverty thresholds in Nueva Ecija Province in the study area. The ratio in the province is about 38%, which exceeds the national average. A majority of the employees in the province are engaged in the agriculture/forestry sector and one of the crucial issues on poverty alleviation for the province concern the increment of income of the employees in the sector.

It is further noted that manufacturing, agriculture/forestry and trade are the three (3) major industries in Region III, which produce the Gross Value Added of more than 50% in the region. Accordingly, these three industrial sectors shall take the principal roles for "Economic Development" in the study area, so that enhancement of the bulk water supply system for manufacturing and the irrigation system

for agriculture would be the important water-related works to promise economic development in the study area.

In order to embody the above visions, the five (5) strategic objectives are raised, and the five (5) sector goals are further adopted to achieve the objectives. These objectives and sector goals are as listed below.

Table 8.2.1 Strategic Objectives of IWRM Plan for Pampanga River Basin

Item	Principal Measures to Attain the Objectives
1. Enhanced Livelihood	• Increase of job opportunities in the agriculture sector • Increase of agricultural productivity with competitive cost for production
2. Improved Quality of Life	• Attain safe drinking water • Mitigate flood and sediment disasters
3. Decentralized Development	• Secure adequate municipal and irrigation water supply capacity • Mitigate flood and sediment disasters
4. Sustained Ecosystem	• Make reforestation of mangrove and other degraded kinds of trees • Spread sanitary facilities • Improve surface water quality
5. Empowered People	• Involve stakeholders in the plan formulation, implementation and monitoring of the project

Table 8.2.2 Sector Goals of IWRM Plan for Pampanga River Basin

Sector	Goal
1. Agriculture/Irrigation and Fishery	• Rehabilitate and develop irrigation systems • Enhance new agricultural technology on water management • Sustainable fishery under integrated water resource management
2. Municipal Water Supply, Sanitation and Sewerage	• Improve water supply quality • Ensure necessary water supply capacity • Reduce pollution load
3. Flood and Sediment Disaster Management	• Mitigate chronic damage by flood and sediment disasters
4. Watershed Management	• Intensify management, protection and maintenance of vulnerable and ecologically sensitive area • Increase forest cover of critically denuded uplands, and mangrove areas and urban corridors
5. Water-related Environment Management	• Strengthen water quality monitoring, data management, regulatory and decision support system • Reduce pollution load from various sources in key areas of Pampanga river basin in order to render quality of waters fit for specified uses

8.3 Ceiling of Project Investment Cost

As stated in Subsection 7.3.5, Step 5, the projects for the IWRM plan are to be divided into Group-A and Group-B, and the Group-B projects are to be oriented to economic development and/or mitigation of flood and sediment control. The implementation of these Group-B projects could be optional.

However, when the projects excessively concentrate upon any of the short-term, mid-term or long-term, the total project investment cost may exceed the affordable limit of the national and/or regional budget. From this point of view, the approximate ceiling of investment cost of the Group-B projects are provisionally estimated as listed in Table 8.3.1 based on the past government budgetary allocations.

Table 8.3.1 Ceilings of Investment Cost for Group-B-Projects

Term	Period	Ceiling Amount
Short-Term	2011 – 2015	31.7 billion pesos
Mid-Term	2016 – 2020	33.7 billion/pesos
Long-Term	2021 – 2025	33.7 billion pesos
Total	2011 – 2025	99.1 billion pesos

9. Selection of Eligible Projects as Components of the Proposed IWRM Plan

9.1 General

The various government agencies and non-government entities currently propose and/or execute the numerous projects related to IWRM in Pampanga river basin. Some of these on-going and proposed projects are selected in order to cope with the problems/issues on the IWRM Plan for Pampanga river basin and at the same time to attain the aforesaid visions, objectives and sector goals in the IWRM Plan. In addition, the Study Team in collaboration with the relevant government agencies as well as the other stakeholders worked out the conceptual projects which would be essentially required as parts of the IWRM Plan. The number of projects selected for the IWRM of Pampanga river basin is as listed in Table 9.1.1.

Table 9.1.1 Number of Programs and Projects as Components of the Proposed IWRM Plan

Sector	On-going	Proposed	Conceptual*	Total
Agriculture/Irrigation and Fishery	14	11	3	28
Municipal Water Supply, Sanitation and Sewerage	3	4	11	18
Flood and Sediment Disaster Management	4	2	4	10
Watershed Management	12	0	4	16
Water-related Environment Management	3	1	4	8
Inter-sector Water Resources Development, Allocation and Distribution	-	-	4	4
Total	36	18	30	84

Note *: Proposed by JICA Study Team
Source: JICA Study Team

9.2 Projects in the Sector of Agriculture and Fishery Development

Self-sufficiency through sustainable rice production is a key component of agriculture in the national policy. In line with this policy, the national/regional development strategies for agriculture were oriented to development of new irrigation systems and rehabilitation of existing systems. In addition, upgrading of the irrigation infrastructure and dissemination of improved agricultural technology are emphasized as the principal strategy. In approaching these strategies, both structural and non-structural measures shall be well linked to maximize their multiple effects to increase productivity and improve livelihood in rural area. The projects in this sector should not be limited to only large-scale national irrigation but also communal and small-scale irrigation, both for the development of new agricultural facilities and rehabilitation/improvement of the existing facilities.

The projects for agriculture and fishery development are selected to comply with the above national/regional strategies and to cope with the problems and issues identified in Section 6.2. The list of on-going, proposed and conceptual projects thus selected are as listed in Table 9.2.1, and the detailed contents of the projects are as shown in Annex-T 9.2.1 in Volume 2, Main Report.

Table 9.2.1 (1/2) List of Projects for Agriculture/Irrigation and Fishery

Code	Name of Project	Problems and Issues to be complied by the Projects		
		Water Shortage for Irrigation	Low Irrigation Efficiency	Water Pollution in Fish Pond
AI-G-01	Balog-Balog Multipurpose Project Phase I	○		
AI-G-02	Along-along Creek Irrigation Project (UPRIIS Div3)	○		
AI-G-03	Repair, Rehabilitation of Existing Groundwater Irrigation Systems, Establishment of Groundwater Pump Project (REGIP)	○		
AI-G-04	Balikatan Sagip Patubig Program (BSPP)	○		
AI-G-05	Repair, Rehabilitation, Restoration & Preventive Maintenance of Existing National & Communal Irrigation Facilities	○		
AI-G-06	Restoration/Rehabilitation of Existing NIA Assisted Irrigation System (RRE-NIAIS)	○		
AI-G-07	Participatory Irrigation Development Project, APL1-Infrastructure Development	○		
AI-G-08	Rehabilitation of Small Water Impounding Projects / Diversion Dams	○		
AI-G-09	Comprehensive Agrarian Reform Program, Irrigation Component	○		
AI-G-10	Upper Tabuating SRIP	○		
AI-P-01	Balintingon Reservoir Multipurpose Project (BRMP)	○		
AI-P-02	Balog-Balog Multipurpose Project Phase II	○		

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Table 9.2.1 (2/2) List of Projects for Agriculture/Irrigation and Fishery

Code	Name of Project	Problems and Issues to be complied by the Projects		
		Waters Shortage for Irrigation	Low Irrigation Efficiency	Water Pollution in the Fish Pond
AI-P-03	Sector Loan on Rehabilitation of Irrigation Facilities	○		
AI-P-04	Casecnan Multi-purpose Irrigation & Power Project Irrigation Component Phase II	○		
AI-P-05	Procurement of Pumps, Drilling Rigs & Related Equipment	○		
AI-P-06	Irrigation Water Resources Augmentation Pump Establishment Project	○		
AI-P-07	Appropriate Irrigation Technologies for Enhanced Agricultural Production		○	
AI-P-08	Central Luzon Groundwater Irrigation Systems Reactivation Project	○		
AI-P-09	Gumain Reservoir Project	○		
AI-P-10	Rehabilitation of AMRIS	○		
AI-P-11	Construction of Priority Small Scale Irrigation Systems/Small Water Impounding Projects, Small Diversion Dam Projects	○		
AI-C-01	New Construction of Small Scale Irrigation Project under BSWM	○		
AI-C-02	Introduction of Water Saving Irrigation Technology		○	
AI-C-03	Improvement of Monitoring System and Capacity Development for Proper Water Management in NISs and CISs		○	
AF-G-01	Aquaculture Fisheries Development Programs			○
AF-G-02	Comprehensive Regulatory Services			○
AF-G-03	Support Projects and Activities			○
AF-G-04	Fisheries Resources Management for Improved and Sustainable Harvest			○

9.3 Municipal Water Supply, Sanitation and Sewerage System

The Government of the Philippines has targeted through the "Philippine Water Supply Sector Roadmap" that 100% of the households shall have access to safe, adequate and sustainable municipal water supply by 2025. At the same time, the Clean Water Act of 2004 requires that the DPWH in coordination with the DOH and other concerned agencies shall employ the septic tank or combined sewerage-septic management system.

The projects for this sector were selected taking the above national policies and the problems/issues identified in Section 6.3 into account. The list of on-going, proposed and conceptual projects thus selected is as listed in Table 9.3.1 and the detailed contents of the projects are as shown in Annex-T 9.3.1 in Volume 2, Main Report.

Table 9.3.1 List of Projects for Municipal Water Supply, Sanitation and Sewerage Program

Code	Name of Project	Problems and Issues to be complied by the Projects		
		Inadequate Water Supply Source	Unsafe Water Supply	Increasing Pollution Load in Water Bodies
MW-G-01	Angat Water Utilization and Aquaduct Improvement Project (AWUAIP) Phase II	○		
MW-P-01	Rehabilitation of Umiray-Macua Facilities	○		
MW-P-02	Sumag River Diversion Project	○		
MW-P-03	Bulacan Treated Bulk Water Supply Project		○	
MW-P-04	Metro Clark Bulk Surface Water Project	○		
MW-C-01	Additional Level 3,2, 1 Facilities towards 2025 in Bulacan	○	○	
MW-C-02	Additional Level 3,2, 1 Facilities towards 2025 in Pampanga	○	○	
MW-C-03	Additional Level 3,2, 1 Facilities towards 2025 in Nueva Ecija	○	○	
MW-C-04	Additional Level 3,2, 1 Facilities towards 2025 in Tarlac	○	○	
MW-C-05	Extended Bulacan Bulk Water Supply Project	○		
MW-C-06	Pampanga Bulk Water Supply Project	○		
MS-C-01	Additional Sanitary Facilities towards 2025 in Bulacan		○	
MS-C-02	Additional Sanitary Facilities towards 2025 in Pampanga		○	
MS-C-03	Additional Sanitary Facilities towards 2025 in Nueva Ecija		○	
MS-C-04	Additional Sanitary Facilities towards 2025 in Tarlac		○	
MP-G-01	Cabanatuan Sewerage System			○
MP-G-02	Expansion of Clark Sewerage System			○
MP-C-01	Septage Treatment and Disposal Facility			○

9.4 Projects in the Sector of Management for Flood and Sediment Disasters

In order to mitigate the flooding problems in the country, the MTPDP 2004-2010 gave priority to the efficient maintenance and rehabilitation of existing flood mitigation facilities, including dredging of the waterways, riverbank protection, relocation of informal settlers along the river/drainage channels, so as to fulfill the inherent flood control capacity of the existing facilities. The MTPDP also emphasizes the necessity of adequate investment to the twelve (12) nationwide priority flood mitigation projects, two (2) of which are addressed to the Mt. Pinatubo Hazard Urgent Management II and III in the study area.

In line with the above national policies, the RPFP raised two (2) regional strategies for flood management: The first is oriented to the adoption of the concept of comprehensive flood mitigation project emphasizing the necessity of nonstructural measures such as flood forecasting and warning and watershed management. The second is addressed to the strengthening of flood detention capacity of the river basin. The RPFP states that the floodwater shall be held back in the upper and middle reaches by a suitable reservoir and/or a flood retarding basin. This would ensure better control over floods and, at the same time, create possible water resources development for irrigation, municipal water supply and other various uses of water.

The on-going, proposed and conceptual projects for this sector were selected to comply with the above national policies and, at the same time, to cope with the problems and issues identified in Section 6.4. The list of on-going, proposed and conceptual projects thus selected are as listed in Table 9.4.1, and the detailed contents of the projects are as shown in Annex-T 9.4.1 in Volume 2, Main Report.

Table 9.4.1 List of Projects for Management of Flood and Sediment Disasters

Code	Name of Project	Problems and Issues to be complied by the Projects		
		Insufficient Structural Capacity for Flood Mitigation	Increment of Flood Damage Potential	Inadequate Information and Knowledge Relevant to Flood Mitigation
FL-G-01	Pinatubo Hazard Urgent Project (PHUMP), Phase III, Part I	○		
FL-G-02	Pinatubo Hazard Urgent Project (PHUMP), Phase III, Part II		○	
FL-G-03	Maintenance and Rehabilitation Works for River Dike and Slope	○		
FL-G-04	Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines			○
FL-P-01	Flood Control Measures in Mt. Pinatubo Devastated Area- Focus on Pasac Delta	○		
FL-P-02	Bacolor Comprehensive Rehabilitation Master Plan	○		
FL-C-01	Flood Mitigation for Pampanga Delta	○		
FL-C-02	Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and Nueva Ecija			○
FL-C-03	Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs	○		
FL-C-04	Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula			○

9.5 Projects in the Sector of Watershed Management

The 2003 Revised Master Plan for Forestry Development (MPFD-2003) raised the policy to enhance the life-sustaining functions of vital forest ecosystems by pursuing the following objectives:

- To sustainably manage the watershed and forest by capable institutions with active participation of empowered stakeholders;
- To enhance protective and biodiversity values of forests;
- To improve the quality of life of upland communities actively participating in sustainable forest management through CBFM;
- To enhance and improve decision-making processes on forest management through adoption of improved management and information system as well as a fully relevant monitoring and evaluation; and
- To enhance effectiveness and competence of forest conservation and management.

Consistent with the national and regional thrusts, the twin goals are set for the watershed management sector under the proposed IWRM Plan, namely; (i) Intensify management, protection and maintenance of vulnerable and ecologically sensitive areas; and (ii) Increase forest cover of critically denuded uplands, and mangrove areas and urban corridors.

The on-going, proposed and conceptual programs and projects for this sector were selected to comply with the above twin sector goals and the same time, to cope with the problems and issues identified in Section 6.5. The list of on-going, proposed and conceptual projects thus selected are as listed in Table 9.5.1, and the detailed contents of the projects are as shown in Annex-T 9.5.1 in Volume 2, Main Report.

Table 9.5.1 List of Projects for Watershed Management

Code	Name of Project	Problems and Issues to be complied by the Projects		
		Watershed Degradation	Weak Reforestation	Poor Institutional Coordination
WS-G-01	Forest Protection and Law Enforcement Program (FPLEP)	○		
WS-G-02	Community-based Forest Management Program	○	○	
WS-G-03	Integrated Agro-Forestry Development Program (CBFM-CARP)	○		
WS-G-04	Coastal Resource Management Program (CRMP)	○		
WS-G-05	Protected Area Community-based Resource Management Program (CBFM-PACBRMA)	○		
WS-G-06	Private Forest Plantation Development Program (PFPDP)		○	
WS-G-07	NIA-UPRIIS' Watershed Management Program	○		
WS-G-08	NPC's Watershed Management Program	○		
WS-G-09	Integrated Social Forestry (ISF) Projects			○
WS-G-10	Private-sector Watershed Management Initiatives		○	
WS-G-11	Forestlands Management Project (FMP)	○		
WS-G-12	Pampanga River Basin Rehabilitation Project (PRBRP)		○	
WS-C-01	Upland Development Program		○	
WS-C-02	Protected Area Management Program (PAMP)	○		
WS-C-03	Urban Greening Program			○
WS-C-04	Community-based Eco-tourism Program	○		

9.6 Projects in the Sector of Water-Related Environmental Management

The national strategy on water-related environmental management is oriented to the well-coordinated management of water-related environment for maintaining of the life-sustaining functions of vital ecosystems. There is also a parallel inter-sector effort to restore the ecological integrity of Manila Bay and to improve the environmental quality of the rivers basins which front on Manila Bay including Pampanga river basin. This is laid out in the Operational Plan for the Manila Bay Coastal Strategy (OPMBCS), which became the basis for the Supreme Court mandamus compelling relevant agencies to clean up Manila Bay. Taking these national/regional strategies and/or policies into account, the following two (2) folds are assumed as the specific water-related environmental management goals under the IWRM Plan for Pampanga river basin:

- Strengthen water quality monitoring, data management, regulatory and decision support system; and
- Reduce pollution load from various sources in key areas of Pampanga river basin in order to render quality of waters fit for specified uses.

The on-going, proposed and conceptual programs and projects for this sector were selected to comply with the above sector goals and, at the same time, to cope with the problems and issues identified in Section 6.6. The list of on-going, proposed and conceptual projects thus selected are as listed in Table 9.6.1, and the detailed contents of the projects are as shown in Annex-T 9.6.1 in Volume 2, Main Report.

Table 9.6.1 List of Projects for Water-Related Environmental Management

Code	Name of Project	Problems and Issues to be complied by the Projects	
		Inadequate Water Quality Data Generation and Management	Contamination of Surface, Ground and Coastal Waters
WQ-G-01	Ecological Solid Waste Management Program (ESWMP)		○
WQ-G-02	Industrial Pollution Control Program (IPCP)		○
WQ-G-03	Sagip-Ilog Project		○
WQ-P-01	Clean Development Mechanism		○
WQ-C-01	Capacity Development to Upgrade WQ Monitoring and Data Management Program	○	○
WQ-C-02	Capacity Development to Improve Water Quality and Aquaculture Fisheries Management		○
WQ-C-03	Capacity Development Project to Improve Industry Adoption of Cleaner Production Options		○
WQ-C-04	Construction of Sanitary Landfills and Support Facilities in Nueva Ecija and Cluster Waste Transfer Stations in Bulacan and Pampanga		○

9.7 Inter-Sector Projects for Water Resources Development, Allocation and Distribution

The water resource development, allocation and distribution discussed in this section aims at supporting the achievement of goals especially for two (2) sectors, namely; (a) agriculture/irrigation and fishery; and (b) municipal water supply, sanitation and sewerage. Among the development projects of water resources for these sectors, those for agriculture/irrigation and fishery may make lower economic contributions as compared with those for municipal water supply. In the IWRM

Plan for Pampanga river basin, however, preservation of the present agricultural productivities is given priority over the economic contribution considering the importance to secure the job opportunities in the agriculture sector and attain poverty alleviation in rural areas. In line with this basic consideration, the policy of water resources development, allocation and distribution aims at attaining equal importance of both goals in the two sectors.

Water resources development could also make a contribution to hydropower generation. However, the increase of capacity of hydropower generation in Pampanga river basin is not considered as the primary issue, since many indicative hydropower plants are projected outside Pampanga river basin for further increase of install capacity in the Luzon Grid as described in the National Energy Plan of 2006.

The conceptual projects were selected to comply with the above policies and, at the same time, to cope with the problems and issues identified in Section 6.7. The list of conceptual projects thus selected are as listed in Table 9.7.1, and the detailed contents of the projects are as shown in Annex T 9.7.1 in Volume 2, Main Report.

Table 9.7.1 List of Inter-Sector Projects for Water Resources Development, Allocation and Distribution

Code	Name of Project	Problems and Issues to be complied by the Projects			
		Sustainable Water Source for Municipal Water Supply	Securing of Necessary Water Sources for Expansion of Large Irrigation System	Inadequate Reliability of Water Supply in Angat-Umiray System	Expected Increase of Conflict among Water Users, especially between Municipal and Irrigation Water Users
IS-C-01	Establishment of Comprehensive Groundwater Monitoring in Pampanga River Basin	○			
IS-C-02	Project for Recovery of Reliability of Water Supply in Angat-Umiray System			○	
IS-C-03	Enhancement of Monitoring System for Surface Water in Pampanga River Basin				○
IS-C-04	Capacity Development of NWRB and Relevant Agencies on Water Allocation and Distribution			○	○

10. Preliminary Study on Alternative Approaches to Specific Issues

10.1 General

Of the 84 projects selected as components of the IWRM Plan in Chapter 9, the nine (9) projects as listed in Table 10.1.1 are preliminarily estimated to possibly contain several alternative approaches to cope with their own specific issues, and a feasibility study would be required to select the optimum approach among the alternatives. However, it is virtually difficult to carry out the feasibility study for all of these projects in detail at the time of formulation of the IWRM Plan due to the constraints on information for the projects and the time for the study. In line with the rules adopted to formulate the IWRM Plan as described in Subsection 7.3.4, the pre-feasibility study was made, at this study stage, on particular projects, which are judged to be prominently influential to the entire IWRM Plan and could provide the basic information for the pre-feasibility study.

Table 10.1.1 Projects which may contain Alternative Approaches to their Specific Issues

Code	Project Title	Contents of Comparative Study on Alternative Approaches
AI-C-01	New Construction of Small-Scale Irrigation Project under BSWM	The optimum plan shall be selected among the alternative combination of developments of the 46 potential sites for small-scale irrigation.
MW-C-05	Extended Bulacan Bulk Water Supply Project	The optimum plan shall be selected among the alternative combinations of the ones which would not be selected by the project: IS-C-02 among (a) development of Bayabas storage dam, (b) development of Balintingon storage dam, (c) upgrading of irrigation system of AMRIS, and (d) Other water sources outside the Pampanga river basin such as Laiban dam
MW-C-06	Pampanga Bulk Water Supply Project	The optimum plan shall be selected among the alternative combinations of (a) development of the residual groundwater at surrounding cities/municipalities, (b) development of Gumain storage dam, (c) direct abstraction from Pampanga River.
MP-C-01	Septage Treatment and Disposal Facility	The optimum plan shall be determined among the alternative combination of project sites and basic project components as well as implementation scheme.
FL-C-01	Pampanga Delta Development Project, Flood Component with Usage of Candaba Swamp as Flood Retarding Basin	The optimum plan shall be selected among the alternative combinations of (a) the river channel improvement, and (b) construction of the flood retarding basin at Candaba Swamp. The optimum design scale for flood mitigation plan shall also be selected among the alternative design scales of 5, 10 and 20-year return period.
WS-C-01	Upland Development Program (UDP)	The optimum plan shall be determined among the alternative combination of project sites and basic project components.
WS-C-04	Community-based Eco-Tourism Program	The optimum plan shall be determined among the alternative combination of project sites and basic project components.
WQ-C-04	Construction of Sanitary Landfills and Support Facilities in Nueva Ecija and Cluster Waste Transfer Stations in Bulacan and Pampanga	The optimum plan shall be determined among the alternative combination of project sites and basic project components as well as implementation scheme.
IS-C-02	Project for Recovery of Reliability of Water Supply in Angat-Umiray System	The optimum plan shall be selected among the alternative combinations of (a) development of Bayabas storage dam, (b) development of Balintingon storage dam, (c) upgrading of irrigation system of AMRIS, and (d) Other water sources outside the Pampanga river basin such as Laiban dam.

In this study, the prefeasibility study was provisionally made for two (2) projects, FL-C-01 and IS-C-02, among the nine (9) projects listed in Table 10.1.1. The principal features of these projects are as described in the following Subsections 10.1.1 and 10.1.2. The detailed contents of the prefeasibility study are in Sections 10.2 to 10.3.

10.1.1 Project for Recovery of Reliability of Water Supply in Angat-Umiray System (IS-C-02)

This project aims at dealing with the inadequate reliability of water supply in Angat-Umiray system. The system currently causes the serious and chronic water shortage in the downstream national

irrigation system of AMRIS, and there could be several alternative combinations of the countermeasures to cope with the issue. The possible components of the countermeasures include: (a) development of Bayabas Dam as a new supplementary source for water supply for Angat-Umiray system; (b) canal lining for the AMRIS to curtail the water demand for irrigation; (c) development of Balintingon Dam with conveyance system to AMRIS as the supplementary source for water supply; and (d) Reduction of municipal water demand from Angat-Umiray system by developing new water source outside the Pampanga river basin. In addition, the introduction of new water saving technologies for irrigation could be the potential measure for the reduction of irrigation water demand.

10.1.2 Pampanga Delta Development Project - Flood Component with Usage of Candaba and San Antonio Swamps as Flood Retarding Basin (FL-C-01)

This project aims at coping with the chronic and serious flood damage along the downstream of Pampanga River (the mainstream), where no dynamic flood mitigation measure has been introduced since the Pampanga Delta Development Project - Flood Component (PDDP-FC), Phase I was completed in 2002. The major hindrances to implementation of the flood mitigation project for the downstream of Pampanga River are the houses densely packed along the river channel, which requires an extremely large number of resettlement for river channel improvement. Taking the necessary number of resettlement and other socio-economic and environmental impacts into account, integrative flood mitigation measures are preliminary examined at the concept level.

10.2 Water Resources Development, Allocation and Distribution

10.2.1 Principal Issue on Water Resources Development, Allocation and Distribution in Angat-Umiray System

Angat-Umiray river system possesses the water resource development facilities of Angat multipurpose dam reservoir together with the basin-transfer system from Umiray River to the dam reservoir, and it has ever been used as the water source for the irrigation of "AMRIS" and the municipal water use in Metro Manila since 1967. However, the municipal water demand in Metro Manila has continued to increase due to the dynamic increment of the urban population, while no fundamental water resources development for such incremental demand has been carried out. As the result, Angat-Umiray System currently causes the water shortage in almost every two years.

Moreover, the Province of Bulacan has acquired the water use permit for 1.9m^3/s from the source of Angat-Umiray System based on the MOU among MWSS, LWUA and the Provincial Government of Bulacan in 1992. This water use permit has not yet been utilized but it is expected as the water source for the Bulacan Treated Bulk Water Supply Project which is proposed to cope with the deterioration of groundwater used as the present source for municipal water supply. Nevertheless, the water use permit is hardly promised due to the aforesaid current low reliability of water supply by the Angat-Umiray System.

Under the above conditions, the reliability of water supply both for municipal and irrigation water use in the Angat-Umiray System shall be one of the most crucial issues in Pampanga river basin, and various alternative approaches are identified to cope with the issue. Hence, this section discusses the comparison of alternatives to recover the reliability of water supply in the Angat-Umiray system.

10.2.2 Possible Options for Recovery of Reliability of Water Supply in Angat-Umiray System

The IWRM Plan formulated in this study takes a strategy such that the primary irrigation area shall be preserved to keep the agricultural productivity and secure the job opportunities in the agricultural sector. Referring to the results of the previous/ongoing study and the programs proposed by the relevant agencies, the seven (7) potential options are firstly assumed as the measures to recover the reliability of water supply in the Angat-Umiray System. However, taking the project economical and technical viabilities into account, three (3) of the said potential options are excluded from the objectives of the alternative study in this section: The potential and objective options for the alternative study are as listed in Table 10.2.1.

Table 10.2.1 Possible Options for Recovery of Water Supply in Angat-Umiray System

Category	Option	Selected for Alternative Study
A: Option to increase water resources potential of Angat-Umiray System	A-1: Development of Bayabas Storage Dam	Selected
B: Options to decrease the irrigation water demand to Angat-Umiray System	B-1: Development of Balintingon Storage Dam and Conveyance System to AMRIS	Selected
	B-2: Conveyance of Excess Water from UPRIIS to AMRIS	Excluded
	B-3: Upgrading and Improvement of Irrigation Facilities and Water Management of AMRIS	Selected
	B-4: Direct abstraction of surface water of Pampanga River at around Apalit and conveyance by pumps to AMRIS	Excluded
	B-5: Water saving technology	Excluded
C: Options to reduce the municipal water demand of Metro Manila to Angat-Umiray System	C-1: Development of Laiban Dam as the New Water Source out of Pampanga river basin	Selected

The above seven (7) options are as briefed below.

(1) Option A-1: Development of Bayabas Storage Dam

Development of Bayabas storage dam with 144MCM in effective storage volume is proposed in the catchment area of Bayabas River, a tributary of Angat River. This storage dam could be utilized as the backup water supply source for irrigation of AMRIS, and it releases the water only when the water level of Angat Dam drops to around the critical level for reservoir operation (EL. 180m above MSL). This would be the only possible option to increase water resources potential in the Angat-Umiray system. It is however noted that the water use permit at this dam site was granted to the Provincial Government of Bulacan in 2004, and therefore, this Option is subject to the transfer of the water use permit from Bulacan Province to the present users of the Angat-Umiray System (i.e., NIA or MWSS).

(2) Option B-1: Development of Balintingon Storage Dam and Conveyance to AMRIS

Development of Balintingon storage dam with 488MCM in effective storage volume is now being proposed in the catchment area of Peñaranda River, a tributary of Pampanga River, which is located north of the Angat-Umiray System. The dam was originally proposed for developing the new Balintingon Irrigation Area of 14,900ha in the lower reaches of the dam reservoir. On the other hand, this option is proposed in this study to transfer a part of the discharge from the dam to AMRIS by reducing the irrigation area from the proposed 14,900ha to 10,000ha. It is herein noted that the water permit for the river flow at the proposed dam site has been already granted but a substantial part of it needs to be transferred to the water users of dam reservoir.

(3) Option B-2: Conveyance of Excess Water from UPRIIS to AMRIS

This option is to convey the excess water in the existing irrigation area of UPRIIS to the lower Maasim diversion dam using the existing UPRIIS Division-4 CX-3 canal. However, the excess water could be available only when expansion of new irrigation area in UPRIIS Division-5 is canceled or reduced, while such cancelation/reduction is judged to be not realistic, because the diversion facilities have already been completed. Accordingly, this option is not adopted for further alternative study.

(4) Option B-3: Upgrading and Improvement of Irrigation Facilities and Water Management of AMRIS

This option is to upgrade the main canals in AMRIS by concrete lining so as to reduce the conveyance loss in the canals. By the concrete lining of the main canals, 5% of diversion water requirement is expected to be reduced by preventing leakage from canals. Soft component for improvement of water management is also included.

(5) Option B-4: Direct Abstraction of Surface Water of Pampanga River around Apalit and Conveyance by Pumps to AMRIS

This option was considered by MWSS as one of possible alternate sources of Angat-Umiray system. The water is abstracted at around Apalit in Pampanga River and conveyed to AMRIS by pumps. However, this option requires a huge amount of energy for pumping, causing extremely high operation and maintenance cost, and is not selected for further alternative study.

(6) Option B-5: Water Saving Technology (WST)

The Department of Agriculture is wrestling with the spread of water saving technology (WST), which would be useful to save irrigation water and maintain the productivity of the rice. However the WST is still experimental and it is difficult to assure the saving of water and keeping the production at this point in time. From this point of view, this option is not selected for further alternative study.

(7) Option C-1: Development of Laiban Dam as the New Water Sources out of Pampanga River Basin

This option is to develop the new water resources out of Pampanga river basin, which aims at strengthening the supply capacity for the municipal water demand in Metro Manila. One of the prominent development projects for municipal water supply in Metro Manila had been addressed to Laiban Dam Project, which would be implemented by the BOT scheme with MWSS and San Miguel Company. However, MWSS terminated the negotiations for the joint venture proposal of San Miguel Company on March 4, 2010.

10.2.3 Selection of Alternative Plans

The following two (2) items are identified as the updated requirements on the reliability of water supply in Angat-Umiray System:

(1) To sustain the municipal water demand of 48.7m^3/s (46m^3/s for Metro Manila and 2.7m^3/s for Bulacan Province) on the premises of the design draft safety level of 10-year return period; and

(2) To sustain the present irrigation diversion requirement for the AMRIS irrigation area of 26,000 ha in dry season and 20,355 ha in wet season on the premises of the design drought level of 5-year return period.

In order to fulfill the above requirements, four (4) alternative plans with different combinations of the aforesaid possible options are scrutinized, as shown in Table 10.2.2.

Table 10.2.2 Component of Alternative Plans

Alt. No.	Components of the Alternative Plan	Annual Ave. Supply
Alt. 1	Option A-1: Development of Bayabas Storage Dam	- *
	Option B-3: Upgrading and Improvement of Irrigation Facilities and Water Management of AMRIS	0.9 m^3/s
Alt. 2	Option B-1: Development of Balintingon Storage Dam and Conveyance to AMRIS	2.9 m^3/s
	Option B-3: Upgrading and Improvement of Irrigation Facilities and Water Management of AMRIS	1.0 m^3/s
	Option C-1: Development of Laiban Dam as the New Water Source out of Pampanga River Basin	0.5 m^3/s
Alt. 3	Option B-3: Upgrading and Improvement of Irrigation Facilities and Water Management of AMRIS	1.0 m^3/s
	Option C-1: Development of Laiban Dam as the New Water Source out of Pampanga River Basin	3.1 m^3/s
Alt. 4	Option C-1: Development of Laiban Dam as the New Water Source out of Pampanga River Basin	4.0 m^3/s

*: Bayabas storage dam supplies the water to AMRIS only just in case of the drought year when the water level of Angat dam reservoir drops below EL. 184m above MSL.

10.2.4 Evaluation of Alternative Plans

The above four (4) alternative plans were evaluated from several different points of view as shown in Table 10.2.3.

Table 10.2.3 Comparison of Alternative Plans

Alt. No.	Project Annual Cost* (Mil. Pesos/ year)	Hydropower Outputs (GWh/year)	Socio-Environment	Institutional Arrangement	Technical Viability
Alt. 1	843	548	Environmental flow shall be a matter of concern.	• It is necessary to review the water use permit granted to NIA, Bulacan and MWSS.	Geological condition in/around dam reservoir must be carefully investigated.
Alt. 2	1,085	563	Resettlement of a thousand families is required.	• It is necessary to review the present water use permit of Peñaranda River. • Conveyance of water to AMRIS requires agreement of the provinces of Nueva Ecija and Bulacan. • The implementation body of Laiban Dam project has not been fixed yet.	Water conveyance method from Balintingon Dam to AMRIS should be carefully studied.
Alt. 3	1,002	569	Resettlement of about 4,300 families is required.	• The implementation body of Laiban Dam project has not been fixed yet.	No significant problem
Alt. 4	1,077	573	- ditto-	• - ditto-	No significant problem

Note*: Project cost includes initial investment cost and annual O&M cost and it is expressed as the annual cost assuming the annual discount rate of 10% and the project life of 50 years.

As listed above, Alternative 1 would require the least project cost and far less resettlement as compared with the other alternatives. On the other hand, Alternative 1 would cause an institutional issue such that the water use permit of Prov. of Bulacan has to be transfer to NIA, but such institutional issue is judged not to be a fatal problem. Only the major concern on Alternative 1 is addressed to the geological conditions in and around the extent of the proposed dam reservoir area. The severe landslide and soil erosion is observed at just upstream of the proposed dam sites. According to the preliminary field survey, such landslide and soil erosion are also judged not to be fatal for the construction of Bayabas storage dam, but further detailed boring tests and other geological surveys are required to confirm the technical viability of Bayabas storage dam.

As compared with Alternative 1, the other alternatives contain prominent disadvantages in the aspect of resettlement. Moreover, difficulties are foreseeable in implementing the Laiban Dam Project, which is one of the components of all alternatives other than Alternative 1, because MWSS encountered difficulties in completing the joint venture proposal for construction of Laiban Dam with San Miguel Company.

From the above points of view, Alternative 1, which contains development of Bayabas storage dam and upgrading/improvement of irrigation facilities and water management of AMRIS, is selected as the optimum plan. Alternative 1 is, however, subject to further detailed geological survey in and around the reservoir area of Bayabas storage dam.

10.2.5 Required Follow-up Programs for Recovery of Reliability of Water Supply in Angat-Umiray System

In order to materialize the aforesaid optimum plan for recovery of reliability of water supply in the Angat-Umiray System, it is provisionally proposed to carry out the following feasibility study and capacity development in the next stages:

(1) Feasibility Study on Recovery of Reliability of Water Supply in Angat-Umiray System: The F/S aims at clarifying the viabilities of Bayabas Dam in the technical aspect as well as economical, financial, socio-environmental and institutional aspects; and

(2) Capacity Development of NWRB and Relevant Agencies on Water Allocation and Distribution: Capacity development is proposed to improve the water governance in Angat-Umiray system.

10.3 Flood Management

10.3.1 Principal Issue on Flood Risk in the Lower Pampanga River Basin

Since the eruption of Mt. Pinatubo in 1991, several projects have been undertaken or being proposed to cope with the flood problems associated with the large volume of sediment run-off in Porac river basin. As for Pampanga river basin, however, no prominent flood mitigation plan has been introduced since the Pampanga Delta Development Project Flood Component (PDDP-FC), Phase I was completed at a reduced scale due to the budgetary constraints and difficulty of land acquisition of the Philippine government. Under such conditions, flood damages occur along the down/midstream of Pampanga River almost every year in spite of a certain effect of flood mitigation by Phase I.

The principal hindrance in implementing the flood mitigation works for the downstream of Pampanga River concerns the houses densely packed along the river channel which requires a large number of resettlement for the widening of river channel. The previous PDDP FC Phase I had required the resettlement of 1,851 households, and the proposed PDDP FC Phase-II would further require the resettlement of about 6,709 households for its target river channel improvement of 30km in length.

Taking the occurrence of frequent disastrous flood damage and the difficulties in implementing the river channel improvement works into account, integrative flood mitigation measures for the PDDP Phase II river channel improvement are preliminarily examined at the concept level in this Section.

10.3.2 Objective Area

The PDDP FC is divided into three (3) phases, namely; Phase I, Phase II and Phase III. Among others, Phase I was completed with the projected channel improvement section of about 300m in length remaining in 2002. Succeeding Phase I, Phase II is projected to start covering the river channel improvement in the lower reaches from Apalit. Phase III is further proposed, as a part of the master plan for PDDP, to undertake the channel improvement of Pampanga River from Apalit to the confluence with Maasim River[1)] (refer to Figure 10.3.1).

The extent of the objective flood mitigation areas is about 324km^2, and it administratively belongs to the municipalities of Calumpit, Hagonoy and Paombong in the Province of Bulacan and the municipalities of Macabebe and Apalit in the Province of Pampanga.

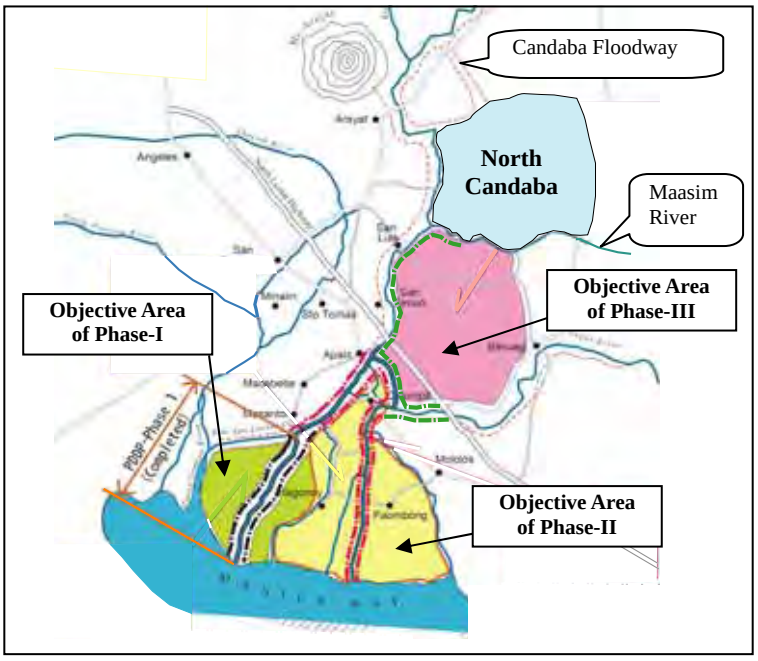

Figure 10.3.1 Objective Flood Mitigation Area for PDDP-FC

10.3.3 Possible Options for Flood Mitigation of the Lower Pampanga River Basin

Taking the topographic and hydrological conditions in the objective area into account, the possible options for the flood mitigation are assumed to be: (1) river channel improvement along the downstream of Pampanga River; and (2) construction of flood retarding basin in the Candaba and San Antonio swamps.

In addition, the design flood scale for the flood mitigation measures could be also optional. PDDP adopted a 20-year return period as the design flood scale. However, Pampanga River had flood overflow in almost every year, and therefore, the flood mitigation work with even the design flood scale of less than 20-year return period is expected to bring about a substantial flood mitigation effect. On the other hand, a lower design scale for the flood mitigation project would require a lesser number of houses to be resettled. From this point of view, the optimum design scale shall be also clarified.

10.3.4 Selection of Alternatives

The alternative flood mitigation plans have various combinations of the aforesaid two (2) optional flood mitigation measures (i.e., Option 1, River Channel Improvement, and Option 2, Flood Retarding Basin in North Candaba Swamp and/or San Antonio Swamp). The alternative flood mitigation plans would also possess various optional design scales within the limits of 20-year return period. Based on the assumption on the above combination of options, eight (8) alternatives for flood mitigation of the lower/middle Pampanga River are conceived, as shown in Table 10.3.1.

Table 10.3.1 Alternatives for Flood Mitigation of the Lower/Middle Reaches of Pampanga River

Design Scale / Optional Flood Mitigation Measures	5-year return period	10-year return period	20-year return period
Option 1 Only (= Sole river channel improvement without flood retarding basin)	Alternative 1	Alternative 2	Alternative 3
Option 2 Only (= Sole flood retarding basin without river channel improvement)	Alternative 4	Alternative 5	*
Combination of Option 1 and Option 2	Alternative 6	Alternative 7	Alternative 8

Note *: The design flood scale of 20-year return period is hardly attained solely by the flood retarding basin in Candaba Swamp without the river channel improvement (refer to Subsection E.3.3.2 in Sector Report E). Accordingly, this alternative is ruled out from the potential alternatives.

10.3.5 Evaluation of Alternatives

The above nine (9) alternatives were evaluated from seven (7) points of evaluation as summarized in Table 10.3.2.

Table 10.3.2 Summary of Evaluation of Alternative Plans

Alt. No.	Points of Evaluation						
	(1) Technical Viability	(2) Economic Viability	(3) Impacts to Social Environment	(4) Impacts to Natural Environment	(5) Benefit to Water Use	(6) Regional Equity in the Flood Safety Level	(7) Adaptation to Climate Change
1	High	C	**A-**	B-		**A-**	
2	High	C	**A-**	B-		B-	
3	High	B+	**A-**	B-			
4	Fair	C	B-	**A-**	A+	**A-**	B+
5	Fair	C	B-	**A-**	A+	B-	B+
6	Fair	C	B-	**A-**	A+	**A-**	B+
7	Fair	C	B-	**A-**	A+	B-	B+
8	Fair	B+	**A-**	**A-**	A+		B+

Note:
Technical Viability: High = Technical viability already confirmed; Fair = Technical viability not yet confirmed but no particular technical difficulty in executing the project is foreseeable, Low = There remain uncertainties in the technical viability of the project
Other Evaluation: A+ = Large positive impact; A- = Large negative impact; B+ = medium positive impact; B- = medium positive impact; C = uncertain; No Score = No or negligible impact

As listed above, Alternatives 1, 2, 3 and 8, which adopt the large scale of river channel improvement along the downstream of Pampanga River, are evaluated to cause serious negative impacts to the "social environment." This negative evaluation is attributed to the large number of resettlement of houses required for the river channel improvement.

On the other hand, the Alternatives 4 to 8, which will use the Candaba Swamp as the flood retarding basin, may require house resettlement though the large resettlement is not required, and they could cause serious impacts to the "natural" environment in the Swamp because of the impounding of floodwaters in the swamp. The Candaba Swamp is an important habitat for migratory birds during the rainy season and declared as a bird sanctuary by LGU. Moreover, the swamp is proposed as a candidate for the Ramsar Site and/or the East Asian-Australasian Flyway. Judging from these situations, difficulties in constructing a flood retarding basin in the swamp are foreseeable.

As for the alternative design scales for flood mitigation, it is evaluated that the alternatives which adopt the design scale of 20-year return period may lead to the dynamic increment of houses to be resettled, while the alternatives which have the design scale of 5-year return period is hardly verified from the viewpoint of regional equity in the flood safety level.

As stated above, any alternatives are still hardly selected as optimum plan at this preliminarily study stage due to the estimated serious negative impacts in the aspects of the resettlement required and the preservation of the natural environment. Under this condition, the non-structural flood mitigation measures such as usage of the flood forecasting and warning system and promotion of the watershed management (i.e. reforestation and hillside works on the steep slope area) are expected to take an important role for the chronic flood damages in Pampanga river basin, which occur almost every year. The existing and proposed non-structural measures for Pampanga river basin are as enumerated below:

- The flood forecasting and warning system for the entire Pampanga river basin had been established in 1981 through the financial and technical assistance of Government of Japan., and it is now being operated and managed by PAGASA. The real time information on the storm rainfall and river flow discharge could be gauged and used for early flood forecasting and evacuation.
- The flood forecasting and warning system for operation of Pantabangan and Angat dam reservoirs had been established in 1994 through the financial and technical assistance of Government of Japan., and it is now being operated and managed by PAGASA. Moreover, the capacity building for operation of the system is now being carried out through the technical assistance by JICA on the premises of the target completion of 2015. This system is expected to enhance the effective reservoir operation for flood control, which could lead to mitigation of the flood damage in the lower reaches of Pampanga River.
- The community-based flood warning system aims at establishing the methods and procedures for issuance of flood warning and evacuation and providing the necessary equipment for them in each of provinces. The system had been already completed in Bulacan Province in 2006, and establishment of the new systems is further proposed for Provinces of Pampanga, Tarlac and Nueva Ecija.
- The twelve (12) major watershed management projects are now being implemented expanding the forest coverage in Pampanga river basin, which could lead to increase the basin detention capacity of the storm rainfall and reduce the flood damages in the lower reaches of Pampanga river basin. Moreover, proposed is the Project of "WS-C-01: Upland Development Plan" in the study, which aims at reforestation as well as hillside works on the steep slope leading to reduction of the peak flood discharge and sediment runoff.

It is indispensable to carry out a further feasibility study in due consideration of: (a) the effectiveness of the above non-structural measures and (b) the results of the topographic/river channel surveys, the hydrological/hydraulic analysis and other basic surveys/analyses.

11. Project Implementation Schedule, Development Scenario and Investment Plan

11.1 Grouping of Projects

The aforesaid projects, which are selected as the eligible components of the IWRM for Pampanga river basin, are classified into Group A and Group B in order to facilitate programming of the project implementation schedule and development scenarios discussed below. The criteria for classification to either Group A or Group B are as described in Subsection 7.3.5 Step 5. The list of projects, which belong to Groups A and B as listed in Annex-T 11.1.1 and summarized in Table 11.1.1.

Table 11.1.1 Results of Grouping of Projects

Group	Sector	Number of Projects	Project Cost (million pesos)
A	Agriculture/Irrigation and Fishery	10	12,388
	Municipal Water Supply, Sanitation and Sewerage	15	68,571
	Management of Flood and Sediment Disasters	3	3,687
	Watershed Management	9	623
	Water-related Environment Management	5	3,417
	Inter-Sector Water Resources Development, Allocation and Distribution	1	7,966
	Sub-total	43	96,652
B	Agriculture/Irrigation and Fishery	18	55,400
	Municipal Water Supply, Sanitation and Sewerage	3	1,155
	Management of Flood and Sediment Disasters	7	12,071
	Watershed Management	7	2,951
	Water-related Environment Management	3	248
	Inter-Sector Water Resources Development, Allocation and Distribution	3	607
	Sub-total	41	72,432
Total		84	169,084

11.2 Project Implementation Schedule

The phased project implementation schedules for short-term (2011-2015), mid-term (2016-2020) and long-term (2021-2020) are programmed for both the Group A and Group B projects.

As described in Subsection 7.3.6 Step 6, the development scenarios relevant to Group-A projects are firstly delineated taking the basic social and natural environmental needs into account. Then, the implementation schedule of the Group A projects is programmed to grasp the development scenarios. Under this concept, the details of the development scenarios relevant to the Group A projects are delineated as described in the following Section 11.4, and the implementation schedule for the Group A projects is programmed in line with the development scenarios as shown in Annex-T 11.2.1.

In contrast to the above implementation schedule for Group A projects, the priority order of the projects is the principal factor for determination of the implementation schedule for the Group-B projects (refer to Subsection 7.3.8, Step 8). The priority order of projects is setup through the evaluation of projects by scoring on the 25 points of evaluation. The criteria for scoring are as described in Subsection 7.3.7, Step 7. The JICA Study Team in collaboration with the TWG members carried out the scoring for the proposed and conceptual projects. The results of scoring are as shown in Annex-T 11.2.2.

Aside from the priority order of projects, there are other two (2) factors to determine the implementation schedule of the Group B projects, namely; (a) the ceiling investment cost of the projects for each of the short, mid and long term (refer to Section 8.3); and (b) the required length of the project implementation period. Taking these factors into account, the implementation schedule for the Group B projects is programmed as shown in Annex-T 11.2.3

The number of projects to be implemented in each of the short, mid and long term is programmed as shown in Table 11.2.1.

Table 11.2.1 Number of Projects to be implemented in the Short, Middle and Long Terms

Classification of Projects		Short-Term	Mid-Term	Long-Term	Total
Project to be Implemented within the Term	Group-A	41	36	36	113
	Group-B	33	17	6	56
	Total	**74 (44%)**	**53 (31%)**	**42 (25%)**	**169 (100%)**
Projects to be started in the Term	Group-A	41	0	2	43
	Group-B	33	7	1	41
	Total	**74 (88%)**	**7 (8%)**	**3 (4%)**	**84 (100%)**
Project to be Completed within the Term	Group-A	5	2	36	43
	Group-B	23	12	6	41
	Total	**28 (33%)**	**14 (17%)**	**42 (50%)**	**84 (100%)**

A total of 84 projects are to be implemented throughout the short, middle and long terms. Out of these projects, the first 74 projects shall commence in the short-term, and 28 of them are to be completed within the same term as listed in Table 11.2.1. The remaining projects (i.e., 46 projects) continue to be implemented in the next mid-term. Likewise, 53 projects are implemented in the mid-term including 7 projects to be newly commenced and 15 projects to be completed within the term. The number of projects to be finally implemented in the long-term is 42, which include 3 projects to be newly commenced.

11.3 Project Investment Plan

It is clarified that a total of about 169 billion pesos would need to be invested for implementation of the whole projects for the IWRM plan of Pampanga river basin. Of the total project investment cost, 61.5 billion pesos (36% of the total investment cost) is to be disbursed in the short-term, followed by 52.7 billion pesos (31%) in the mid-term and 55.0 billion pesos (33%) in the long-term, as shown in Table 11.3.1.

Table 11.3.1 Project Cost to be disbursed in the Short, Mid and Long Terms

(Unit: million pesos)

Classification of Project	Short-Term	Mid-Term	Long-Term	Total
Agriculture/Irrigation and Fishery Development	22,163	26,164	19,461	67,788
Municipal Water Supply, Sanitation and Sewerage Development	29,137	8,980	31,609	69,726
Management of Flood and Sediment Disasters	6,431	6,597	2,730	15,758
Watershed Management	1,721	1,588	265	3,574
Water-Related Environmental Management	1,501	1,371	793	3,666
Inter-Sector Water Resources Development, Allocation and Distribution	509	7,965	99	8,573
Total	61,462	52,665	54,957	169,085

The project investment cost includes 21.5 billion pesos for the ongoing projects and 77.5 billion pesos for the proposed projects as shown in Table 11.3.2. The necessary budgetary sources for these ongoing and proposed projects have been arranged and/or being programmed by the project proponents.

On the other hand, there is nothing to be done with the project investment cost of about 70.1 billion pesos for the conceptual projects. The particular concerns for project investment are given to the conceptual projects for three (3) sectors, namely; (a) municipal water supply, sanitation and sewerage development; (b) management of the flood and sediment disasters; and (c) water resources development, allocation and distribution. The investment cost of the conceptual projects for these sectors is estimated at about 93% of the cost for the whole conceptual projects, and thereby, the prospect of possible project investment for the sectors is examined as described in Subsection 11.3.1 to 11.3.3.

Table 11.3.2 Project Investment Cost divided according to Classification and Status of Projects (Project Implementation Period: 2011–2025)

(Unit: million pesos)

Classification of Project	Ongoing Project	Proposed Projects	Conceptual Projects	Total
Agriculture/Irrigation and Fishery Development	12,766	54,208	814	67,788
Municipal Water Supply, Sanitation and Sewerage Development	5,213	16,456	48,057	69,726
Management of Flood and Sediment Disasters	1,454	5,820	8,484	15,758
Watershed Management	1,662		1,912	3,574
Water-Related Environmental Management	356	1,036	2,273	3,665
Inter-Sector Water Resources Development, Allocation and Distribution			8,573	8,573
Total	21,452	77,520	70,113	169,085

11.3.1 Investment Plan for Development of Municipal Water Supply, Sanitation and Sewerage

The projects, which belong to this sector, would require the project investment cot of about 69.7 billion pesos in total as listed below.

Table 11.3.3 Project Investment Cost for the Development of Municipal Water Supply, Sanitation and Sewerage

(Unit: million pesos)

Object*	Principal Entities for Financing	Short-Term		Mid-Term		Long-Term		Total	
1	WD	3,793	13.0%	3,610	40.2%	3,722	11.8%	11,127	16.0%
2	Public Corporation/ Private Firm**	0	0.0%	255	2.8%	255	0.8%	510	0.7%
3		13,111	45.0%	1,176	13.1%	23,661	74.9%	37,948	54.4%
4		5,562	19.1%	0	0.0%	0	0.0%	5,562	8.0%
5	LGU	519	1.8%	304	3.4%	267	0.8%	1,090	1.6%
6		5,507	18.9%	3,635	40.5%	3,704	11.7%	12,846	18.4%
7		645	2.2%	0	0.0%	0	0.0%	645	0.9%
Total		22,163	29,137	100%	8,980	100%	31,609	100%	69,726

Note:

*: Object 1: Expansion of Level 3 and 2 municipal water supply system
Object 2: Construction/provision of sewage treatment and disposal facilities
Object 3: Development of bulk water supply system
Object 4: Strengthening of Water Supply Capacity of Angat-Umiray System
Object 5: Expansion of Level 1 municipal water supply system
Object 6: Construction/provision of sanitary toilets
Object 7: Development of Sewerage System

**: MWSS and private firms such as Manila Water Company Inc. (MWCI) and Maynilad Water Service Incorporated (MWSI)

The project investment cost for Object 4 and 7 shown in Table 11.3.3 have been secured by the public water service corporations such as MWSS and Clark Water as well the local government of Cabanatuan City. Moreover, the project investment cost for Object 5 and 6 could be allotted from the budget of the LGUs. Thus, the available financial sources for the project investment of Object 4 to 7 could be foreseeable. On the other hand, the budgeting process of the project investment cost for the following items in Table 11.3.3) has to be newly clarified:

- Object 1: Expansion of Level 3 and 2 municipal water supply system
- Object 2: Construction/provision of sewage treatment and disposal facilities
- Object 3: Development of bulk water supply system

The project investment for the above items is subject to the “full cost recovery” both for the initial construction cost and the annual O&M cost for the project facilities. That is, the WDs and/or the public water service corporations such as MWSS and CDC as the project implementing bodies, would have to secure the necessary initial construction cost of the facilities and recover the initial cost as well as the annual O&M cost of the facilities by collecting fees for the use of facilities from the water users.

In order to clarify the availability of the above “full cost recovery” the project investment costs for the above Objects 1 to 3 are converted to the unit costs per served water volume and compared with the

current prevailing water tariff. The results of the conversion are as listed in Table 11.3.4 and the detailed clarification on the "full cost recovery "is as described in items (1) to (3) below.

Table 11.3.4 Conversion of Project Investment Cost to Unit Cost

Object*	Initial Investment Cost (million pesos)	Annual Cost (million pesos/year)			Annual Water Consumption (mil. m^3/year)	Unit Cost (peso/m^3)
		Annual Initial Investment Cost**	Annual O&M Cost	Total		
1	11,130	1,137.5	1,030.8	2,168.4	103.1	21.0
2	510	104.8	355	459.8	110.5***	4.2
3	37,948	3,880.4	379.7	4,260.1	225.9	18.9

Note:

*: Object 1: Expansion of Level 3 and 2 municipal water supply system
Object 2: Construction/provision of sewage treatment and disposal facilities
Object 3: Development of bulk water supply system

**: Initial investment cost is converted to annual cost based on the following assumptions:
- Project life is assumed at 50 years for Object 1 and 3, while it is 7 years for Object 2.
- The time interval for the replacement of facilities is assumed at 25 years for Object 1 and 3, while it is 7 years for Object 2.
- The annual discount rate is assumed at 10%

***: The figure is estimated on the premises of the volume of water consumption for Level 3 water supply system

(1) Investment Plan for Expansion of Level 3, 2 Municipal Water Supply System

The "expansion of Level 3, 2 and 1 municipal water supply systems toward 2025" is raised as one of the development scenarios for improvement of water supply quality and securing of the necessary water supply volume.

Expansion of the Level 1 water supply system is to be financed by the LGUs and it is not subject to full cost recovery as described above. On the other hand, the necessary investment cost for expansion of Level 3 and 2 water supply system is to be secured and recovered by the WDs. That is, WDs would secure the initial investment cost by their own budget or loan from LWUA, and recover it by collecting water service fees from the water users. The viability of full cost recovery for the expansion of Level 3 and 2 water supply system is verified judging from the following points of view:

- The initial investment cost for the water supply system could be secured either from the budget of WDs or available loan from LWUA to WDs.
- As shown in Table 11.3.4, the unit cost for the initial investment and the O&M for expansion of Level 3 and 2 water supply systems is estimated at about 21 pesos/m^3. On the other hand, the water tariff for services of Level 3 and 2 municipal water supply systems is in a range of 16 to 21 pesos/m^3. Judging from the unit cost for project investment and the current water tariff for services, the project investment could be fully recovered by the water tariff without a large increment in the water tariff.

(2) Investment Plan for Construction/Provision of Sewage Treatment and Disposal Facilities

One of the development scenarios is oriented to the construction/provision of sewage treatment and disposal facilities, which shall cover about 80% of the households in the urban area of the principal ten (10) cities/municipalities by 2025. In this study, it is proposed that this project is to be implemented by WDs, and its investment cost is to be fully recovered in the following manner:

- As shown in Table 11.3.4, the necessary project investment cost is estimated at 4.2 pesos/m^3 assuming the water consumption volume of the Level 3 water supply system. In order to recover the said project investment cost, it is proposed that the investment cost of 4.2 pesos/m^3 shall be surcharged to the above water tariff for the Level 3 water supply service.
- The above surcharge cost is called "Environmental Fee" as suggested in "the business model for development of sewage treatment and disposal facilities by WDs" project and, MWSS has been applying it since 2008.

(3) Investment Plan for Development of Bulk Water Supply System

Development of the bulk water supply system is proposed for Bulacan Province, Pampanga Province and Metro Clark area in particular. The project investment cost for development of the bulk water supply system is to be recovered through the following manner:

- The public water service corporations such as MWSS as well as the relevant private firms shall be the implementing body for development of the bulk water supply system. The budgetary capacities of these implementing bodies shall be able to secure the necessary initial investment cost judging from their previous business showings.
- As shown in Table 11.3.4, the sum of initial investment cost and annual O&M cost for the development of the bulk water supply system could be equivalent to about 19 pesos per unit m^3 of water consumption. In addition, the aforesaid cost of about 21 pesos/m^3 for the expansion of Level 3 and 2 water supply systems is required as a part of the bulk water supply service. Accordingly, the investment cost of about 40 pesos/m^3 in total is required for the service of the bulk water supply system, while the present water tariff for the existing bulk water supply service is around 42 pesos/m^3, which is almost equal to the above necessary investment cost (i.e., 40 pesos/m^3).
- As compared with the necessary investment cost with the present water tariff for the bulk water supply services, the investment cost could be fully recovered by the water tariff.

11.3.2 Investment Plan for Management of Flood and Sediment Disasters

A substantial part of the investment cost for the conceptual projects is addressed to the following:

- Investment cost of 5.5 billion pesos for the Project of FL-C-01: Flood Mitigation for Pampanga Delta by DPWH; and
- Investment cost of 3.0 billion pesos for FL-C-03: Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under the Jurisdiction of LGUs

The investment cost for the above Project of FL-C-03 is likely to have been programmed by the LGUs based on the "Medium-Term Development Plan, 2011-20113."[2] On the other hand, the Project of FL-C-01 is left behind since Phase I of the project was completed at a reduced scale in 2002 and budgetary arrangement for the project is required. The investment shall be made by the budgetary source of DPWH and would require foreign loan assistance judging from the scale of the investment cost.

11.3.3 Investment Plan for Inter-Sector Water Resources Development, Allocation and Distribution

The project investment cost of about 8.6 billion pesos in total is to be disbursed during the 15-year period from 2011 to 2025. Out of the total investment cost, about 93% or 8.0 billion pesos is for the project for recovery of reliability of water supply capacity of the existing Angat-Umiray System (Project Code: IS-C-02). The feasibility study for this project needs to be firstly undertaken by NWRB to clarify the necessary project components, which would include the new water resources development, and the organizational setup for implementation of the project. Moreover, it would be necessary to clarify the possible financial sources and their shares for allotment. The possible financial sources would include the national government fund by NWRB, NIA, NPC, the LGU's fund by Bulacan Province, the corporation/private fund by MWSS and its relevant MWCI and MWSI, and other private funds collected through BOT.

[2] The investment cost of 3.0 billion pesos was assumed by the JICA Study Team as the approximate amount for maintenance, rehabilitation and improvement for drainage and flood control facilities to be undertaken by municipalities/cities in the study area for a 15-year period from 2011 to 2025.

11.4 Development Scenarios

11.4.1 Development Scenarios for Group A Projects

The target development scenarios for Group A projects are proposed for each of the sectors as described hereinafter.

(1) Development Scenarios in Sector of Agriculture/Irrigation and Fishery Development

In order to enhance the sector goals of "rehabilitation and development of the irrigation system" and "sustainable fishery under integrated water resources management," the following two (2) development scenarios shall be achieved, and a total of ten (10) projects shall be implemented for the scenarios throughout the period from 2011 to 2015.

Table 11.4.1 Development Scenarios and Relevant Projects in Group A for Agriculture/Irrigation and Fishery Development

Development Scenario	Execution Period	Relevant Project
1. Rehabilitation of Existing Irrigation Facilities Agricultural productivities shall be improved through rehabilitation of the existing irrigation facilities.	2011-2025	AI-G-03: Repair, Rehabilitation of Existing Groundwater Irrigation Systems, Establishment of Groundwater Pump Project AI-G-04: Balikatan Sagip Patubig Program (BSPP) AI-G-05: Repair, Rehabilitation, Restoration & Preventive Maintenance of Existing National & Communal Irrigation Facilities AI-G-06: Restoration/Rehabilitation of Existing NIA-Assisted Irrigation System (RRE-NIAIS) AI-G-08: Rehabilitation of Small Water Impounding Projects/Diversion Dams AI-G-09: Comprehensive Agrarian Reform Program, Irrigation Component
2. Sustainable Fishery Production Fishery productivities shall be sustained through the ongoing regular projects.	2011-2025	AF-G-01: Aquaculture Fisheries Development Programs AF-G-02: Comprehensive Regulatory Services AF-G-03: Support Projects and Activities AF-G-04: Fisheries Resources Management for Improved and Sustainable Harvest

(2) Development Scenarios in Sector of Municipal Water Supply, Sanitation and Sewerage System

In order to achieve the sector goal of "improvement of water quality", "ensuring of necessary water supply capacity", and "reduction of pollution load", seven (7) development scenarios are proposed in the study. Moreover, in order to embody these development scenarios, the implementation of 17 projects is proposed as listed in Table 11.4.2.

Table 11.4.2(1/2) Development Scenarios and Relevant Projects in Group A for Municipal Water Supply, Sanitation and Sewerage System Development

Development Scenario	Execution Period	Relevant Project
1. Short-Term Development of Bulk Water Supply System for Bulacan Province MWSS shall provide the bulk municipal water supply system to Bulacan Province in order to deter deterioration of the groundwater currently used as the source for municipal water use in the province by 2015. The water supply system shall have the supply capacity of 2.7m^3/s, which could cover the municipal water demand of about one million.	2011-2015	MW-P-03: Bulacan Treated Bulk Water Supply Project
2. Strengthening of Water Supply Capacity of Angat-Umiray System A more sustainable water supply by Angat-Umiray system shall be enhanced through implementation of MW-G-01, MW-P-01 and MW-P-02 by 2015 so as to mitigate the chronic shortage of municipal water supply to Metro Manila and the irrigation water in AMRIS.	2011-2015	MW-G-01: Angat Water Utilization and Aqueduct Improvement Project (AWUAIP) Phase II MW-P-01: Rehabilitation of Umiray-Macua Facilities MW-P-02: Sumag River Diversion Project
The reliability of water supply in Angat-Umiray System shall be fully recovered through implementation of IS-C-02 by 2020.	2011-2020	IS-C-02: Project for Recovery of Reliability of Water Supply in Angat-Umiray System

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Table 11.4.2(2/2) Development Scenarios and Relevant Projects in Group A for Municipal Water Supply, Sanitation and Sewerage System Development

Development Scenario	Execution Period	Relevant Project
3. Expansion of Level 3, 2, 1 Municipal Water Supply System The coverage of Level 3, 2, 1 water supply system with safe drinking water supply shall reach 100% by 2025. The coverage ratios of the Level 3 Water Supply System in the urban area shall increase to 1% per annum by 2015, and their average ratio shall reach 80% by 2025. At the same time, the lowest coverage ratio in the urban area shall not be below 46.5%* in 2025. The present average coverage ratio of Level 3 Water Supply System in the rural area shall be maintained until 2025, notwithstanding the future increment of population. The target coverage ratio to be maintained is 18% in average for the whole study area.	2011-2025	MW-C-01: Additional Level 3,2, 1 Facilities towards 2025 in Bulacan MW-C-02: Additional Level 3,2, 1 Facilities towards 2025 in Pampanga MW-C-03: Additional Level 3,2, 1 Facilities towards 2025 in Nueva Ecija MW-C-04; Additional Level 3,2, 1 Facilities towards 2025 in Tarlac
4. Construction/Provision of Sanitary Toilet The rate of construction/provision of sanitary toilets in all municipalities and cities shall increase at the rate of 10% per annum by 2015, and all households in the study area shall be provided with sanitary toilets by 2025**.	2011-2025	MS-C-01: Additional Sanitary Facilities towards 2025 in Bulacan MS-C-02: Additional Sanitary Facilities towards 2025 in Pampanga MS-C-03: Additional Sanitary Facilities towards 2025 in Nueva Ecija MS-C-04: Additional Sanitary Facilities towards 2025 in Tarlac
5. Development of Bulk Water Supply System for Metro Clark The bulk water supply system (supply capacity of 0.8m^3/s) shall be gradually expanded to the entire Metro Clark by 2025.	2011-2025	MW-P-04: Metro Clark Bulk Surface Water Project
6. Long-Term Development of Bulk Water Supply System for Bulacan and Pampanga Province The bulk water supply system with the supply capacity of additional 3.8m^3/s for Bulacan and 1.3m^3/s for Pampanga Province shall be developed by 2025 in order to serve the incremental provincial population and cope with the deterioration of groundwater quality.	2021-2025	MW-C-05: Extended Bulacan Bulk Water Supply Project MW-C-06: Pampanga Bulk Water Supply Project

Remarks:
*: The boundary of 46.5% for the lowest coverage ratio is derived from the future expected incremental rates of 17% for a period of 17 years (from 2008 to 2025) added to half of the present average coverage ratio as of 2008 (= 29.5%).
**: The target year is set at 2025, because the main purpose of construction/provision of sanitary toilets is to secure the access to safe drinking water for all by 2025, which is stated in the Philippine Water Sector Roadmap.

(3) Development Scenarios in Sector of Management of Flood and Sediment Disasters

In order to make a contribution to the mitigation of chronic flood damage and improvement of knowledge on the flood management, the three (3) development scenarios are proposed: Moreover, in order to embody these development scenarios, the implementation of three (3) projects as listed in Table 11.3.3 below is proposed.

Table 11.4.3 Development Scenarios and Relevant Projects in Group A for Management of Flood and Sediment Disasters

Development Scenario	Execution Period	Relevant Project
1. Sustainment of Regular Program for Maintenance and Rehabilitation of River Dike and Slope Until 2025, the ongoing regular program for maintenance and rehabilitation of the deteriorated river dike and slope of Pampanga, Angat and Pasac river systems of 54km in length, which are under jurisdiction of DPWH, shall be sustained to maintain the original river flow capacities and morphology	2011-2025	FL-G-03: Maintenance and Rehabilitation Works for River Dike and Slope
2. **Sustainment of Regular Program for Maintenance and Rehabilitation of Drainage and Flood Control Facilities for LGUs** Until 2025, the proposed regular program for maintenance and rehabilitation of the drainage and flood control facilities, which are under jurisdiction of the Provincial Governments of Pampanga, Bulacan, Nueva Ecija and Tarlac, shall be sustained to maintain the original design capacity of the facilities	2011-2025	FL-C-03: Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs
3. **Improvement of Public Awareness on IWRM** Toward 2025, public awareness on IWRM shall be improved through the annual regular program on the salient points of IWRM into school curricula for primary and secondary school in the aspect of IWRM for Pampanga river basin.	2011-2025	FL-C-04: Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula

(4) Development Scenarios in Sector of Watershed Management

The development scenario is oriented to the sector goals of "intensifying of management, protection and maintenance of vulnerable and ecologically sensitive area" and "increase of forest cover of critically denuded uplands, mangrove areas and urban corridors." In order to attain the development scenario, proposed is to sustain the ongoing nine (9) regular programs as listed below for watershed management in Pampanga river basin until 2025.

Table 11.4.4 Development Scenarios and Relevant Projects in Group A for Watershed Management

Development Scenario	Execution Period	Relevant Project
Sustainment of On-going Regular Program for Watershed Management The major on-going nine (9) regular programs for watershed management in Pampanga river basin shall be sustained by 2025, which could lead to the following outcomes: • The 285,300has of tenured and untenured forestlands shall be protected against illegal harvesting, encroachment, forest fires, illegal land use and conversion. • The present forest cover of 187,500has shall be expanded through timber forest establishment and agro-forestry by about 10,000has at the rate of 660has per annum. Forest expansion will cover an additional 2.63% of the total classified and unclassified forestlands (377,500has) in Pampanga river basin by 2025. • The present agro-forestry cover shall expand by about 29,700has at the rate of 200has per annum as the basic strategy to provide additional income source to upland dwellers, particularly, the indigenous people. • Conservation of natural ecosystems and their critical habitats will be sustained in order to protect bio-diversity. The area to be conserved includes: (i) natural forests within the 79,800has of protected areas of Mt. Arayat NP, Pantabangan-Carranglan WFR and Angat WFR; and (ii) old and re-established mangrove forests within 77,400has of coastal areas of Pampanga and Bulacan.	2011-2025	WS-G-01: Forest Protection and Law Enforcement Program (FPLEP) WS-G-02: Community-Based Forest Management Program WS-G-04: Coastal Resource Management Program (CRMP) WS-G-05: Protected Area Community-Based Resource Management Program (CBFM-PACBRMA) WS-G-06: Private Forest Plantation Development Program (PFPDP) WS-G-07: NIA-UPRIIS' Watershed Management Program WS-G-08: NPC's Watershed Management Program WS-G-09: Integrated Social Forestry (ISF) Projects WS-G-10: Private-Sector Watershed Management Initiatives

(5) Development Scenarios in Sector of Water-Related Environment Management

The development scenarios aim at enhancing the sector goals for the reduction of pollution load. In order to attain the development scenarios, five (5) projects as listed Table 11.3.5 are proposed as the regular programs.

Table 11.4.5 Development Scenarios and Relevant Projects in Group A for Water-Related Environment Management

Development Scenario	Execution Period	Relevant Project
1. **Dealing with Contamination of Surface, Ground and Coastal Water** The pollution load from various sources shall be reduced by sustaining the ongoing non-structural measures under three (3) ongoing regular DENR and LGU programs that are intended to protect water quality.	2011-2025	WQ-G-01: Ecological Solid Waste Management Program (ESWMP) WQ-G-02: Industrial Pollution Control Program (IPCP) WQ-G-03: Sagip-Ilog Project
2. **Reduction of Risk for Contamination in Water Body** By 2025, the structural measures will be implemented to reduce the risk of contamination from livestock, domestic and industrial wastes. These include: (a) waste-to-energy CDM projects for livestock farms in Bulacan and the sanitary landfill in Tarlac and Bulacan; and (b) sanitary landfills in Nueva Ecija and waste transfer stations in Pampanga and Bulacan.	2011-2025	WQ-P-01: Clean Development Mechanism Projects WQ-C-04: Construction of Sanitary Landfills and Support Facilities in Nueva Ecija and Cluster Waste Transfer Stations in Bulacan and Pampanga

11.4.2 Development Scenarios for Group B Projects

The target development scenarios to be attained through the implementation of Group B projects are as described hereinafter.

(1) Development Scenarios for Agriculture, Irrigation and Fishery

The following development scenarios could be assumed to enhance the sector goals of: (a) Improvement of irrigation system, and (b) enhancement of new agricultural technologies on water management in particular:

Table 11.4.6 Development Scenarios and Relevant Projects in Group B for Agriculture, Irrigation and Fishery

Development Scenario	Execution Period	Relevant Project
1. **Improvement of Irrigation Technologies** Innovative irrigation technologies shall be developed and capacity building on the usage of technologies shall be made so as to increase the irrigation efficiency and save irrigation water by 2015.	2011-2015	AI-P-07: Appropriate Irrigation Technologies for Enhanced Agricultural Production AI-C-02: Introduction of Water Saving Irrigation Technology AI-C-03: Improvement of Monitoring System and Capacity Development for Proper Water Management in NISs and CISs
2. **Short-Term Development of Infrastructures for Irrigation** Agricultural productivity shall be increased through the following seven (7) irrigation development projects, which contribute to the beneficial area (newly developed) of 5,880ha, the beneficial area (rehabilitated) of 37,046 ha and beneficiaries of 56,640 farm-families in total by 2015.	2011-2015	AI-G-01: Balog-Balog Multipurpose Project Phase I AI-G-02: Along-along Creek Irrigation Project (UPRIIS Div3) AI-G-10: Upper Tabuating SRIP AI-G-07: Participatory Irrigation Development Project, APL1-Infrastructure Development AI-P-10: Rehabilitation of AMRIS AI-P-03: Sector Loan on Rehabilitation of Irrigation Facilities AI-P-11: Construction of Priority Small Scale Irrigation Systems/Small Water Impounding Projects, Small Diversion Dam Projects
3. Mid-Term Development of Infrastructure for Irrigation Agricultural projects shall be increased through the following seven (7) irrigation development projects, which contribute to the beneficial area (newly developed) of 58,443ha, the beneficial area (rehabilitated) of 50,904ha and beneficiaries of 101,893 farm-families in total by 2020.	2016-2020	AI-P-02: Balog-Balog Multipurpose Project Phase II AI-P-04: Casecnan Multi-purpose Irrigation & Power Project Irrigation Component Phase II AI-C-01: New Construction of Small Scale Irrigation Project under BSWM AI-P-08: Central Luzon Groundwater Irrigation Systems Reactivation Project AI-P-06: Irrigation Water Resources Augmentation Pump Establishment Project AI-P-05: Procurement of Pumps, Drilling Rigs & Related Equipment
4. Long-Term Development of Infrastructure for Irrigation The agricultural projects shall be increased through the following two (2) projects, which contribute to beneficial area (newly developed) of 31,199ha and beneficiaries of 9,152 farm-families by 2025.	2021-2025	AI-P-01: Balintingon Reservoir Multipurpose Project (BRMP) AI-P-09: Gumain Reservoir Project

(2) Development Scenarios for Municipal Water Supply, Sanitation and Sewerage

The following development scenarios could be assumed to enhance the sector goal of "reduce the pollution load" in particular:

Table 11.4.7 Development Scenarios and Relevant Projects in Group B for Municipal Water Supply, Sanitation and Sewerage Development

Development Scenario	Execution Period	Relevant Project
1. **Development of Sewerage Systems** The two (2) on-going projects for development of the sewerage systems shall be completed by 2015. Upon completion of the projects, about 12% of the population in Cabanatuan City and 100% in Clark would be served by the public sewerage system.	2011-2015	MP-G-01: Cabanatuan Sewerage System MP-G-02: Expansion of Clark Sewerage System
2. **Construction/Provision of Sewage Treatment and Disposal Facilities** The services of the sewage treatment and disposal facilities shall be provided to about 80% of the urban area in the ten principal cities/municipalities by 2025*.	2016-2025	MP-C-01: Sewage Treatment and Disposal Facilities

Remarks:
*: The target year has been set at 2025 referring the output from 4th stakeholder meetings, although the target water quality of Manila Bay by DENR is to be Class SB category by 2020.

(3) Development Scenarios for Management of Flood and Sediment Disasters

The following five (5) development scenarios in the sector are to be achieved through the implementation of seven (7) projects:

Table 11.4.8 Development Scenarios and Relevant Projects in Group B for Management of Flood and Sediment Disasters

Development Scenario	Execution Period	Relevant Project
1. **Flood Mitigation for Pasac River Basin (Eastern Pinatubo Area)** The two (2) on-going and one (1) proposed flood mitigation projects for Pasac river basin shall be completed by 2015. Upon completion of the projects, the chronic flood damage in the area of about 57,300 ha would be mitigated, and about 309,000 people would be benefitted.	2011-2015	FL-G-01: Pinatubo Hazard Urgent Project (PHUMP) Phase III, Part I FL-G-02: Pinatubo Hazard Urgent Project (PHUMP) Phase III, Part II FL-P-01: Flood Control Measures in Mt. Pinatubo Devastated Area - Focus on Pasac Delta
2. Flood Mitigation for Pampanga Delta The chronic flood damage in Pampanga Delta shall be mitigated through implementation of the project of FL-C-01 by 2020. Upon completion of the project, the potential flood inundation area of about 32,400 ha would be mitigated, and about 175,000 people would be benefitted.	2011-2020	FL-C-01: Flood Mitigation for Pampanga Delta
3. **Capacity Building on the Appropriate Dam Reservoir Operation against Flood** The capacity building on the appropriate reservoir operation against flood for Pantabangan Dam and Angat Dam shall be completed through the technical cooperation with JICA by 2015.	2011-2015	FL-G-04 : Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines
4. **Establishment of Community-Based Flood Forecasting and Warning System for Provinces of Pampanga, Tarlac and Nueva Ecija** Three (3) provinces in the study area, Pampanga, Tarlac and Nueva Ecija, shall be provided with the community-based flood forecasting and waning system by 2015.	2011-2015	FL-C-02: Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and Nueva Ecija
5. **Flood Mitigation for Bacolor Municipality** The flood mitigation project for Bacolor Municipality shall be implemented by 2025. Upon completion of the Project, the flood damage potential in the area of about 107,500 ha would be mitigated.	2021-2025	FL-P-02: Bacolor Comprehensive Rehabilitation Master Plan

(4) Development Scenarios for Watershed Management

The following development scenarios shall be achieved to attain the sector goals of: “intensifying of management, protection and maintenance of vulnerable and ecologically sensitive area” and “increase of forest cover of critically denuded uplands, mangrove areas and urban corridors”:

Table 11.4.9 Development Scenarios and Relevant Projects in Group B for Watershed Management

Development Scenario	Execution Period	Relevant Project
1. **Strengthening of On-going Reforestation Efforts** The seven (7) special projects shall be implemented in order to strengthen the on-going reforestation efforts. Upon completion of the projects, the forest cover shall expand by 39,900ha.	2011-2025	WS-G-03: Integrated Agro-Forestry Development Program (CBFM-CARP) WS-G-11: Forestlands Management Project (FMP) WS-G-12: Pampanga River Basin Rehabilitation Project (PRBRP) WS-C-01: Upland Development Program (UDP) WS-C-02: Protected Area Management Program (PAMP) WS-C-03: Urban Greening Program WS-C-04: Community-based Eco-tourism Program

(5) Development Scenarios for Water-Related Environmental Management

The following development scenarios shall be achieved to attain the sector goals of “strengthening of the water quality monitoring” and “reduce of pollution loads.”

Table 11.4.10 Development Scenarios and Relevant Projects in Group B for Water-Related Environment Management

Development Scenario	Execution Period	Relevant Project
1. **Improvement of Monitoring and Processing System for the Water Quality Data** By 2015, DENR shall improve the monitoring and processing system for the water quality data.	2011-2015	WQ-C-01: Capacity Development to Upgrade WQ Monitoring and Data Management Program
2. Capacity Development to Reduce Pollution Load By 2020, the capability of fishpond operators and non-compliant industries shall be improved towards adopting cleaner production options in order to reduce their impacts on water quality.	2011-2020	WQ-C-02: Capacity Development to Improve Water Quality and Aquaculture Fisheries Management WQ-C-03: Capacity Development Project to Improve Industry Adoption of Cleaner Production Options

(6) Development Scenarios for Inter-Sector Water Resources Development, Allocation and Distribution

The following two (2) development scenarios shall be achieved in order to strengthen the monitoring system for water resources and attain capacity development on water allocation and distribution:

Table 11.4.11 Development Scenarios and Relevant Projects in Group B for Inter-Sector Water Resources Development, Allocation and Distribution

Development Scenario	Execution Period	Relevant Project
1. **Enhancement of Monitoring of Groundwater and Surface Water** By 2025, the monitoring of groundwater and surface water shall be enhanced in order to comprehend the actual status of the water resources in Pampanga river basin.	2011-2025	IS-C-01: Establishment of Comprehensive Groundwater Monitoring in Pampanga River Basin IS-C-03: Enhancement of Monitoring System for Surface Water in Pampanga River
2. **Capacity Development on Water Allocation and Distribution** By 2015, the appropriate methodologies on water allocation and distribution for municipal water use, irrigation, hydropower generation and other various water uses shall be introduced to NWRB and other relevant agencies.	2011-2015	IS-C-04: Capacity Development of NWRB and Relevant Agencies on Water Allocation and Distribution

12. Proposed Institutional Setup for IWRM

12.1 Basic Institutional Framework

The role of the institutional setup is at the position of implementing arrangements to localize and implement the IWRM Plan for Pampanga river basin. The Plan would neither be implemented by improvement of the existing laws only nor capacity strengthening of the existing organizations only. The key actions are structurally studied to empower the existing institution from the three basic aspects defined as follows:

- Legal Aspect: Improvement of related laws (the Water Code, the Local Government Code, etc.), regulations, rules, standards, guidelines;
- Organizational Aspect: Capacity strengthening of the existing organizations (NGAs, RLAs, LGUs, etc.) and supplement of missing functions to the existing ones; and
- Financial Aspect: Strengthening of financial capacity necessary to achieve the sustainable IWRM.

12.2 Key Actions to Amend the Water Code and Related Rules and Guidelines

The following key actions are proposed to resolve the strategic issues related to the Water Code, and related rules and guidelines:

- Control the water resources supply security level in a region or the whole basin within the target risk of failure (Actions for Issue 1);
- Mitigate the regional water rights conflict by the quantitative regulation of the regional water balance covering the aggregated discharge and quantity of more than two water permits in a region where daily or seasonal water diversion conflict prevails (Actions for Issue 1);
- Strengthen the enforcing power of NWRB to regulate effectively over issues or to control of the aggregate rate and quantity of water permit provided with the NWRB-owned monitoring system (Actions for Issue 1);
- Enhance incentive of water saving activities for water users in particular irrigators, and mitigate the present wasteful consumption and growing scarcity of water (Actions for Issues 2 & 3);
- Make the national and local governments be legally responsible to maintain the sustainability of groundwater (Actions for Issue 4);
- Make the national and local governments be legally responsible to monitor the environmental flow and water quality for sustainability of the regional water environment (Actions for Issues 6 & 7);
- Make the national and local governments be legally responsible to mitigate regional risks from floods linked with the flood control basin plan (FCBP) (Actions for Issue 8); and
- Setup flood control function of dam reservoirs legally to mitigate regional risks from floods linked with the FCBP (Actions for Issue 8).

12.3 Key Actions to Introduce Cost Allocation Rule of Multipurpose Dam

The following key actions are proposed to enhance multipurpose dam projects and to resolve the existing cost allocation issues:

- Enhance multipurpose dam projects based on the legal basis on the cost and reservoir volume allocation rule among multiple water users including both public and private sectors (Actions for Issue 5);

- Make the national and regional government be legally responsible to share equitably the cost of flood control function of dam reservoirs with water users to mitigate regional risks from floods (Actions for Issues 5 & 8); and
- Define water permit as property or asset which can be treated as guaranty in the civil code (Actions for Issue 5).

12.4 Key Actions to Strengthen National Government Agencies and Local Government Units

The following key actions are proposed to strengthen the execution capacity of the national government agencies and local governments:

- Set-up NWRB owned reliable monitoring stations for surface water uses, environmental flow at key conflict areas (Actions for Issues 1 & 2);
- Strengthen NWRB to monitor and enforce water rights (Actions for Issues 1 &2);
- Empower groundwater monitoring and enforcing function of LGUs from the regional interests (Actions for Issue 4);
- Setup monitor system for the regional groundwater level, quantity and quality collaborated with EMB and LGUs (Actions for Issue 4);
- Strengthen EMB, FMB and LGUs to execute and enforce water quality management with the improved surface water quality monitoring system (Actions for Issue 7); and
- Strengthen weak execution functions of FMB and LGUs based on the capacity assessment on the outcomes of ongoing capacity development projects/programs for forest and watershed management financed by JICA and other donors (Actions for Issue 9).

12.5 Key Actions to Build Capacity of Missing Function for IWRM

The adopted mission and functions of the IWRM are not included in the existing functions of NGAs, RLAs, LGUs and RDC (Actions for Issue 10).

It is proposed to setup the River Basin Committee (RBC) under RDC Region III among the options studied. RBC will lead in the advocacy for the adoption of the PRB-IWRM Plan in the respective plans and investment programs of the bureaucratic levels. The RBC advocates and maintains the IWRM under the strong coordination by the existing RDC without overlapping authority, while the implementation of the project plans and programs will remain under the jurisdiction of concerned LGUs, RLAs, NGAs or Government Owned and Controlled Corporation (GOCC).

12.6 Power and Functions of River Basin Committee

The RBC has the power of decision in its functions at the level of committee of RDC. However, RDC Region III has the authority to reverse the decision. The RBC shall perform the following functions:

- To prepare the PRB-IWRM policy and plan, coordinate, and localize the IWRM Plan;
- To oversee and coordinate the implementation of the IWRM Plan; i.e., to arbitrate and monitor water rights, to regularly review and update water resources development plan, to advocate the IWRM and monitor water quality and quantity and watershed environment, and to monitor O&M of the river facilities;
- To secure funding sources to support the activities for the PRB-IWRM;
- To establish, supplement or scrap technical working groups (TWGs) for specific purposes to support the Committee, such as providing necessary information and technical support and monitoring activities including data collection, clarification and analyses; and
- To enjoin the committee members to execute their specific tasks as determined by the Committee.

12.7 Organizational Structure and Secretariat

The Committee shall be composed of members, a chairperson, a co-chairperson, vice chairperson, secretariat and technical working groups (TWGs). Member of the Committee shall be the provincial governors (7 provinces), Regional Directors of the Technical Secretariat, NWRB, DA, RBCO, NPC, a representative of NGOs, a representative of private sector, etc., within Pampanga river basin.

12.8 Responsibilities of the Committee Members

The organizations represented by the Committee members shall be responsible for the execution of their specific tasks as determined by the Committee and to contribute to the relevant TWG activities.

12.9 Key Actions to Strengthen Financial Capacity

Key actions to strengthen the financial capacity (Actions for Issues-11) shall cover the increase of funds of DENR for water quality monitoring, to increase the share O&M budget for the relevant river facilities and monitoring systems, and to set-up special accounts for the sustainable IWRM. How to materialize the financial sustainability for the PRB-IWRM is one of the biggest challenges.

12.10 Legal Basis

The power and functions of the Committee and the source of funds to implement the Committee, the TWGs and the specific tasks of the executing organizations shall be appropriated by a MOA or Executive Order. In the long term, enactment of a Republic Act will be targeted.

13. Environmental and Social Considerations on Programs and Projects of the IWRM Plan

13.1 Introduction

Aiming to assess if the implementation of the proposed programs and projects under the IWRM Plan would create any adverse impact on the natural and social environment in the localities, the Study Team conducted a simple initial environmental examination (IEE) of the proposed projects by using screening and scoping methods during the formulation of the IWRM Plan. In addition, the present legislative and institutional framework governing environmental assessment in the country was also reviewed as summarized in the following sections with the result of IEE.

13.2 Existing Legislation and Legal Systems governing Environmental and Social Consideration in Philippines

Philippine Environmental Impact Statement System (PEISS), composed of a set of legal tools relevant to EIA, regulates the application of Environmental Impact Assessment (EIA) to any private or public project or activity which is envisaged to cause adverse impacts on the natural and social conditions. PEISS defines four (4) Environmentally Critical Projects (ECPs) and projects in twelve (12) Environmentally Critical Areas (ECAs) considering their potential adverse impacts on the quality of environments.

As the responsible agency for the review and supervision of PEISS, the Environmental Management Bureau (EMB), Department of Environment and Natural Resources (DENR) is in charge of the issuance of decision documents such as Environmental Compliance Certificate (ECC), Certificate of Non-Coverage (CNC) and Denial Letter, while the EMB regional office (RO) in the respective regions are for the consultation and supervision of development projects. The process of application of the decision documents mentioned above varies depending on the project grouping under PEISS as shown in Table 13.2.1.

Besides, PEISS states the procedures of Information, Education and Communication (IEC) and Public Scoping as well as Public Hearing/Consultation to enhance public participation in the EIA process. In consideration of Indigenous Peoples (IPs), Administrative Order No. 1, namely; the Free and Prior Informed Consent (FPIC) guidelines developed by the National Commission of Indigenous People (NCIP) aims to ensure genuine participation of Indigenous Cultural Communities (ICCs) and IPs in decision-making as well as to protect the rights of ICCs/IPs in the introduction and implementation of activities that will impact upon their Ancestral Domains/Lands (ADs/ALs).

Table 13.2.1 Summary of Project Groups, EIA Report Types, Decision Documents, Deciding Authorities and Processing Duration

Project Groups		Documents Required For ECC/CNC Application	Decision Document	Deciding Authority	Processing Duration (Working Days)
I: ECPs in either ECA or NECA (Non-Environmentally Critical Area)	I-A: New	Environmental Impact Statement (EIS)	ECC	EMB Director / DENR Secretary	40 days
	I-B: Existing Projects for Modification, Re-startup or Operating without ECC	Environmental Performance Report and Management Plan (EPRMP)			
II: NECPs (Non-Environmentally Critical Projectsin ECA	II-A: New	EIS	ECC	EMB RO Director	20 days
		Initial Environmental Examination Report (IEER)/IEE Checklist (IEEC)	ECC		
		App. for Automated Processing System (APS)	CNC	EMB RO Director	1 day
	II-B: Existing Projects for Modification, Re-startup or Operating without ECC	EPRMP	ECC	EMB RO Director	20 days
		App. for APS	CNC	EMB RO Director	1 day
III: NECPs in NECA	III-A: New	App. for APS	CNC	EMB RO Director	1 day
IV: Co-Located Projects	IV-A: New	Programmatic EIS (PEIS)	ECC	DENR Secretary/EMB Director	40 days
	IV-B: Existing Projects for Modification, Re-startup or Operating without ECC	Programmatic Environmental Performance Report and Management Plan (PEPRMP)	ECC/ECC Amendment	EMB RO Director	20 days
V: Unclassified Projects		App. for APS	CNC	EMB RO Director	1 day

Source: Prepared by the Study Team based on Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) (2007), Memorandum Circular No.2010-14, and information obtained from the interview with EMB

13.3 Preliminary Evaluation of Potential Environmental and Social Impacts

13.3.1 Identification of Projects Covered by PEISS and Selection of Alternative Options for Conceptual Projects Categorized as ECPs

Among the 18 proposed and 30 conceptual programs and projects under the IWRM plan, 22 programs and projects may require preparation of the documents for ECC/CNC application under PEISS, at least, their F/S. Especially, there are four (4) proposed and four (4) conceptual projects identified as ECPs under Group I which require EIS for ECC application. In order to mitigate the potential adverse impacts especially by the conceptual projects identified as ECPs, thirteen (13) alternative options were proposed for the same conceptual projects.

13.3.2 Procedures of Screening and Scoping of Programs and Projects based on Former JICA Guidelines for Environmental and Social Considerations

As for the impact assessment of the Screening, the relevant environmental impact items were ranked depending on their environmental and social significance in accordance with the JICA Guidelines for Environmental and Social Considerations issued in 2004 due to the commencement timing of the Study.

To do so, due procedures such as Screening, Scoping and Selection of mitigation measures were taken considering the following environmental components which cover three categories, namely; social environment, natural environments and pollution as shown below.

Table 13.3.1 Environmental Components Considered in IEE

Category	Environmental Components
Social Environment	(1) Involuntary resettlement, (2) Local economy such as employment & livelihood, etc., (3) Land use & utilization of local resources, (4) Regional severance, (5) Existing social infrastructure & services such as traffic/existing public facilities, (6) Social vulnerable groups such as the poor and ethnic minority, (7) Inequality between beneficiaries and project-affected people, (8) Cultural heritage, (9) Conflict of interests, (10) Water use right and common land use right, (11) Sanitation
Natural Environment	(12) Disaster (natural risk) and epidemics such as HIV, (13) Topography and geology, (14) Soil erosion, (15) Groundwater, (16) Flow regime of lake and river, (17) National park of equivalent area in terms of its ecological importance, (18) Coastal and sea area, (19) Flora and fauna, (20) Climate, (21) Landscape
Pollution	(22) Global warming, (23) Air pollution, (24) Water pollution, (25) Soil pollution, (26) Waste, (27) Noise and vibration, (28) Ground subsidence, (29) Offensive odor, (30) Bottom sediment, (31) Accident

Source: JICA Study Team

For the impact assessment in the Screening, the potential impacts on the above-listed components were ranked depending on their environmental and social significance based on the following criteria.

Table 13.3.2 Rating Criteria for Initial Environmental Examination

Rating	Contents
A+/-:	Significant positive (+) or negative (-) impact is expected.
B+/-	Some positive (+) or negative impact (-) is expected
C+/-	Extent of positive/negative impact is unknown. A further examination is required in the further project formulation.
-	No negative impact is expected

Source: JICA Study Team

13.3.3 Results of Screening and Scoping of the Programs and Projects of IWRM Plan

As the result of the initial screening of all the proposed and conceptual projects in the IWRM plans, eleven (11) programs and projects including ten (10) options were identified with the rating of A- and/or B- as listed below.

Table 13.3.3 Projects Identified to have the Rating of A- and/or B-

Code No.	Name of Project and Possible Options
AI-P-01	Balintingon Reservoir Multipurpose Project (BRMP)
AI-P-02	Balog-Balog Multipurpose Project Phase II
AI-P-04	Casecnan Multipurpose Power & Irrigation Project Irrigation Component Phase II
AI-P-09	Gumain Reservoir Project
MW-P-01	Rehabilitation of Umiray-Macua Facilities
MW-P-02	Sumag River Diversion Project
MW-P-04	Metro Clark Bulk Surface Water Project
MW-C-05*	Extended Bulacan Bulk Water Supply Project
MW-C-06*	Pampanga Bulk Water Supply Project
FL-C-01*	Flood Mitigation for Pampanga Delta
IS-C-02*	Project for Recovery of Reliability of Water Supply in Angat-Umiray System

Note*: MW-C-05, MW-C-06, FL-C-01 and IS-C-02 contain several alternative options and it is preliminarily evaluated at this study stage that significant adverse impacts (A-) or less significant adverse impacts B- are expected when the projects take the following options:
- MW-C-05: Option 1 for development of Bayabas storage dam, Option 2 for development of Balintingon storage dam and conveyance to AMRIS or Option 4 for development of Laiban storage dam
- MW-C-06: Option 1 for abstraction of residual groundwater at surrounding cities/municipalities, Option 2 for Direct abstraction of surface water of Pampanga River at Cong Dadong Dam or Option 3 for development of Gumain reservoir
- FL-C-01: Option 1 for a large scale river improvement or Option 2 for construction the flood retarding basin
- IS-C-02: Option 1 for development of Bayabas storage dam, Option 2 for development of Balintingon storage dam and conveyance to AMRIS or Option 4 for development of Laiban storage dam

Source: JICA Study Team

In terms of the environmental components to be impacted, there are three (3) and 14 components in total ranked as A- and B- respectively as tabulated below.

Significant Adverse Impacts (A-)

Table 13.3.4 Details, Timing of Occurrence and Mitigation Measures for Significant Adverse Impacts (A-)

Environmental Components	Details of the adverse impacts	Projects	Timing of the occurrence of impacts	Mitigation measures
i) Involuntary resettlement	Involuntary resettlement caused by the installation of the infrastructures	AI-P-01, 02, MW-C-05(Opt.2,4), IS-C-02(Opt.2,4), FL-C-01(Opt.1)	Planning phases	- Selection of alternative project sites - Proper planning, implementation and monitoring of appropriate resettlement action plans.
ii) Land use/ utilization of local resources	Land acquisition for the flood retarding basin (approx.16,000 ha)	FL-C-01(Opt.2)	Planning phase	- Proper planning, implementation and monitoring of compensation measures for the land owners
iii) Social vulnerable groups	Involuntary resettlement of Indigenous Peoples (IPs).	AI-P-01, 02, MW-C-05(Opt.2,4), IS-C-02(Opt.2,4)	Planning phases	- Enhancement of full participation of IPs in project cycles - Preparation, implementation and monitoring of the action plans to recover the livelihoods for the IPs affected

Source: JICA Study Team

Less Significant Adverse Impacts (B-)

Table 13.3.5(1/2) Details, Timing of Occurrence and Mitigation Measures for Less Significant Adverse Impacts (B-)

Environmental Components	Details of the adverse impacts	Projects	Timing of the occurrence of the impacts	Mitigation measures
i) Existing Social Infrastructures	Existing roads affected by the construction of the dike	FL-C-01 (Opt. 2)	Construction and operation phases	- Supplementary infrastructures at the junction of existing roads and planned dike
ii) Inequality between beneficiaries and project-affected peoples	Less Income of the project-affected peoples by the resettlement	AI-P-01, 02, MW-C-05 (Opt. 2, 4), IS-C-02 (Opt.2, 4), FL-C-01 (Opt. 1)	Construction and operation phases	- Proper planning, implementation and monitoring of appropriate resettlement action plans
iii) Conflict of interests	Some conflict arisen between relevant LGUs in terms of the allocation of required ground water sources	MW-C-06(Opt.1)	Planning phase	- Information sharing between relevant LGUs from the early stage of the project - Organizational setup of inter-municipal bodies to mediate disputes
	Some conflict of the interest arisen between the implementing agencies and some environmental organizations	FL-C-01(Opt.2)	Planning phase	- Information sharing between relevant stakeholders from the early stage of the project
iv) Water use right and common land use right	Some conflict of the water use right among relevant agencies on status of water use right	AI-P-01,02,09, MW-P-04, MW-C-05(Opt.1,2), MW-C-06(Opt.3), IS-C-02(Opt.1,2)	Construction and operation phases	- Information sharing with the holders of current water use right at the project relevant area from the early stage of the project - Organizational setup to mediate disputes among stakeholders
v) Topography and geology	Some changes on topography and geographical features due to the relevant earthworks	AI-P-01,02,09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), IS-C-02(Opt.1,2,4)	Construction phases	- Introduction of slope protection works -Examination of alternative project sites

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Table 13.3.5(2/2) Details, Timing of Occurrence and Mitigation Measures for Less Significant Adverse Impacts (B-)

Environmental Components	Details of the adverse impacts	Projects	Timing of the occurrence of the impacts	Mitigation measures
vi) Flow regime of lake and river	Some changes on flow regime of water body due to the construction of the infrastructure	AI-P-01,02,04, 09, MW-P-01,02,04, MW-C-05 (Opt.1,2,4), MW-C-06 (Opt.2,3), IS-C-02 (Opt.1,2,4)	Operation phases	- Examination and securement of the amount of water flow required for the livelihood activities and biodiversity in the down streams
vii) National park or equivalent area in terms of the ecological importance	Habitat change of the area connected to Important Bird Area	AI-P-02	Operation phase	- Examination and consideration of the amount of water flow required for the habitats of the area
	Change of the condition of Candaba swamp declared as a bird sanctuary by LGU as well as recognized as a Ramsar candidate site and part of the East Asian-Australasian Flyway.	FL-C-01 (Opt.2)	Construction and operation phases	- Conservation measures for the habitats of the important species, especially waterfowls - Examination of the alternative project site
viii) Flora and Fauna	Change of the distribution of flora and fauna in the area due to the clearance of vegetation by the construction works and change of the flow regime	AI-P-01, 02, 09, MW-C-05 (Opt.1,2,4), MW-C-06 (Opt.3), FL-C-01 (Opt.2), IS-C-02 (Opt.1,2,4)	Construction and operation phases	- Minimal cleaning of vegetation - Restoration of the vegetation cleared by the project implementation - Examination and consideration of the amount of water flow required for the habitats
ix) Landscape	Change of the landscape by the slope cutting works by the installation of the facilities.	AI-P-01, 02, 09, MW-P-04, MW-C-05 (Opt.1,2,4), MW-C-06 (Opt.3), IS-C-02 (Opt.1,2,4)	Construction phase	- Plantation of grasses at the slope with installation of the structure measures if necessary
x) Air pollution	Air pollution due to equipment use for installation of the infrastructures Dust and particulate generation	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06 (Opt.3), FL-C-01 (Opt.1) IS-C-02 (Opt.1,2,4)	Construction phase	- Proper maintenance of the equipment - Spraying water on exposed surfaces of the construction area
xi) Water pollution	Deterioration of water quality due to soil inflow by the earthworks	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), FL-C-01 (Opt.1), IS-C-02(Opt.1,2,4)	Construction Phase	-Quarrying of the gravels at the site apart from the rivers - Slope protection works with vegetation covers
	Deterioration of water quality by soil inflow into the water bodies due to the erosion of upper catchments	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), IS-C-02(Opt.1,2,4)	Operation phase	- Slope protection works with vegetation covers - Check dams at the critical tributaries
xii) Waste	Increase of the amount of the waste or generate waste scrap materials by the construction workers	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), FL-C-01 (Opt.1), IS-C-02(Opt.1,2,4)	Construction phases	-Proper treatment of the waste in coordination with LGUs
xiii) Noise and vibration	Local residents in and around the project sites disturbed by noise due to the construction works	AI-P-01,02, MW-C-05(Opt.2,4), FL-C-01 (Opt.1), IS-C-02(Opt.2,4)	Construction phases	-Time-limited use of the equipment
xvi) Bottom sediment	Possible limitation of the water storage capacity of the dams or water pollution caused by the bottom sediment at the water storages	AI-P-01,02,09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), IS-C-02(Opt.1,2,4)	Operation phases	- Slope protection works with vegetation cover - Check dams at the critical tributaries

Source: JICA Study Team

13.4 Identification of Necessary Monitoring Items during Project Cycles

Based on the adverse impacts identified in the former section, there are five (5) and three (3) parameters to be monitored at the construction and operation phases respectively, as shown below.

Table 13.4.1 Recommended Monitoring Measures of Environmental Parameters at the Construction and Operation Phases

Parameters to be monitored	Projects	Location	Frequency of monitoring	Analysis measures
1) Construction Phase				
1-a. Soil erosion	AI-P-01,02,09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06 (Opt.3), IS-C-02 (Opt.1,2,4)	Project sites	Monthly	- Measurement of the size of soil erosion and slope failures
1-b. Air quality/ Dust pollution Total Suspended Particulate (TSP)	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), FL-C-01 (Opt.1), IS-C-02 (Opt.1,2,4)	In and around the project sites	Prior to operation	- Gravimetric method
1-c. Water quality: BOD, PH, DO	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), FL-C-01 (Opt.1) IS-C-02(Opt.1,2,4)	Project sites	Quarterly	- Water sampling
1-d. Waste	AI-P-01, 02, 09, MW-P-04, MW-C-05(Opt.1,2,4), MW-C-06(Opt.3), FL-C-01(Opt.1), IS-C-02(Opt.1,2,4)	Project and camping sites	Twice a week	- Waste characterization - Waste Volume measurement
1-e. Noise and vibration	AI-P-01,02, MW-C-05(Opt.2,4), FL-C-01 (Opt.1), IS-C-02(Opt.2,4)	In and around the project sites	Quarterly	- Use of Sound Level Meter
2) Operation Phase				
2-a. Biodiversity	AI-P-01, 02, 09, MW-C-05 (Opt.1,2,4), MW-C-06 (Opt.3), FL-C-01 (Opt.2), IS-C-02 (Opt.1,2,4)	Project sites and/or affected surrounding area	Yearly	- Reconnaissance survey to grasp the current condition of fauna and flora - Counting of the important species
2-b. Water quality: BOD, PH, DO	AI-P-01, 02, 09, MW-P-04, MW-C-05 (Opt.1,2,4), MW-C-06 (Opt.3), FL-C-01 (Opt.1), IS-C-02 (Opt.1,2,4)	Outfall of spillway, reservoir zone	Quarterly	- Water sampling
2-c. Bottom sediment	AI-P-01,02,09, MW-P-04, MW-C-05 (Opt.1,2,4), MW-C-06 (Opt.3), IS-C-02 (Opt.1,2,4)	Reservoir	Once in 5 years	- Measurement with the equipment such as echo sounder

Source: JICA Study Team

Besides, implementation of the resettlement action plan, compensation plan and other action plans for the recovery of livelihoods of the project affected people shall be monitored by the implementation agencies through the project cycles in order to mitigate the possible impact on the project affected people including indigenous people to be caused by the involuntary resettlement and land acquisition.

13.5 Important Notice on Implementation of the Projects

When the environmental and social consideration of the project, which consists of the IWRM Plan, is examined, the comments, suggestions and recommendations of the stakeholders have to be incorporated through stakeholder meetings. Moreover, the methodologies and procedures for organizing of the stakeholder meetings shall accord to the standards in the Philippines, and those in of the donor, if the project is implemented through assistance from the donor.

14. Conclusions and Recommendation

14.1 Principal Water-related Problems in Pampanga River Basin

The particular water-related problems in Pampanga river basin are as enumerated below:

14.1.1 Conflicts on Surface Water Allocation and Distribution among the Water Users

Pampanga river basin (i.e. the study area) has ever played an important role as the food basket for the Philippines through its large scale of national irrigation schemes such as UPRIIS in Pampanga main river basin and AMRIS in Angat river basin. Such large scale of irrigation area requires the bulk surface irrigation water. Pampanga river basin has also functioned as the important surface water source to cover about 90% of the domestic water use in Metro Manila and its outskirts, which are located out of Pampanga river basin. These surface water demands for irrigation and domestic use have largely relied on the supply from the two large dam reservoirs; namely Pantabangan and Angat storage dams. Nevertheless, the surface water supply capacity of Angat storage dam in particular is judged to be critical causing the serious conflicts between the water supplies for irrigation in Pampanga river basin and the domestic water use in Metro Manila.

14.1.2 Deterioration of Groundwater and Relevant Problems Caused by the Excessive Abstraction of Groundwater

Almost whole domestic water use in Pampanga river basin relies on the groundwater as the water source. However, the ever increasing population/industrial activities and the concentration of the population/industrial estates into the regional urban centers induces the excessive abstraction of groundwater and causes the deterioration of quality of groundwater and lowering of groundwater level/land subsidence. As the results, the sustainable water supply for the domestic use is being hardly performed in many water districts. The land subsidence due to the excessive abstraction of the groundwater also aggravates the flood problems.

14.1.3 Flood and Sediment Disasters

The flood overflow along Pampanga River and its tributaries occurs almost every year due to inadequate channel flow capacity, which leads to a large flood damages. Moreover, the serious sediment accumulations in the downstream river channels are in progress. The flood and sediment problems are caused by the following unfavorable activities:

- Increment of the flood peak discharges inflicted by expansion of the urbanized areas in the river basin,
- Encroachment of the houses and fishponds into the river areas,
- Increment of population and assets in the habitual flood inundation areas, which lead to increment of the potential flood damages,
- Decrease of the basin flood detention capacity caused by the excessive logging in the upland forest areas, and
- Damage of the river structures caused by the excessive sand mining in the river channels.

14.1.4 Problems on Watershed Management

The present extent of forest cover is limited to only about 50% of the classified forestlands in Pampanga river basin. Moreover, forest fires, illegal loggings and other unfavorable activities in the forest area are causing the serious degradation of watersheds. The devastation of the watershed tends to cause various water-related adverse effects such as increment sediment runoff associated with acceleration of the slope failure, increment of flood peak runoff discharge and reduction of low flow discharge due to reduction of the basin rainfall detention capacity.

14.1.5 Water Pollution and Other Water-related Environment Problems

The serious water pollution such as mixture of toxic material into the surface water as well as the groundwater has not occurred in the most part of Pampanga river basin, yet. The quality of the groundwater in the coastal part of the river basin is, however, being aggravated due to the excessive abstraction associated with intrusion of the salinity water. Moreover, the domestic wastewater is now directly discharged into rivers and drainages without adequate treatment. Pollution control for industrial discharge is also not enough due to lack of proper control and monitoring system. In addition, there is illegal dumping of solid waste. All of these could degrade the water quality and may possibly bring out the critical pollution of the surface water, groundwater as well as the ocean water in Manila Bay in the future.

14.2 Significance and Necessity of IWRM for Pampanga River Basin

In order to cope with the aforesaid water-related problems, the relevant government agencies as well as the non-government entities have ever implemented a variety of the projects for water resources management and development. Many of the problems are, however, still left behind without any fundamental solution. Moreover, the completed and/or proposed projects are not always based on the adequate coordination with all water-related sectors, and at the same time, the requirements of the stakeholders have not been well reflected to the projects.

As the results, the project in a specific water-sector has often caused the adverse effect to other water related sectors, which led to difficulties in achieving the accountable, effective and sustainable project. Moreover, the problems in the water sector would be unavoidably more significant as the population increase, the economic activities expand and other socio-economic conditions change in the future.

In view of the above natures of the water-related problems, it is indispensable to adapt the concept of IWRM for Pampanga river basin, which stresses the following four different principles:

- Integrated and holistic approach crossing multi-water sectors,
- Adaptable response to the future dynamic changes of the socio-economic conditions and the natural conditions inflicted by increment of population, change of industrial structures, change of the vegetation, climate changes and other factors,
- Involvement of stakeholders at every stages and steps of plan formulation and implementation of the water-related project and
- Broader focus points such as fairness, economical effect, efficiency and sustainability of the water-related projects.

14.3 Recommendations on the Proposed IWRM Plan for Pampanga River Basin

The various proposals on IWRM for Pampanga river basin are made in this study. The principal recommendations on the proposals are as described hereinafter.

14.3.1 Guideline for Formulation of IWRM Plan

The member of NWRB formulated the “IWRM Plan Framework in the Philippines” in 2006 clarifying the concept and the direction of the IWRM Plan. Taking the “IWRM Plan Frame Work” in to account, the guideline on the methodologies and procedures for formulation of the IWRM Plan was prepared in this study and used as the basic material for consensus buildings of the stakeholders on the procedures of the plan formulation. The guideline is also expected to be used as the references to formulation of IWRM Plans for other river basins.

The guideline prepared in the study is, however, likely to still contain an immature part, and it would be necessary to improve such immature part through actual implementation of the IWRM Plan. The immature part to be improved is addressed especially to the project evaluation method for determination of the priority orders of the projects for IWRM.

The project evaluation is made through viewpoints of 6 different categories such as “Viability of the Project”, “Enhanced Livelihood”, “Improved Quality of Life”, “Decentralized Development”,

"Sustained Ecosystem" and "Empowered People". Each of the 6 categories further involves 4 to 5 detailed points of evaluation, and thereby the evaluation is made from 25 detailed viewpoints in total. Introduction of such multi-evaluation points aims at enhancing the objective and precise evaluation of the inter-sector projects based on the comprehensive viewpoints. However, the members of TWG for the study pointed out that the proposed evaluation method would contain too many evaluation points and some of the evaluation points would be ambiguous. Hence, it would be necessary to monitor the results of project implementation and improve the project evaluation method through clarification of difference between the results of project evaluation before project implementation and the outcomes of the actual project implementation.

14.3.2 Principal Visions of the IWRM Plan for Pampanga River Basin

The "Poverty Alleviation" and the "Economic Development" are adopted as the principal visions of the IWRM Plan for Pampanga river basin, and all development scenarios in the Plan shall be oriented to these principal visions. However, the following particular attentions shall be given to these principal visions:

(1) Poverty Alleviation

The "Poverty Alleviation" is oriented to betterment of the livelihood/increase of the income for the poverty thresholds and at the same time, it aims at securing the basic human needs such as the safe drinking water and safe living conditions against flood and other water-related disasters. Moreover, the approaches to the "Poverty Alleviation" shall not be made by sacrifice of the vital ecosystem.

The average ratio of the poverty thresholds in the study area as of 2006 is about 20%, which is lower than the national average of about 33%. However, a particular attention shall be given to the ratio of the poverty thresholds in Nueva Ecija Province in the study area. The ratio in the Province is about 38%, which exceed the national average. The majority of the employees in the Province are engaged to the agriculture/forestry sector and one of the crucial issues on the poverty alleviation for the province shall be addressed to increment of the income of the employees in the sector.

(2) Economic Development

The "Economic Development" is oriented to not only development of the regional economy but also preserving and/or recovery of the ecosystem in Pampanga river basin. It is further noted that the manufacturing and the agriculture are the major industries in Region III, which produce the Gross Value Added of more than 50% in the Region. Accordingly, these industrial sectors shall take the principal roles for the "Economic Development" in Pampanga river basin, and thereby enhancement of the bulk water supply system for the manufacturing and the irrigation system for the agriculture shall be the important water-related works to promise the economic development in the study area.

14.3.3 Projects Proposed as the Components of IWRM Plan for Pampanga River Basin

The proposed IWRM Plan involves the inter-sector projects, which belong to various water-related sectors such as "the agriculture/fishery development", "the municipal water supply, sanitation and sewerage development", "management of flood and sediment disasters", "the watershed management" and "the water-related environmental management" The following special attentions on implementation of these projects shall be given:

(1) Project Implementation Schedule

The IWRM Plan for Pampanga river basin include the 84 projects in total, which are to be implemented in the short-term (2011-2015), the mid-term, (2016-2020) and/or the long-term (2021-2025). Of these projects, those to be implemented in the short-term shall be provided with the earlier budgetary arrangement as well as other necessary preparatory works for project implementation. As for the projects to be implemented in the mid-term and long-term, however, the changes of social and natural environments relevant to the project implementation shall be carefully monitored and the reexamination may be required to the

project implementation schedule as well as the contents of the projects in accordance with the results of monitoring.

(2) Project Investment Plan

The projects as the components of the IWRM Plan for Pampanga river basin is classified into the on-going projects, the proposed projects and the conceptual projects. The necessary investment cost of about 99 billion pesos for the on-going and proposed projects have been arranged and/or they are being programmed by the projects proponents. However, there is nothing to be done with the project investment cost of about 70.1 billion pesos for the conceptual projects. Hence, the budgetary arrangement for the conceptual projects is newly required and the following particular attentions shall be given:

- The feasibility studies for many of the conceptual projects shall be carried out before project implementation in order to verify the project viability, decide the project implementation bodies and estimate the precise project investment cost.
- The project investment shall be shouldered by the central government, the LGUs and/or the corporation/private firm. Of these project investors, the corporation/the private firm would be required to arrange a substantial part of the necessary project investment cost for development of the municipal water supply system and sanitation facilities. The investment cost by the corporation/private firm has to be fully recovered through collection of the water service charges. Such full cost recovery has been preliminarily verified based on the comparison between the necessary investment cost and the possible amount of water service charge. Nevertheless, the details on the full-cost recovery for development of the municipal water supply shall be reexamined before project implementation.

(3) Implementation of the Inter-sector Projects

The projects as the components of the IWRM Plan for Pampanga river basin involve the inter-sector projects, which are related to the plural water-sectors. The inter-sectors projects would need to be implemented jointly by the several government agencies and private firms under the umbrella of the under-mentioned River Basin Committee (RBC). At the same time, it is necessary to clarify the demarcations of each of the relevant agencies for the inter-sector projects based on the prevailing laws and regulations. The inter-sector projects and their principal issues in Pampanga river basin are as enumerated below:

(a) Water Allocation and Distribution for Multipurpose Dam

There exist two (2) large scale multipurpose dam reservoirs in Pampanga river basin; namely Pantabangan Dam and Angat Dam. Moreover, in order to cope with the incremental water demands, several new multipurpose dams are proposed in this study. The existing and proposed multipurpose dams aim at allocating and distributing the water for various purposes such as irrigation, municipal water use and hydropower generation. Such water allocation and distribution would require the proper coordination among the water users, and thereby, the typical potential conflicts, which would require the proper coordination, are as enumerated below:

- Conflict between water allocations and distributions for irrigation and municipal water use during a drought period,
- Conflict between the intensive discharges released from dam for peak hydropower generation and .the constant discharge from dam for water distribution to irrigation and municipal water uses, and.
- Cost share of the relevant agencies for development of new multipurpose dams.

(b) Flood Control by Multipurpose Dam

The clear reservoir operation rule for flood control has not been set forth for Angat

multipurpose dam in spite of the flood control capacity of 42 MCM allocated to the dam during the wet season. As the results, the flood control capacity is sometimes curtailed and a part of it is used for water supply, which may lead to the excessive discharge released from the dam during a flood and man-made floods in the lower leaches of the dam. In order to avoid such man-made flood damage, it is indispensable to set forth the definite reservoir operation rule for flood control through coordination among the various agencies related to dam reservoir operation, flood control and use of discharge released from the dam.

(c) Watershed Management in Cooperation with Flood/Sediment Disaster Management and Water Resources Development/Management

The extensive deforestation would reduce the basin detention capacity of the rainfall, whereby the excessive basin peak runoff would occur during a flood, while the river flow discharge would be reduced during a dry season. Such dynamic hydrological change would lead to the various calamities such as: (i) the flood disasters in a wet season, (ii) the water deficit in a dry season, and (iii) reduction of the river environmental flow. Moreover, the deforestation in the upper reaches of the dam reservoir would cause a large volume of sediment inflow into the dam reservoir causing the serious deterioration of the function of the reservoir.

As described above, the watershed management, which could control the excessive deforestation, is closely related to the management of flood/sediment disaster and/or the water resources development/management. Accordingly, the projects in these three (3) sectors would need to be implemented through the close mutual cooperation.

(d) Coordination between the Flood Management and the Fishery Development

The fishery development is one of the important sectors for the water-related economic development in Pampanga river basin. However, some of the fish ponds developed as a part of fishery development encroach to the river area reducing the river channel flow capacity. In order to check such encroachment of the fishponds and preserve the river channel flow capacity, development of fish ponds shall be jointly monitored and controlled by the agencies in charge of flood control and fishery development.

(e) Flood Management in Cooperation with Agricultural Development

One of serious problems for the agricultural development in Pampanga river basin is addressed to the flood overflow from the river to the irrigation areas by the river and/or the poor drainage in the irrigation area. In order to cope with the flood problems in the irrigation area, it is required to identify the habitual flood inundation area and formulate the strategic flood mitigation plan for protection of the irrigation area in cooperation each other of flood management and agricultural development sectors.

(f) Approaches to Preservation of Environmental River Flow

The environmental river flow is the important factor to preserve the appropriate river ecosystem, and it is indispensable to estimate the necessary minimum river discharge as the environmental river flow and secure it throughout a year. The environmental river flow is largely influenced by the forest conservation in the upper reaches, the discharge released from the dams and the water intakes from the rivers. Accordingly, securing of the environmental river flow shall be jointly undertaken by the agencies in charge of the river ecosystem as well as the watershed management, the dam reservoir management and the management of water resources in corporation each other.

14.4 Proposed Institutional Setup for IWRM in Pampanga River Basin

14.4.1 Organization Setup

The River Basin Committee (RBC) shall be newly established under the existing Regional Development Council (RDC) Region III in order to lead the relevant government agencies and the

private entities to the effective IWRM for Pampanga river basin. The RBC is composed of the Committee, the Secretariat and TWG. The roles and members of these components are as below:

- The Committee is at the top of the RBC having the roles of formulation of the policy and framework for IWRM Plan of Pampanga river basin and coordination/direction to the under-mentioned TWG members for implementation of IWRM Plan. The Committee shall involve the relevant provincial governors and the representatives of the TWG, and NGOs.
- The NEDA Region III supports the Committee as the Secretariat.
- The TWG formulate the details of the IWRM Plan and monitors the project implementation relevant to IWRM. The members of the TWG are summoned from the relevant national government agencies/regional line agencies, NGOs and private firms, as required.

14.4.2 Legal Set up

Amendments of the existing regulations and/or laws and establishment of the new legal frameworks shall be made to attain the appropriate and effective IWRM for Pampanga river basin. The principal work items required to the legal setup are as below:

(1) Establishment of the New Legal Basis for Regulation of Water Use Right

In order to attain the more rational and equitable water permit system, it is required to set the new legal basis, which specifies the seasonal variations of the allowable maximum limits of the water uses, and the minimum water supply security level for the water uses. A detailed implementation rule and regulation (IRR) shall be also prepared to clarify the rules, processes, compensation and all other necessary conditions for lease and transfer of the water right so as to enhance the more efficient water uses.

(2) Amendments of the Present Legal Set up for Overlapping Water Charge System

The Water Code prescribes that NWRB is entitled to collect the water fees and charges for the water permit, while the Local Government Code prescribes that the LGU is entitled to collect a share from the proceeds of water resources within its jurisdiction area. It is required to unify the overlapping provisions on the water charges in the Water Code and the Local Government Code.

(3) Establishment of New Legal Basis on Cost Allocation Rule for Multipurpose Dam Projects

The legal basis on cost allocation rule for multipurpose dam projects shall be newly established to achieve the rational and equitable water allocation for irrigation/municipal water use and hydropower generation during a drought.

(4) Establishment of New Legal Basis on Environmental River Flow

The legal basis on the minimum the environmental river flow shall be newly established in order to preserve the appropriate rivet ecosystem.

(5) Establishment of New Legal Basis on River Basin Committee (RBC) for IWRM in Pampanga River Basin

The power and functions of the RBC and the necessary financial source for activities of RBC shall be appropriated by MOAs or Executive Order.

14.5 Application of the Results of the Study to the Future IWRM in Philippines

The results of the study include various items such as: (a) the guideline for formulation of IWRM Plan, (b) the development scenarios for IWRM by the target year 2025, (c) the eligible projects as the components of the IWRM Plan as well as their implementation and investment schedule and (d) the organization and legal setup required to implementation of IWRM Plan for Pampanga river basin. These results of study shall be applied to the actual IWRM immediately after completion of the study and sustainably developed through the continuous efforts by the relevant agencies. NWRB in

particular as the leading counterpart agency for the study, is expected to accomplish the following missions:

14.5.1 Support for Establishment of and Activities by River Basin Committee (RBC)

NWRB would take the following missions to support establishment and activities of the RBC proposed in the study:

- To support preparation of the Minutes of Agreement (MOA) or Executive Order (EO), which appropriates the power and functions of the RBC and the financial source for activities of RBC,
- To monitor the outcomes of the activities by RBC (i.e., the results of implementation of the proposed IWRM plans), and
- To review and revise the proposed IWRM plans based on the results of the above monitoring.

14.5.2 Missions as the Member of RBC

NWRB would accomplish the following missions related to management of water use right and water allocation/distribution as a core member of RBC:

- To make capacity development on appraisal of water use right and adjustment of water allocation and distribution including capacity development on estimation of eligible water supply capacity and development of the basic database,
- To strengthen the monitoring system for usage of surface water and groundwater,
- To arbitrate the conflicts among the various water users, when the arbitration could not be made at the level of RBC, and
- To amend the present legal setup related to approval of water use right and water allocation/distribution.

14.5.3 Development of Concept of IWRM as the Nationwide Movement

NWRB would be required to develop the concept of IWRM all over the country trough the following activities:

- To formulate the strategic plan for development of the concept of IWRM,
- To review and make the necessary revisions on the guideline for formulation of IWRM Plan proposed in the study, and
- To introduce the IWRM Plan to other river basins.

Annex-Tables

Annex-T4.6.1 (1/2) On-going Watershed Management Programs and Projects

Programs/Projects	Contents
Forest Protection and Law Enforcement Program (FPLEP)	The program is a regular undertaking of the DENR Region III through the respective Provincial/Community ENR Offices. It involves protection of about 1,984km^2 of untenured forestlands through surveillance, apprehension, and initiation of legal proceedings against perpetrators of illegal forest activities. Other activities in coordination with other agencies such as NIA, NPC and concerned LGUs: fire management through multi-sectoral forest protection councils; vulnerability assessment/geo-hazard mapping; capacity building, IEC
Community Based Forest Management (CBFM) Program	The CBFM program grants tenurial authority to organized communities to manage, develop, protect and utilize forest resources, subject to the issuance of CBFM Agreement for 25 years, renewable for another 25 years. The Program is being implemented by the DENR-FMS-Regional CBFM Office. The activities under the program include forest plantation development, agro-forestry, forest protection and maintenance and livelihood development. The livelihood component is anchored on agro-forestry, which provides additional income sources from fruit bearing trees, seedling production, cash crops (such as vegetables, ginger, coffee, pineapple and cassava), livestock, poultry, freshwater fish culture, etc.
Integrated Agro-forestry Development Program (IAFDP)	The IAFD program is a special CBFM program for upland agrarian reform beneficiaries under the Comprehensive Agrarian Reform Program (CARP). It is being undertaken by the DENR through a Memorandum of Understanding with the Department of Agrarian Reform (DAR). The component activities include agro-forestry, forest protection and maintenance, livelihood development, organizational development and stakeholder capability building.
Coastal Resources Management Program (CRMP)	The DENR's Protected Area, Wildlife and Coastal Zone Management Services-Coastal and Marine Management Division (PAWCZMS-CMMD) reforests logged over mangrove areas and protects old-growth mangrove forests within the coasts of Bulacan and Pampanga. The program supports the initiative of the Manila Bay Coastal Strategy to conserve critical marine habitats and biodiversity. Other activities involve coastal resource assessment, mapping, and database development; formulation of Coastal Zone and Sea Use Plans; establishment of coastal and marine sanctuaries; monitoring, law enforcement and policy support; capacity development and IEC.
Protected Area Community-based Forest Management Program (PACBRMP)	The program is being undertaken by the RCBFMO. It covers the protected areas and ancestral domains of indigenous communities. The main strategy is CBFM with timber establishment and agro-forestry, which is expected to provide alternative sources of income to upland communities, especially the IP communities.
Private Forest Plantation Development Program (PFPDP)	Private forest plantation development is covered by various forms of forest lease contracts and management agreements with private companies or individuals, such as IFMA, SIFMA, AFFLA, PFDA, TFLA and FLGMA. The concessionaires plant commercial species of timber and derive their income from harvested tree stands. The DENR-Forest Resource Development Division (FRDD) regulates the volume of timber extraction in accordance with the annual allowable cut (ACC) specified in the lease agreement.
NIA-UPRIIS's Watershed Management Program	The NIA-UPRIIS co-manages with the DENR and organized POs and cooperatives the 10,356 ha of Pantabangan-Carranglan Watershed forest Reserve (WFR). The activities include maintenance of established timber plantations and agro-forests as well as protection (patrolling, surveillance, monitoring, fire management), road grading, infra support, stakeholder capability building, and sustenance of livelihood projects. An Inter-agency Task Force composed of NIA, NPC, DENR, the concerned LGUs and the representatives of the Protected Area Management Board (PAMB) was created in 2008 in order to craft a comprehensive Forest Land Use Plan (FLUP) with technical assistance from EcoGov, a national environmental NGO. In 2009, the NIA-UPRIIS started to rehabilitate and reforest an initial 100 ha of Pantabangan-Masiway watersheds jointly with the Energy Development Corporation, a private power company that now operates the Masiway dam for hydroelectric power generation. Under this joint management arrangement, EDC provides funds and technical assistance in the propagation and use of indigenous species to reforest the denuded areas surrounding the dam. The NIA helps create additional income sources by hiring locals for nursery seedling production, contract reforestation and agro-forestry establishment.

Annex-T4.6.1 (2/2) On-going Watershed Management Programs and Projects

Programs/Projects	Contents
NPC'S Watershed Management Program	The NPC manages the watersheds that support two hydro-electric dams in the basin, namely Pantabangan and Angat WFRs. This is undertaken through the respective Watershed Action Teams (WAT). The activities are financed out of the environmental charges collected from power consumers. The NPC's programs are anchored primarily on forest protection involving patrolling, surveillance and apprehension of violations in partnership with organized community volunteers. In Angat WFR, the NPC maintains the strong support of the Armed Forces of the Philippines military contingent. To strengthen protection, the AWAT plans include resettlement and livelihood development such as rattan production, inland fishery and honey bee culture. The AWAT also conducts research and development for the conservation of biodiversity, specifically under the Philippine Eagle Conservation Project in partnership with the UPLB and the Philippine Eagle Foundation. In the Pantabangan-Carranglan area, the PWAT is an active member of the Inter-Agency Task Force together with the NIA, the DENR, the LGU and the Protected Area Management Board (PAMB). The major challenges for PWAT include the management of forest fires, which are rampant in the Pantabangan-Carranglan area, and protection against illegal activities such as timber poaching, charcoal making and "kaingin" farming. PWAT partners with universities and colleges to implement livelihood programs for forest occupants, such as handicraft making, mushroom growing, honey bee culture and charcoal briquette production. - Area Planted (as of 2008): 90 ha of Pantabangan-Carranglan WFR; 130 ha of Angat WFR
Integrated Social Forestry (ISF) Projects	The implementation of ISF projects has been devolved to LGUs by virtue of RA 9160 or the Local Government Code of 1991. Through the program, the province of N. Ecjia plans to rehabilitate 200 ha of ISF areas within Carranglan watershed. Tarlac plans to rehabilitate 500 ha of ISF areas in O'Donnell watershed, which is expected to be funded out of the country-wide development fund. - Tenured Area under ISF (as of 2008): 12,942 ha - Actual Area Planted (as of 2008): 100 ha in Talavera and Aulo-Cabo Watersheds - Number of Beneficiaries: 5,590 households
Private Sector Watershed Management Initiatives	As part of their corporate social responsibility commitment, the private sector partners with the DENR in reforestation activities through the "Adopt-a-Watershed Program". Among active partners in the basin are: (1) Water Districts in watersheds supporting domestic water supply sources; (2) Clark Development Corporation (CDC) and Subic-Clark Alliance for Development (SCAD) in Tarlac-O'Donnell Watershed in line with the future domestic water supply projects for Clark SEZ ; (3) Holcim Cement in Angat-Maasim watersheds; (4) Manila Water Corp. and Maynilad Water Services in the Angat watershed areas in order to sustain the domestic water supply of Metro Manila; and (5) various NGOs in support of the Trees for Life program in the basin.
Pampanga River Basin Rehabilitation Project (PRBRP)	The PRBRP is a special project undertaken in Pampanga, N. Ecija, Bulacan and Tarlac by the DENR-Forest Resource Conservation Division (FRCD) III from 2004 to 2008 in response to flood events in the basin. The objective of the Plan is to double the forest cover of Pampanga river basin from 24% to 48%. The PRBP utilized the CBFM beneficiaries who were contracted to undertake the reforestation and maintenance activities. It was temporarily shelved in 2009 due to budget constraints. In 2010-2012, the project will resume in order to complete the maintenance and protection works involving a backlog of 500 ha newly established tree plantations. - Target area: 67,700ha - Actual area planted (as of 2008): 10,075ha newly planted; 5,766ha maintained and protected - Beneficiaries: 62 POs
Forestland Management Project (FMP)	The FMP is a 10-year JICA-assisted project in the pipeline and targeted for implementation in 2011. It covers three critical river basins in the country, namely, Upper Magat-Cagayan River Basin in Region II, Jalaur River Basin in Iloilo and Upper Pampanga River Basin. The project components include: (i) physical survey and mapping and socio-economic baseline profiling; (ii) PO formation and CBFMA acquisition; (iii) PO capacity building; (iv) forest tree plantation, silvi-pasture and agro-forestry with bio-fuel and soil conservation measures; (v) infrastructure support such as farm-to-market roads, bridges, and pipeline irrigation system for agro-forestry; (vi) policy initiative (including establishment of cost sharing mechanism and payment for environmental services); and (vii) monitoring and evaluation. - Target area (Upper PRB): 44,600ha - Target reforestation/agroforestry area: 14,133ha - Estimated project cost: P998million as of 2009

Annex-T 4.7.1 On-going Water-related Environment Management Programs and Projects

Name of Programs/Projects	Contents
Ecological Solid Waste Management Program (ESWMP)	The LGUs implement respective 10-year ESWM Plans pursuant to RA 9003. Activities, however, are limited in scale due to budgetary constraints. Most LGUs undertake only the soft components of the ESWM Plans such as segregation at source, reduction, composting and IEC. Only a few LGUs have established MRFs at the barangay and municipal level. Most LGUs in Pampanga and N. Ecija still resort to open dumping. Eleven LGUs in Bulacan have upgraded into controlled dumpsites. The sanitary landfill in Norzagaray needs to be improved. The industrial locators of Clark SEZ together with the 8 LGUs of Tarlac, 5 LGUs of Pampanga and 2 LGUs of Bulacan dispose of their residual wastes in the 100-ha Sanitary Landfill in Sitio Kalangitan, Capas, Tarlac. This facility also receives hospitals wastes and other hazardous wastes from such generators throughout Region .
Industrial Pollution Control Program	The DENR-EMB regulates industrial pollution by monitoring compliance with the ECC, Discharge Permits and Self-Monitoring Reports (SMRs). It undertakes pollution adjudication for non-compliant industries. The agency also promotes industrial self-regulation under the Revised Industrial Eco-watch System (RIES) and the Philippine Environmental Partnership Program (PEPP). The former is a public disclosure system where industries are rated in color codes (Gold, Silver, Green or Blue and Red or Black) to indicate compliance or non-compliance, respectively. The latter is an incentive and reward system for industries that voluntarily adopt pollution prevention and cleaner production processes. A number of big industries in the basin such as BASECOM Corporation and Far East Alcohol Corporation (FEACO) are signatory to the Environmental Consent Agreement (ECONA) as a commitment to self-regulation. Likewise, Clark Development Corporation (CDC) was deputized by the DENR-EMB to police industrial and commercial locators in the Clark Special Economic Zone.
Sagip-log Projects	The LGU of San Fernando City rehabilitates San Fernando River through periodic clean up activities. Future plans also include dredging, slope protection works, resettlement of informal settlers and creation of a river park to boost local tourism. Similarly, the LGU of San Rafael, Bulacan aims to restore Angat River by engaging the participation of the industries and local communities in periodic clean up and pollution monitoring, starting with the profiling of potentially pollutive industries and business establishments.

Source: DENR-EMB,CDC, PPDOs(2008-2009).

Annex-T 11.1.1 (1/2) Grouping of Projects (Group-A Projects)

Project Group	Sector	Serial No.	Project		Implementing Agency	Initial Investment Cost	O&M cost
			Code	Name of Project		(Million Pesos)	(Mil.Pesos/year)
A	Agriculture/ Irrigation and Fishery	1	AI-G-03	Repair, Rehabilitation of Existing Groundwater Irrigation Systems, Establishment of Groundwater Pump Project (REGIP)	NIA	398	None
		2	AI-G-04	Balikatan Sagip Patubig Program (BSPP)	NIA	46	None
		3	AI-G-05	Repair, Rehabilitation, Restoration & Preventive Maintenance of Existing National & Communal Irrigation Facilities	NIA	1,579	None
		4	AI-G-06	Restoration/Rehabilitation of Existing NIA Assisted Irrigation System (RRE-NIAIS)	NIA	8,767	None
		5	AI-G-08	Rehabilitation of Small Water Impounding Projects / Diversion Dams	DA-BSWM	128	None
		6	AI-G-09	Comprehensive Agrarian Reform Program, Irrigation Component	NIA	1,020	None
		7	AF-G-01	Aquaculture Fisheries Development Programs	DA-BFAR	450	None
		8	AF-G-02	Comprehensive Regulatory Services	DA-BFAR		
		9	AF-G-03	Support Projects and Activities	DA-BFAR		
		10	AF-G-04	Fisheries Resources Management for Improved and Sustainable Harvest	DA-BFAR		
			Sub-total			12,388	0.0
A	Municipal Water Supply, Sanitation and Sewerage	11	MW-G-01	Angat Water Utilization and Aquaduct Improvement Project (AWUAIP) Phase 2	MWSS	4,568 *	30.5
		12	MW-P-01	Rehabilitation of Umiray-Macua Facilities	MWSS	454	2.3
		13	MW-P-02	Sumag River Diversion Project	MWSS	540	2.7
		14	MW-P-03	Bulacan Treated Bulk Water Supply Project	MWSS/LGU	11,935	119.3
		15	MW-P-04	Metro Clark Bulk Surface Water Project	CDC	3,527	35.3
		16	MW-C-01	Additional Level 3,2, 1 Facilities towards 2025 in Bulacan	LWUA/WDs/LGUs /Private WSPs	3,839	324.2
		17	MW-C-02	Additional Level 3,2, 1 Facilities towards 2025 in Pampanga	LWUA/WDs/LGUs /Private WSPs	4,914	416.6
		18	MW-C-03	Additional Level 3,2, 1 Facilities towards 2025 in Nueva Ecija	LWUA/WDs/LGUs /Private WSPs	2,903	249.3
		19	MW-C-04	Additional Level 3,2, 1 Facilities towards 2025 in Tarlac	LWUA/WDs/LGUs /Private WSPs	559	46.2
		20	MW-C-05	Extended Bulacan Bulk Water Supply Project	LGU	16,754	167.7
		21	MW-C-06	Pampanga Bulk Water Supply Project	LGU	5,732	57.4
		22	MS-C-01	Additional Sanitary Facilities towards 2025 in Bulacan	LGUs	3,676	18.4
		23	MS-C-02	Additional Sanitary Facilities towards 2025 in Pampanga	LGUs	4,725	23.6
		24	MS-C-03	Additional Sanitary Facilities towards 2025 in Nueva Ecija	LGUs	3,477	17.4
		25	MS-C-04	Additional Sanitary Facilities towards 2025 in Tarlac	LGUs	968	4.8
			Sub-total			68,571	1,515.6
A	Management of Flood and Sediment Disasters	26	FL-G-03	Maintenance and Rehabilitation Works for River Dike and Slope	DPWH	679	None
		27	FL-C-03	Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs	LGUs	3,000	None
		28	FL-C-04	Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula	DE-Region III	8	None
			Sub-total			3,687	0.0
A	Watershed Management	29	WS-G-01	Forest Protection and Law Enforcement Program (FPLEP)	DENR/PENRO/CENRO	39	None
		30	WS-G-02	Community-based Forest Management Program	DENR/RCBFMO	71	None
		31	WS-G-04	Coastal Resource Management Program (CRMP)	DENR/PAWCZMS	37	None
		32	WS-G-05	Protected Area Community-based Resource Management Program (CBFM-PACBRMA)	DENR/PAWCZMS	13	None
		33	WS-G-06	Private Forest Plantation Development Program (PFPDP)	DENR-FRDD	93	None
		34	WS-G-07	NIA-UPRIIS' Watershed Management Program	NIA-UPRIIS	180	None
		35	WS-G-08	NPC's Watershed Management Program	NPC	107	None
		36	WS-G-09	Integrated Social Forestry (ISF) Projects	LGUs/DENR/RCBFMO	51	None
		37	WS-G-10	Private-sector Watershed Management Initiatives	Private Firm/NGOs	32	None
			Sub-total			623	0.0
A	Water-related Environment Management	38	WQ-G-01	Ecological Solid Waste Management Program (ESWMP)	DENR-EMB III	192	None
		39	WQ-G-02	Industrial Pollution Control Program (IPCP)	DENR-EMB III	153	None
		40	WQ-G-03	Sagip-Ilog Project	DENR-EMB/LGUs/Pvt. Sector	11	None
		41	WQ-P-01	Clean Development Mechanism	Private Industries	1,036	63.0
		42	WQ-C-04	Construction of Sanitary Landfills and Support Facilities in Nueva Ecija and Cluster Waste Transfer Stations in Bulacan and Pampanga	LGUs	2,025	349.0
			Sub-total			3,417	412.0
A	Others	43	IS-C-02	Project for Recovery of Reliability of Water Supply in Angat-Umiray System	NWRB/NIA/MWSS/NPC/LGU	7,966	39.8
			Sub-total			7,966	39.8
	Total for Group A Projects					**96,652**	**1,967.4**

Note: *: The project cost is not total cost, but only for 2011-2025.

Annex-T 11.1.1 (2/2) Grouping of Projects (Group-B Projects)

Project Group	Sector	Serial No.	Project		Implementing Agency	Initial Investment Cost	O&M cost
			Code	Name of Project		(Million Pesos)	(Mil.Pesos/year)
B	Agriculture/ Irrigation and Fishery	1	AI-G-01	Balog-Balog Multipurpose Project Phase 1	NIA	236 *	11.8
		2	AI-G-02	Along-along Creek Irrigation Project (UPRIIS Div3)	NIA	25 *	1.3
		3	AI-G-07	Participatory Irrigation Development Project, APL1-Infrastructure Development	NIA	41 *	0.3
		4	AI-G-10	Upper Tabuating SRIP	NIA	76 *	1.3
		5	AI-P-01	Balintingon Reservoir Multipurpose Project (BRMP)	NIA/G. Trino	13,591	68.0
		6	AI-P-02	Balog-Balog Multipurpose Project Phase 2	NIA	16,095	80.5
		7	AI-P-03	Sector Loan on Rehabilitation of Irrigation Facilities	NIA	222	1.1
		8	AI-P-04	Casecnan Multi-purpose Irrigation & Power Project Irrigation Component Phase 2	NIA	7,000	35.0
		9	AI-P-05	Procurement of Pumps, Drilling Rigs & Related Equipment	NIA	206	1.0
		10	AI-P-06	Irrigation Water Resources Augmentation Pump Establishment Project	NIA	130	0.7
		11	AI-P-07	Appropriate Irrigation Technologies for Enhanced Agricultural Production	NIA	654	3.3
		12	AI-P-08	Central Luzon Groundwater Irrigation Systems Reactivation Project	NIA	1,429	7.1
		13	AI-P-09	Gumain Reservoir Project	NIA	13,729	68.6
		14	AI-P-10	Rehabilitation of AMRIS	NIA	983	4.9
		15	AI-P-11	Construction of Priority Small Scale Irrigation Systems/Small Water Impounding Projects, Small Diversion Dam Projects	DA Region III/LGUs	169	0.8
		16	AI-C-01	New Construction of Small Scale Irrigation Project under BSWM	BSWM/LGUs	514	2.6
		17	AI-C-02	Introduction of Water Saving Irrigation Technology	NIA	150	None
		18	AI-C-03	Improvement of Monitoring System and Capacity Development for Proper Water Management in NISs and CISs	NIA	150	7.5
		Sub-total				55,400	295.8
B	Municipal Water Supply, Sanitation and Sewerage	19	MP-G-01	Cabanatuan Sewerage System	LGU	189	1.9
		20	MP-G-02	Expansion of Clark Sewerage System	Clark Water	456	4.6
		21	MP-C-01	Septage Treatment and Disposal Facility	MCWMC/LGUs/WDs/Private	510	355.0
		Sub-total				1,155	361.5
B	Management of Flood and Sediment Disasters	22	FL-G-01	Pinatubo Hazard Urgent Project (PHUMP) Phase III Part I	DPWH	470 *	23.5
		23	FL-G-02	Pinatubo Hazard Urgent Project (PHUMP) Phase III Part II	DPWH	5 *	0.3
		24	FL-G-04	Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines	PAGASA	300	None
		25	FL-P-01	Flood Control Measures in Mt. Pinatubo Devastated Area- Focus on Pasac Delta	DPWH	4,320	21.6
		26	FL-P-02	Bacolor Comprehensive Rehabilitation Master Plan	LGU	1,500	7.5
		27	FL-C-01	Flood Mitigation for Pampanga Delta	DPWH	5,468	27.3
		28	FL-C-02	Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and N. Ecija	LGUs	8	0.4
		Sub-total				12,071	80.6
B	Watershed Management	29	WS-G-03	Integrated Agro-Forestry Development Program (CBFM-CARP)	DENR/RCBFMO/DAR	31	None
		30	WS-G-11	Forestlands Management Project (FMP)	DENR-FASPO	996	None
		31	WS-G-12	Pampanga River Basin Rehabilitation Project (PRBRP)	DENR-FRCD	12 *	None
		32	WS-C-01	Upland Development Program	DA/DENR/LGUs	980	None
		33	WS-C-02	Protected Area Management Program (PAMP)	DENR/PAWCZMS	404	None
		34	WS-C-03	Urban Greening Program	DENR/LGUs/Pvt. Sector	264	None
		35	WS-C-04	Community-based Eco-tourism Program	DOT/DENR/LGUs	264	None
		Sub-total				2,951	0.0
B	Water-related Environment Management	36	WQ-C-01	Capacity Development to Upgrade WQ Monitoring and Data Management Program	DENR-EMB	140	None
		37	WQ-C-02	Capacity Development to Improve Water Quality and Aquaculture Fisheries Management	DA-BFAR	48	None
		38	WQ-C-03	Capacity Development Project to Improve Industry Adoption of Cleaner Production Options	DTI/DENR/Private Industries	60	None
		Sub-total				248	0.0
B	Others	39	IS-C-01	Establishment of Comprehensive Groundwater Monitoring in Pampanga River Basin	NWRB/Others	297	3.7
		40	IS-C-03	Enhancement of Monitoring System for Surface Water in Pampanga River Basin	NWRB/Others	10	2.0
		41	IS-C-04	Capacity Development of NWRB and Relevant Agencies on Water Allocation and Distribution	NWRB/Others	300	None
		Sub-total				607	5.7
	Total for Group B Projects					**72,432**	**743.5**
Grand Total						**169,084**	**2,710.9**

Note: *: The project cost is not total cost, but only for 2011-2025.

Annex-T 11.2.1 Implementation Schedule for Group-A Projects

Sector	Code	Name of Project	Implementing Agency	Short-term	Mid-term	Long-term
Agriculture/ Irrigation and Fisheries	AI-G-03	Repair, Rehabilitation of Existing Groundwater Irrigation Systems, Establishment of Groundwater Pump Project (REGIP)	NIA			
	AI-G-04	Balikatan Sagip Patubig Program (BSPP)	NIA			
	AI-G-05	Repair, Rehabilitation, Restoration & Preventive Maintenance of Existing National & Communal Irrigation Facilities	NIA			
	AI-G-06	Restoration/Rehabilitation of Existing NIA Assisted Irrigation System (RRE-NIAIS)	NIA			
	AI-G-08	Rehabilitation of Small Water Impounding Projects / Diversion Dams	DA-BSWM			
	AI-G-09	Comprehensive Agrarian Reform Program, Irrigation Component	NIA			
	AF-G-01	Aquaculture Fisheries Development Programs	DA-BFAR			
	AF-G-02	Comprehensive Regulatory Services	DA-BFAR			
	AF-G-03	Support Projects and Activities	DA-BFAR			
	AF-G-04	Fisheries Resources Management for Improved and Sustainable Harvest	DA-BFAR			
Municipal Water Supply, Sanitation and Sewerage	MW-P-03	Bulacan Treated Bulk Water Supply Project	MWSS/LGU			
	MW-G-01	Angat Water Utilization and Aquaduct Improvement Project (AWUAIP) Phase 2	MWSS			
	MW-P-01	Rehabilitation of Umiray-Macua Facilities	MWSS			
	MW-P-02	Sumag River Diversion Project	MWSS			
	IS-C-02	Project for Recovery of Reliability of Water Supply in Angat-Umiray System	NWRB/NIA/MWSS/NPC/LGU			
	MW-C-01	Additional Level 3,2, 1 Facilities towards 2025 in Bulacan	LWUA/WDs/LGUs/Private WSPs			
	MW-C-02	Additional Level 3,2, 1 Facilities towards 2025 in Pampanga	LWUA/WDs/LGUs/Private WSPs			
	MW-C-03	Additional Level 3,2, 1 Facilities towards 2025 in Nueva Ecija	LWUA/WDs/LGUs/Private WSPs			
	MW-C-04	Additional Level 3,2, 1 Facilities towards 2025 in Tarlac	LWUA/WDs/LGUs/Private WSPs			
	MS-C-01	Additional Sanitary Facilities towards 2025 in Bulacan	LGUs			
	MS-C-02	Additional Sanitary Facilities towards 2025 in Pampanga	LGUs			
	MS-C-03	Additional Sanitary Facilities towards 2025 in Nueva Ecija	LGUs			
	MS-C-04	Additional Sanitary Facilities towards 2025 in Tarlac	LGUs			
	MW-P-04	Metro Clark Bulk Surface Water Project	CDC			
	MW-C-05	Extended Bulacan Bulk Water Supply Project	LGU			
	MW-C-06	Pampanga Bulk Water Supply Project	LGU			
Management of Flood and Sediment Disasters	FL-G-03	Maintenance and Rehabilitation Works for River Dike and Slope	DPWH			
	FL-C-03	Maintenance, Rehabilitation and Improvement for Drainage and Flood Control Facilities under Jurisdiction of LGUs	LGUs			
	FL-C-04	Integration of Salient Points of IWRM for Pampanga River Basin into School Curricula	DE-Region III			
Watershed Management	WS-G-01	Forest Protection and Law Enforcement Program (FPLEP)	DENR/PENRO/CENRO			
	WS-G-02	Community-based Forest Management Program	DENR/RCBFMO			
	WS-G-04	Coastal Resource Management Program (CRMP)	DENR/PAWCZMS			
	WS-G-05	Protected Area Community-based Resource Management Program (CBFM-PACBRMA)	DENR/PAWCZMS			
	WS-G-06	Private Forest Plantation Development Program (PFPDP)	DENR-FRCD			
	WS-G-07	NIA-UPRIIS' Watershed Management Program	NIA-UPRIIS			
	WS-G-08	NPC's Watershed Management Program	NPC			
	WS-G-09	Integrated Social Forestry (ISF) Projects	LGUs/DENR/RCBFMO			
	WS-G-10	Private-sector Watershed Management Initiatives	Private Firm/NGOs			
Water-related Environment Management	WQ-G-01	Ecological Solid Waste Management Program (ESWMP)	DENR-EMB III			
	WQ-G-02	Industrial Pollution Control Program (IPCP)	DENR-EMB III			
	WQ-G-03	Sagip-Ilog Project	DENR-EMB/LGU/Pvt. Sector			
	WQ-P-01	Clean Development Mechanism Projects	Private Industries			
	WQ-C-04	Construction of Sanitary Landfills & Support Facilities in Nueva Ecija and Cluster Waste Transfer Stations in Bulacan & Pampanga	LGUs			

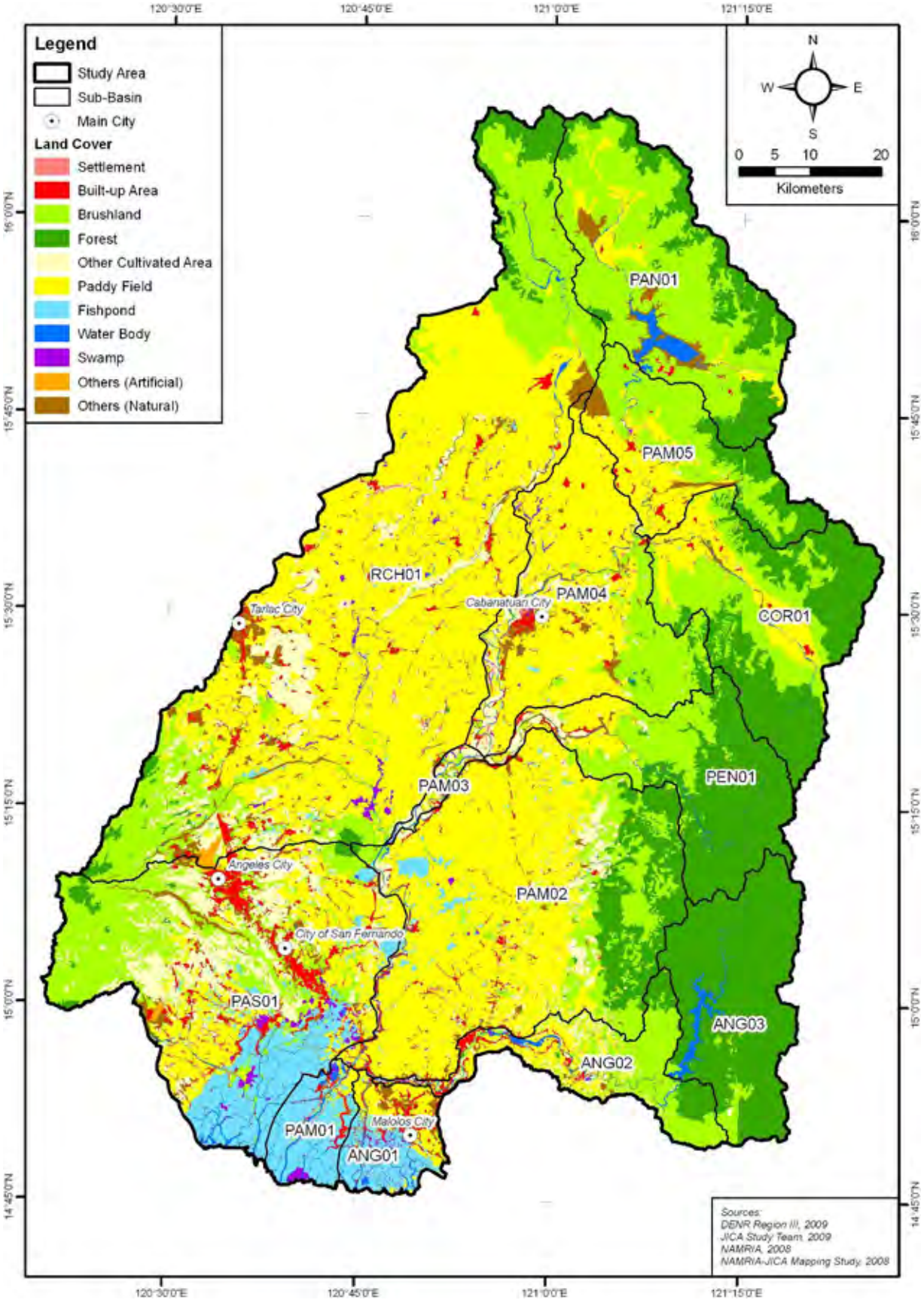
Annex-T 11.2.2 Results of Evaluation (Scoring) of Group-B Projects

Sector	Project Code	Viability of the Project						Enhanced Livelihood					Improved Quality of Life					Decentralized Development					Sustained Ecosystem					Empowered People					Grand Total	Rank
		1	2	3	4	5	T	1	2	3	4	T	1	2	3	4	T	1	2	3	4	T	1	2	3	4	T	1	2	3	4	T		
Agriculture / Irrigation and Fishery	AI-P-01	2.9	2.7	1.9	1.8	1.1	10.4	2.9	2.9	2.0	2.8	10.7	1.0	1.0	1.0	1.9	4.9	2.0	3.0	2.0	2.0	9.0	1.0	1.0	1.0	1.0	4.0	2.0	1.9	2.8	1.9	8.6	**47.6**	**18**
	AI-P-02	3.0	3.0	3.0	2.0	1.0	12.0	3.0	3.0	2.0	2.8	10.8	1.0	1.0	1.0	2.0	5.0	2.0	3.0	2.0	2.0	9.0	1.0	1.0	1.0	1.0	4.0	2.0	2.0	3.0	2.0	9.0	**49.8**	**13**
	AI-P-03	3.0	2.9	3.0	2.9	2.0	13.8	2.0	2.9	2.1	2.8	9.8	1.0	1.0	1.0	1.1	4.1	1.9	2.1	1.9	2.7	8.6	1.0	1.0	1.0	1.0	4.0	1.9	1.9	1.9	1.9	7.6	**47.8**	**17**
	AI-P-04	3.0	3.0	2.0	3.0	1.1	12.1	2.9	2.9	2.0	2.8	10.7	1.0	1.0	1.0	1.0	4.0	2.0	3.0	2.0	2.0	9.0	1.0	1.0	1.1	1.0	4.1	2.0	2.0	3.0	2.0	9.0	**48.8**	**14**
	AI-P-05	2.0	2.0	2.0	3.0	1.0	10.0	1.9	1.9	2.0	1.9	7.7	1.0	1.0	1.0	1.0	4.0	2.0	2.0	2.0	2.0	8.0	1.0	1.0	1.0	1.0	4.0	1.0	2.0	2.0	1.0	6.0	**39.7**	**29**
	AI-P-06	2.0	3.0	2.0	2.0	2.0	11.0	2.0	2.0	2.0	2.0	8.0	1.0	1.0	1.0	1.0	4.0	1.0	3.0	1.0	1.0	6.0	1.0	1.0	1.0	1.0	4.0	1.0	2.0	2.0	2.0	7.0	**40.0**	**28**
	AI-P-07	2.0	2.0	3.0	3.0	2.0	12.0	2.0	3.0	3.0	3.0	11.0	2.0	2.0	1.0	2.0	7.0	1.0	2.0	2.0	2.0	7.0	1.0	1.0	2.0	1.0	5.0	3.0	3.0	3.0	3.0	12.0	**54.0**	**4**
	AI-P-08	2.0	2.0	2.0	2.0	2.0	10.0	2.0	3.0	2.0	3.0	10.0	1.0	1.0	1.0	1.0	4.0	1.0	3.0	1.0	2.0	7.0	1.0	1.0	2.0	1.0	5.0	2.0	2.0	2.0	2.0	8.0	**44.0**	**24**
	AI-P-09	2.0	2.0	2.0	2.0	1.0	9.0	2.0	2.0	2.0	2.0	8.0	1.0	1.0	1.0	1.0	4.0	2.0	2.0	2.0	2.0	8.0	1.0	1.0	1.1	1.0	4.1	1.0	1.0	2.0	1.0	5.0	**38.1**	**30**
	AI-P-10	2.1	2.0	2.9	2.1	1.1	10.1	2.9	3.0	1.9	2.9	10.7	2.9	2.9	1.9	1.1	8.8	1.9	3.0	1.9	1.9	8.7	1.0	1.0	2.1	1.0	5.1	1.9	1.9	1.9	2.8	8.5	**51.9**	**8**
	AI-P-11	2.1	2.1	1.9	2.1	2.9	11.1	3.0	3.0	2.1	3.0	11.1	1.1	1.1	1.1	1.1	4.2	1.1	3.0	2.0	2.9	8.9	1.1	1.1	2.1	1.1	5.2	2.9	2.0	3.0	2.1	9.9	**50.4**	**12**
	AI-C-01	2.0	1.9	1.0	2.1	2.9	9.8	3.0	3.0	2.1	3.0	11.1	1.1	1.1	1.1	1.1	4.2	1.1	3.0	2.0	2.0	8.0	1.1	1.1	1.1	1.1	4.3	2.0	2.0	2.8	1.9	8.6	**46.0**	**21**
	AI-C-02	2.1	2.1	2.1	2.0	2.8	11.0	2.7	2.8	2.8	2.8	11.1	1.8	1.0	1.0	1.0	4.8	1.8	2.7	1.8	2.0	8.3	1.0	1.0	1.8	1.0	4.8	2.6	2.7	2.7	2.7	10.7	**50.7**	**10**
	AI-C-03	2.0	2.0	2.0	2.0	2.0	10.0	2.0	3.0	2.9	2.9	10.8	1.0	2.0	2.0	1.0	6.0	1.0	2.0	2.0	2.0	7.0	2.0	2.0	2.0	2.0	8.0	3.0	3.0	3.0	3.0	12.0	**53.8**	**5**
Municipal Water Supply, Sanitation and Sewerage	MW-P-04	1.9	1.9	1.9	1.9	1.0	8.6	1.9	2.0	1.0	1.0	5.9	2.1	2.9	1.9	1.0	7.9	2.0	2.0	2.1	1.1	7.1	1.0	1.1	1.0	1.1	4.1	1.0	1.0	1.0	1.0	4.0	**37.6**	**32**
	MP-C-01	2.0	2.0	2.0	1.9	1.0	8.9	1.0	1.0	1.0	1.0	4.0	2.5	1.1	2.9	1.0	7.5	1.9	1.0	1.9	2.0	6.8	1.0	2.9	1.9	2.9	8.7	2.0	2.0	2.0	1.0	7.0	**42.9**	**27**
Management of Flood and Sediment Disasters	FL-P-01	3.0	3.0	3.0	2.0	1.1	12.1	1.9	2.9	2.0	1.9	8.7	1.0	1.0	2.9	3.0	7.9	2.9	2.9	2.9	2.0	10.7	1.0	2.0	1.0	2.0	6.0	3.0	2.0	3.0	2.0	10.0	**55.4**	**2**
	FL-P-02	1.0	1.0	1.0	2.0	1.1	6.1	1.9	2.0	2.0	2.0	7.9	1.0	1.0	2.0	3.0	7.0	2.0	2.0	2.0	1.0	7.0	1.0	1.0	1.0	1.0	4.0	2.0	1.0	2.0	1.0	6.0	**38.0**	**31**
	FL-C-01	2.0	2.0	2.0	2.0	2.0	10.0	1.9	3.0	3.0	2.0	9.9	1.0	2.0	2.0	3.0	8.0	2.8	2.8	3.0	2.0	10.5	2.0	1.0	1.0	1.0	5.0	3.0	3.0	3.0	2.0	11.0	**54.5**	**3**
	FL-C-02	2.0	2.0	1.0	3.0	3.0	11.0	1.9	2.0	2.0	3.0	8.9	1.0	1.0	2.0	3.0	7.0	2.0	1.0	2.0	1.0	6.0	1.1	1.1	1.1	1.1	4.2	3.0	3.0	3.0	2.0	11.0	**48.1**	**15**
Watershed Management	WS-C-01	1.9	1.9	2.0	3.0	3.0	11.8	2.0	2.0	2.0	2.0	8.0	1.0	1.0	1.0	2.9	5.9	1.0	2.0	2.0	3.0	8.0	1.1	3.0	3.0	2.0	9.1	3.0	2.1	3.0	2.1	10.1	**52.9**	**7**
	WS-C-02	2.0	2.0	2.0	3.0	3.0	12.0	2.0	2.0	2.0	1.9	7.9	1.1	1.1	1.0	3.0	6.2	1.0	2.0	2.0	3.0	8.0	1.1	3.0	3.0	2.0	9.1	3.0	2.0	2.9	2.0	9.9	**53.1**	**6**
	WS-C-03	2.0	3.0	2.0	3.0	1.0	11.0	1.0	1.0	1.0	1.0	4.0	1.0	1.0	2.0	2.0	6.0	1.0	1.0	2.0	1.0	5.0	2.0	3.0	3.0	2.0	10.0	3.0	2.0	3.0	2.0	10.0	**46.0**	**20**
	WS-C-04	2.0	2.0	2.0	3.0	1.0	10.0	2.0	2.0	2.0	2.0	8.0	1.0	1.0	2.0	1.0	5.0	2.0	2.0	1.0	2.0	7.0	2.0	2.0	2.0	2.0	8.0	2.0	1.1	2.0	2.0	7.1	**45.1**	**23**
Water-related Environment Management	WQ-P-01	1.9	2.0	2.0	3.0	3.0	11.9	1.0	2.9	1.1	1.0	6.0	1.0	1.0	2.0	1.0	5.0	2.0	1.0	2.0	1.1	6.1	1.0	2.0	3.0	2.0	8.0	2.0	2.0	3.0	3.0	10.0	**46.9**	**19**
	WQ-C-01	2.0	2.9	2.0	3.0	1.0	10.9	1.0	1.0	1.0	1.0	4.0	3.0	1.9	3.0	1.0	8.9	2.0	1.0	2.0	1.0	6.0	2.9	2.0	2.0	2.0	8.9	2.0	2.0	2.0	1.0	7.0	**45.7**	**22**
	WQ-C-02	2.0	2.0	2.0	3.0	1.0	10.0	1.9	2.0	2.0	2.0	7.9	1.0	1.0	2.0	1.0	5.0	1.0	3.0	2.0	2.0	8.0	3.0	3.0	1.0	1.9	8.9	2.0	2.0	2.0	2.0	8.0	**47.8**	**16**
	WQ-C-03	2.0	2.0	2.0	2.1	2.0	10.1	1.0	1.0	1.0	1.0	4.0	2.0	1.0	3.0	1.0	7.0	1.0	1.0	2.0	1.0	5.0	3.0	2.0	1.0	3.0	9.0	2.0	2.0	2.1	2.0	8.1	**43.1**	**26**
	WQ-C-04	2.0	2.0	2.0	2.1	1.1	9.1	1.1	1.0	1.1	1.0	4.1	2.6	1.0	3.0	1.0	7.6	2.0	1.1	2.0	1.1	6.1	1.0	2.9	2.0	3.0	8.9	2.0	2.0	2.0	2.0	8.0	**43.8**	**25**
Others	IS-C-01	2.0	3.0	2.0	3.0	2.0	12.0	1.0	1.0	1.0	1.0	4.0	2.9	2.9	3.0	1.0	9.8	1.0	2.0	2.0	1.0	6.0	3.0	3.0	1.0	2.1	9.1	2.8	2.8	1.9	2.0	9.6	**50.5**	**11**
	IS-C-03	2.0	3.0	2.0	3.0	2.0	12.0	1.0	1.0	1.0	1.0	4.0	2.9	2.9	3.0	1.1	9.9	1.0	2.0	2.0	1.0	6.0	3.0	2.1	1.0	2.0	8.1	2.9	2.9	3.0	2.0	10.8	**50.8**	**9**
	IS-C-04	2.0	2.0	2.0	3.0	2.0	11.0	1.9	2.8	2.1	2.0	8.8	2.8	2.8	2.8	1.0	9.5	2.0	2.9	2.9	2.9	10.7	2.0	2.0	2.0	1.0	7.0	2.9	2.9	2.9	2.8	11.6	**58.6**	**1**

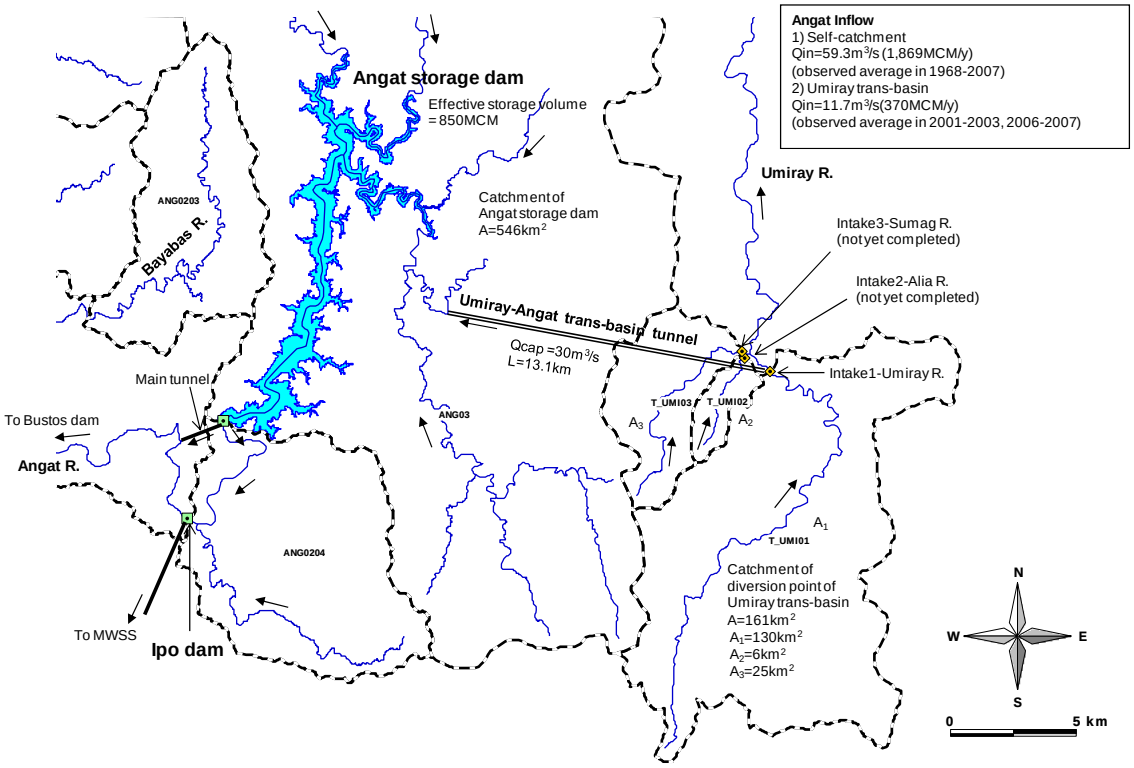
Annex-T 11.2.3 Implementation Schedule for Group-B Projects

Sector	Code	Name of Project	Implementing Agency	Short-term	Mid-term	Long-term
Agriculture/Irrigation and Fisheries	AI-P-07	Appropriate Irrigation Technologies for Enhanced Agricultural Production	NIA			
	AI-C-02	Introduction of Water Saving Irrigation Technology	NIA			
	AI-C-03	Improvement of Monitoring System and Capacity Development for Proper Water Management in NISs and CISs	NIA			
	AI-G-01	Balog-Balog Multipurpose Project Phase 1	NIA			
	AI-G-02	Along-along Creek Irrigation Project (UPRIIS Div3)	NIA			
	AI-G-10	Upper Tabuating SRIP	NIA			
	AI-G-07	Participatory Irrigation Development Project, APL1-Infrastructure Development	NIA			
	AI-P-10	Rehabilitation of AMRIS	NIA			
	AI-P-03	Sector Loan on Rehabilitation of Irrigation Facilities	NIA			
	AI-P-11	Construction of Priority Small Scale Irrigation Systems/Small Water Impounding Projects, Small Diversion Dam Projects	DA Region III/LGUs			
	AI-P-02	Balog-Balog Multipurpose Project Phase 2	NIA			
	AI-P-04	Casecnan Multi-purpose Irrigation & Power Project Irrigation Component Phase 2	NIA			
	AI-C-01	New Construction of Small Scale Irrigation Project under BSWM	BSWM/LGUs			
	AI-P-08	Central Luzon Groundwater Irrigation Systems Reactivation Project	NIA			
	AI-P-06	Irrigation Water Resources Augmentation Pump Establishment Project	NIA			
	AI-P-05	Procurement of Pumps, Drilling Rigs & Related Equipment	NIA			
	AI-P-01	Balintingon Reservoir Multipurpose Project (BRMP)	NIA/G. Trino			
	AI-P-09	Gumain Reservoir Project	NIA			
Municipal Water Supply, Sanitation and Sewerage	MP-G-01	Cabanatuan Sewerage System	LGU			
	MP-G-02	Expansion of Clark Sewerage System	Clark Water			
	MP-C-01	Septage Treatment and Disposal Facility	LWUA/WDs/LGUs/Private WSPs			
Management of Flood and Sediment Disasters	FL-G-01	Pinatubo Hazard Urgent Project (PHUMP) Phase III Part I	DPWH			
	FL-G-02	Pinatubo Hazard Urgent Project (PHUMP) Phase III Part II	DPWH			
	FL-P-01	Flood Control Measures in Mt. Pinatubo Devastated Area- Focus on Pasac Delta	DPWH			
	FL-C-01	Flood Mitigation for Pampanga Delta	DPWH			
	FL-G-04	Flood Forecasting and Warning System Capacity Building Project upon Dam Release in the Philippines	PAGASA			
	FL-C-02	Community Based Flood Early Warning System for Provinces of Pampanga, Tarlac and N. Ecija	LGUs			
	FL-P-02	Bacolor Comprehensive Rehabilitation Master Plan	LGU			
Watershed Management	WS-G-03	Integrated Agro-Forestry Development Program (CBFM-CARP)	DENR/RCBFMO/DAR			
	WS-G-11	Forestlands Management Project (FMP)	DENR-FASPO			
	WS-G-12	Pampanga River Basin Rehabilitation Project (PRBRP)	DENR-FRCD			
	WS-C-01	Upland Development Program (UDP)	DA/DENR/LGUs			
	WS-C-02	Protected Area Management Program (PAMP)	DENR-PAWZCMS			
	WS-C-03	Urban Greening Program	DENR/LGUs/Pvt. Sector			
	WS-C-04	Community-based Eco-tourism Program	DOT/DENR/LGUs			
Water-related Environment Management	WQ-C-01	Capacity Development to Upgrade WQ Monitoring and Data Management Program	DENR-EMB			
	WQ-C-02	Capacity Development to Improve Water Quality and Aquaculture Fisheries Management	DA-BFAR			
	WQ-C-03	Capacity Development Project to Improve Industry Adoption of Cleaner Production Options	DTI/DENR/Private Industries			
Others	IS-C-01	Establishment of Comprehensive Groundwater Monitoring in Pampanga River Basin	NWRB/Others			
	IS-C-03	Enhancement of Monitoring System for Surface Water in Pampanga River	NWRB/Others			
	IS-C-04	Capacity Development of NWRB and Relevant Agencies on Water Allocation and Distribution	NWRB/Others			

Annex-Figures

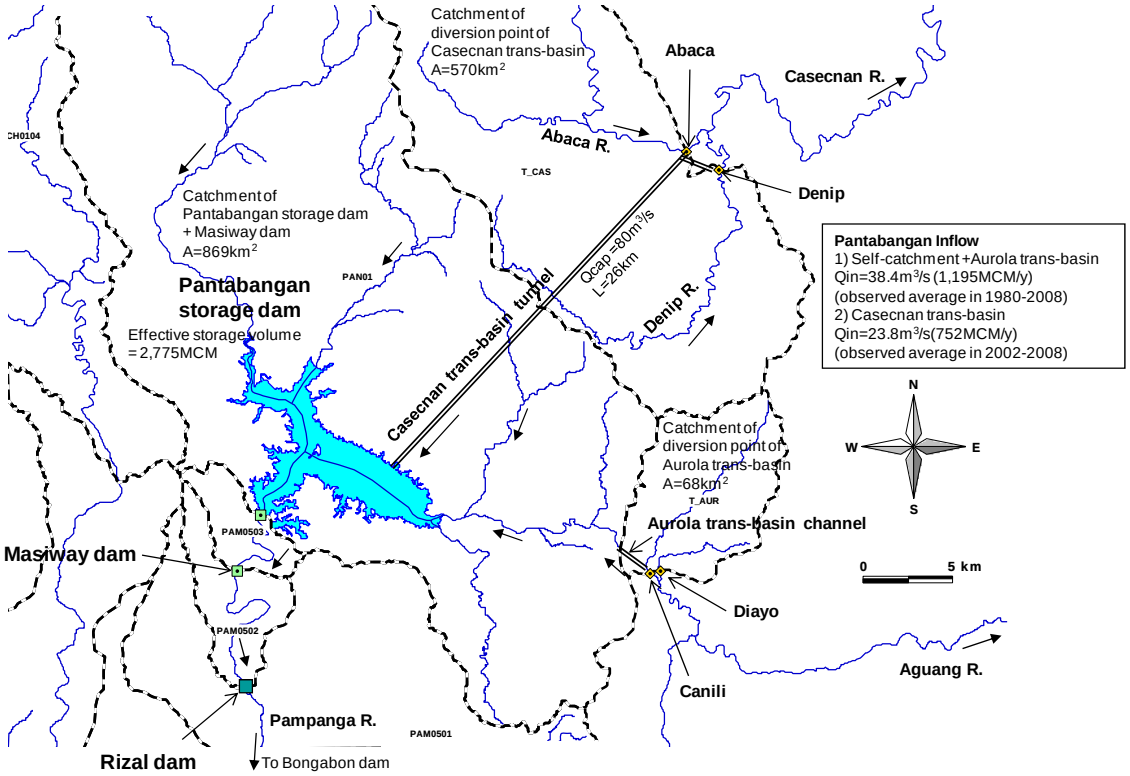


Annex-F 3.4.1 Land Cover in the Study Area



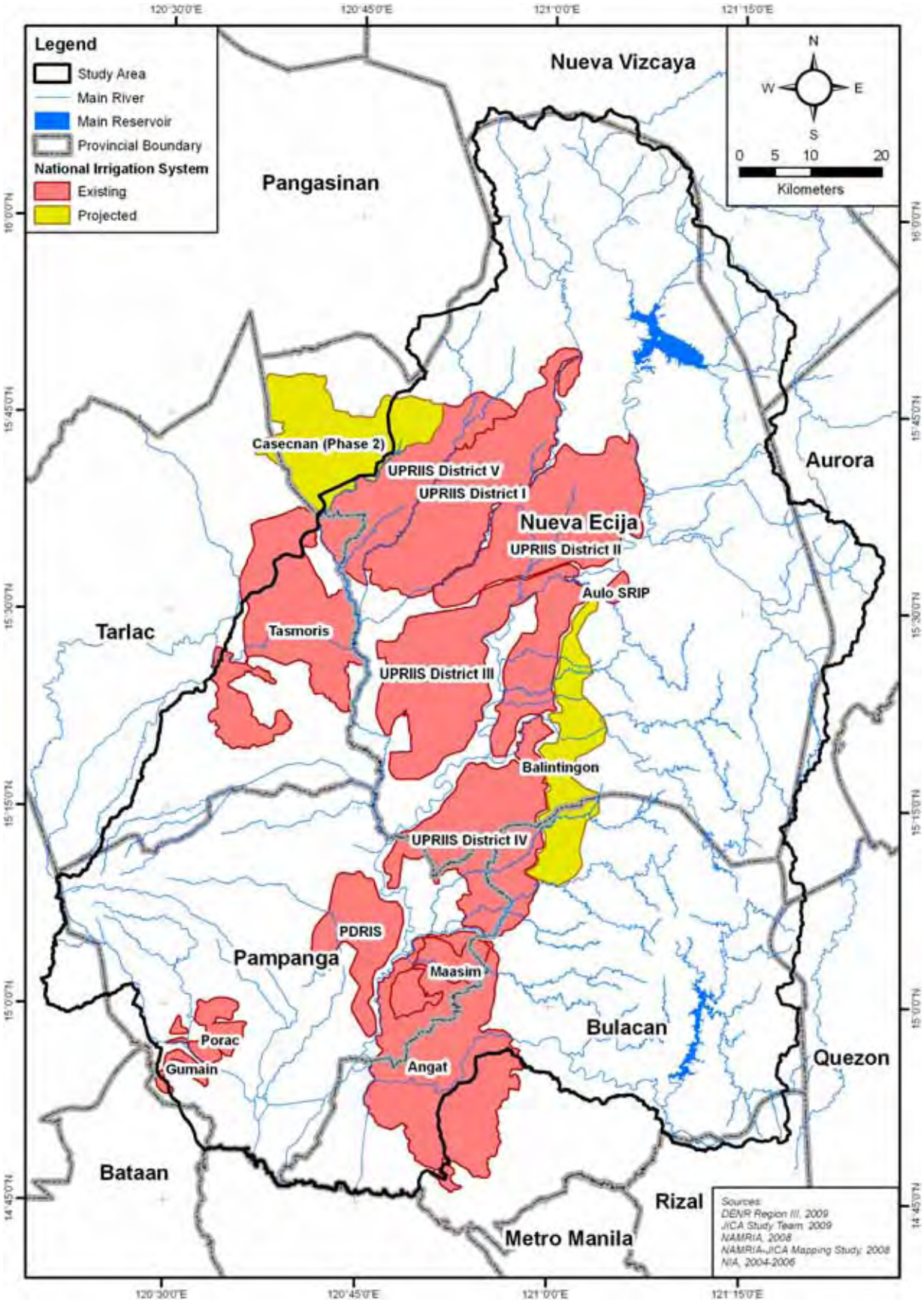
Source: JICA Study Team

Annex-F 4.1.1 Location of Angat Storage Dam

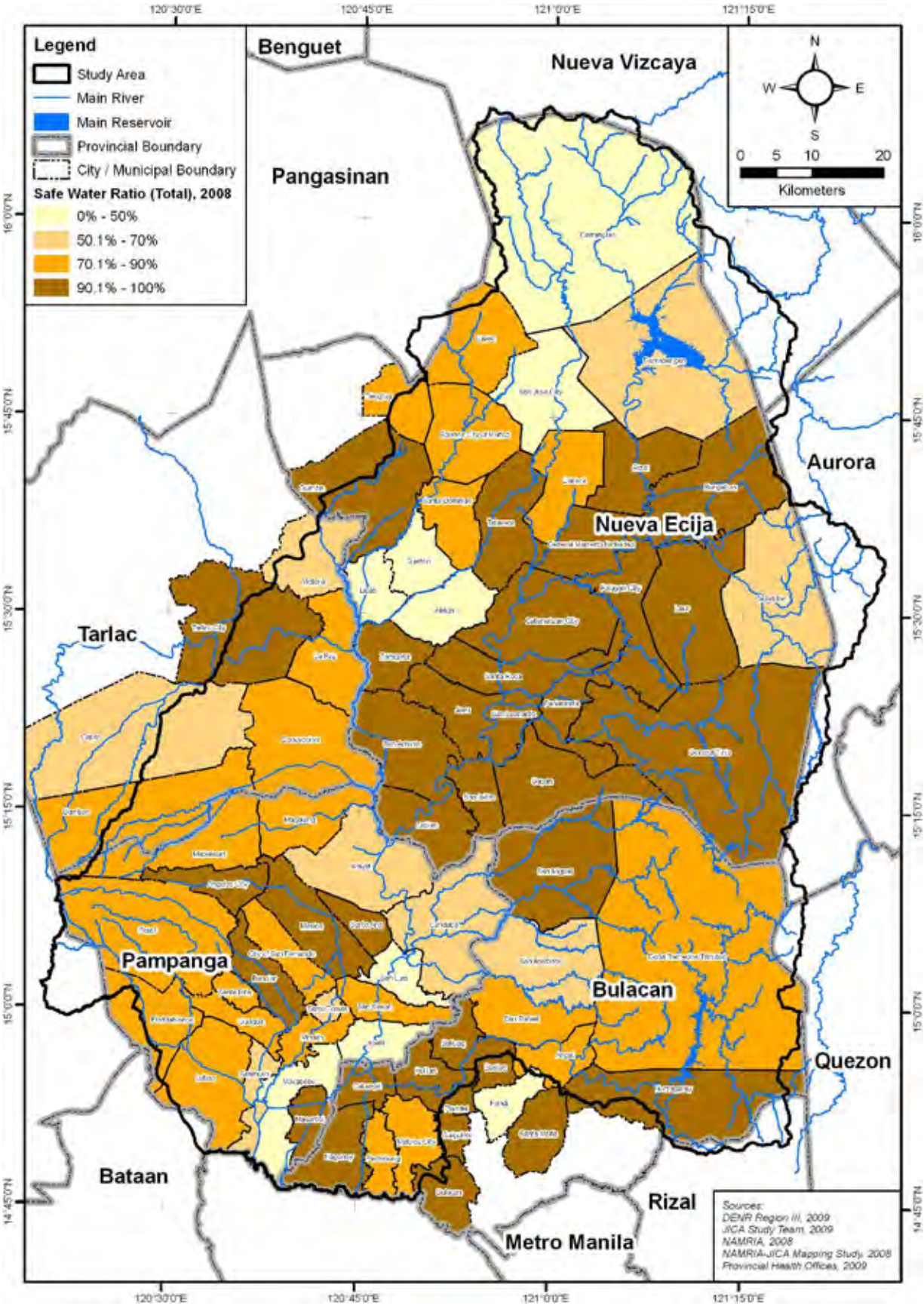


Source: JICA Study Team

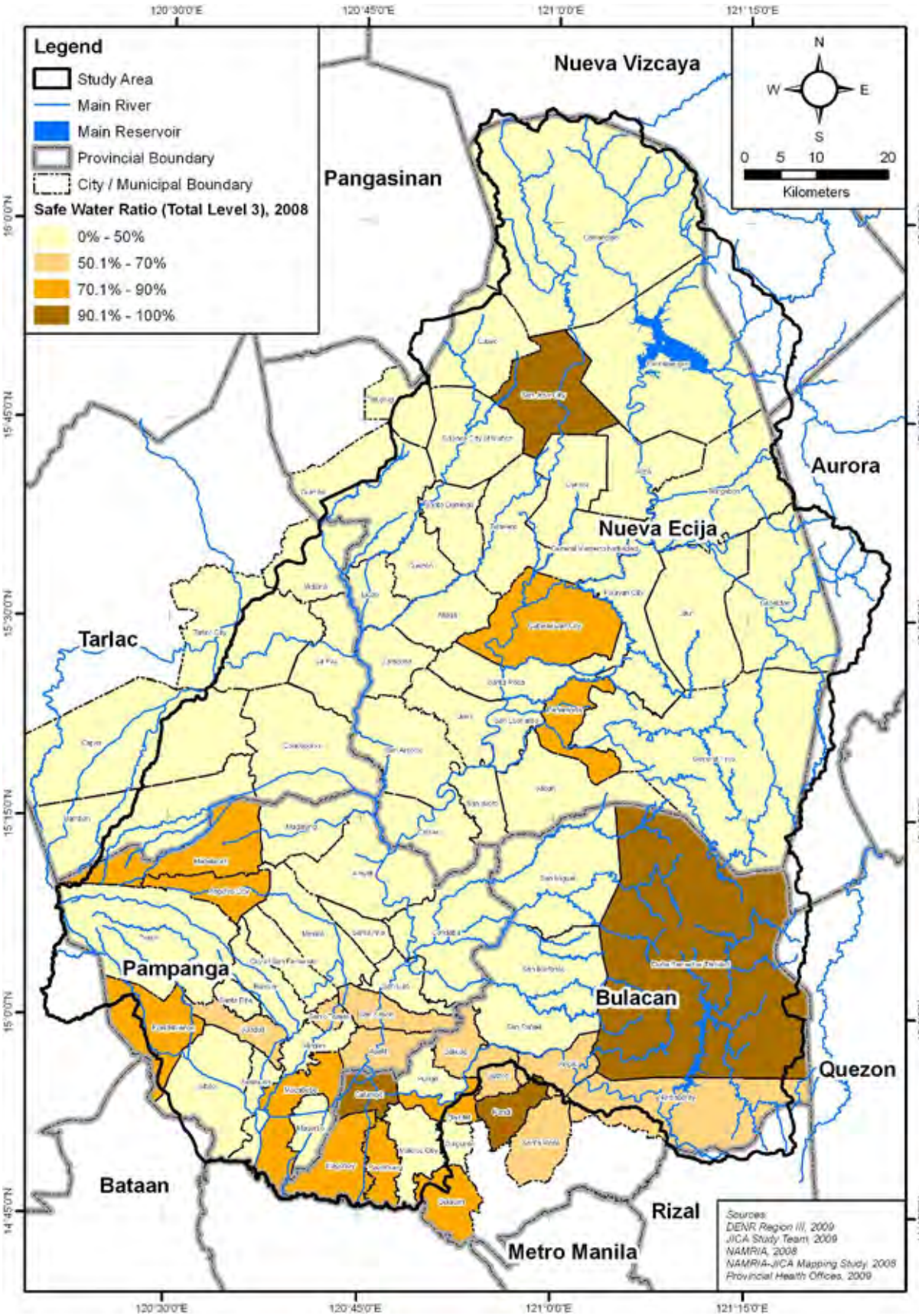
Annex-F 4.1.2 Location of Pantabangan Storage Dam



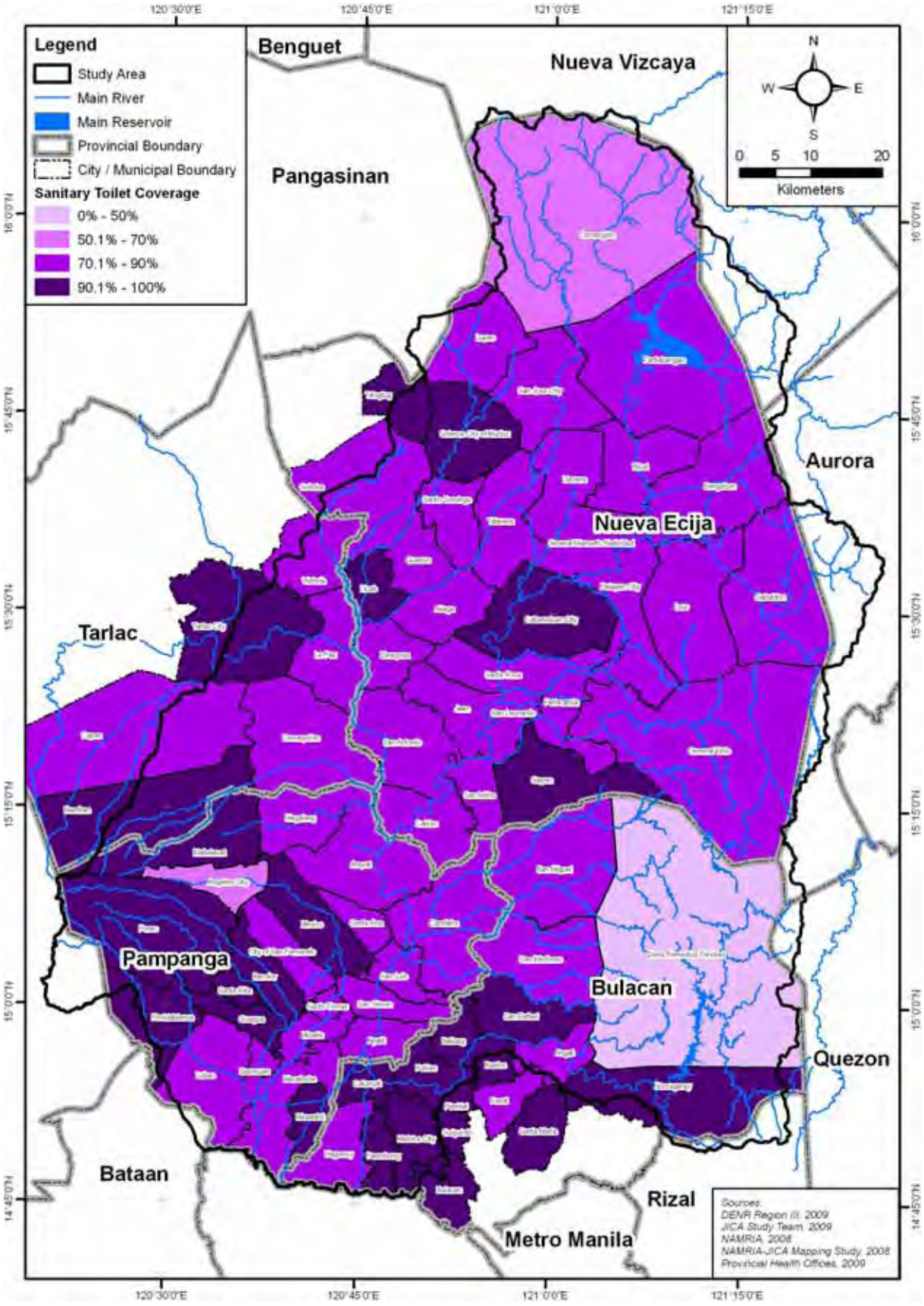
Annex-F 4.2.1 Location Map of Existing and Projected NIS



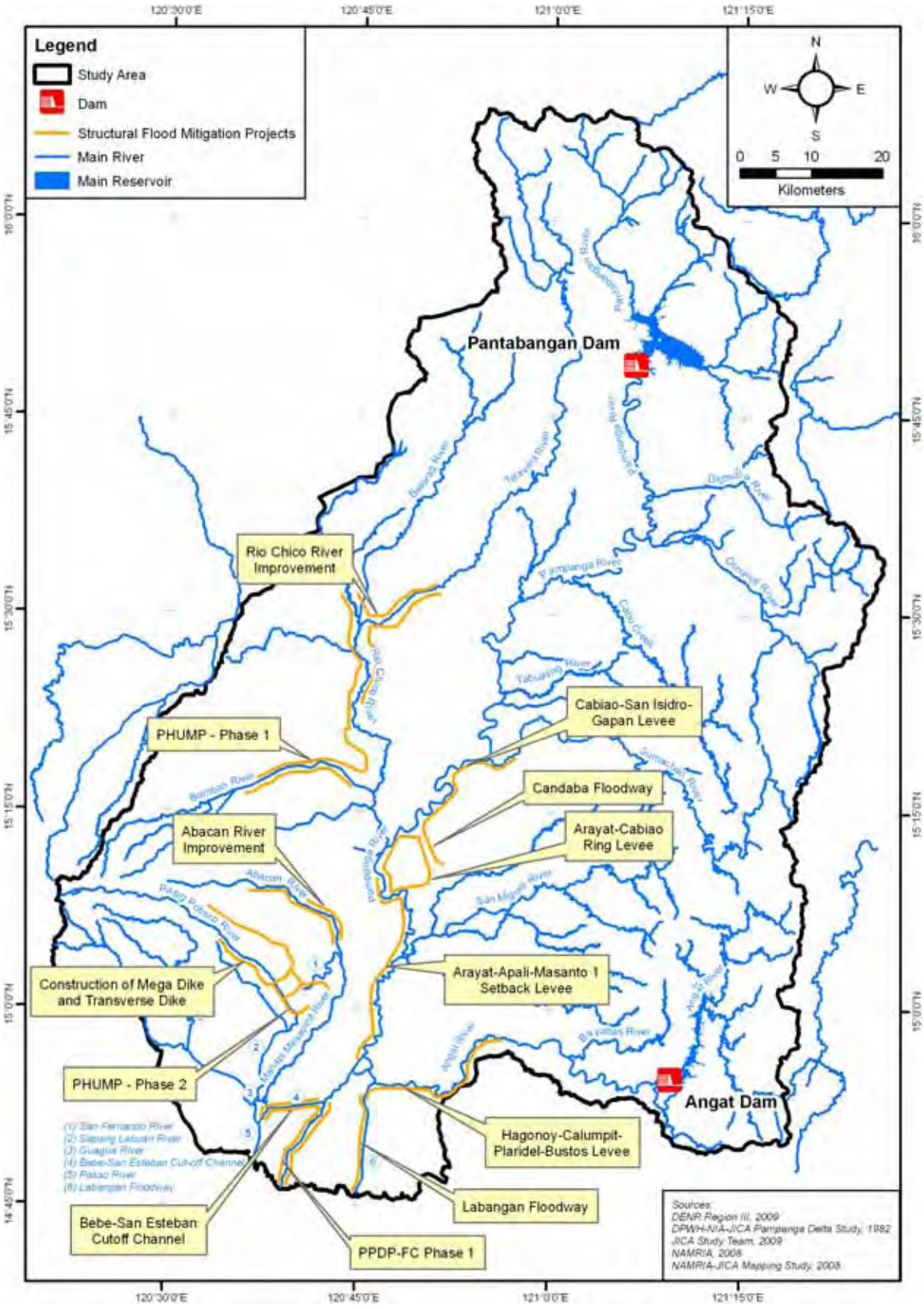
Annex-F 4.3.1 Present Coverage of Water Supply Facilities for Access to Safe Drinking Water



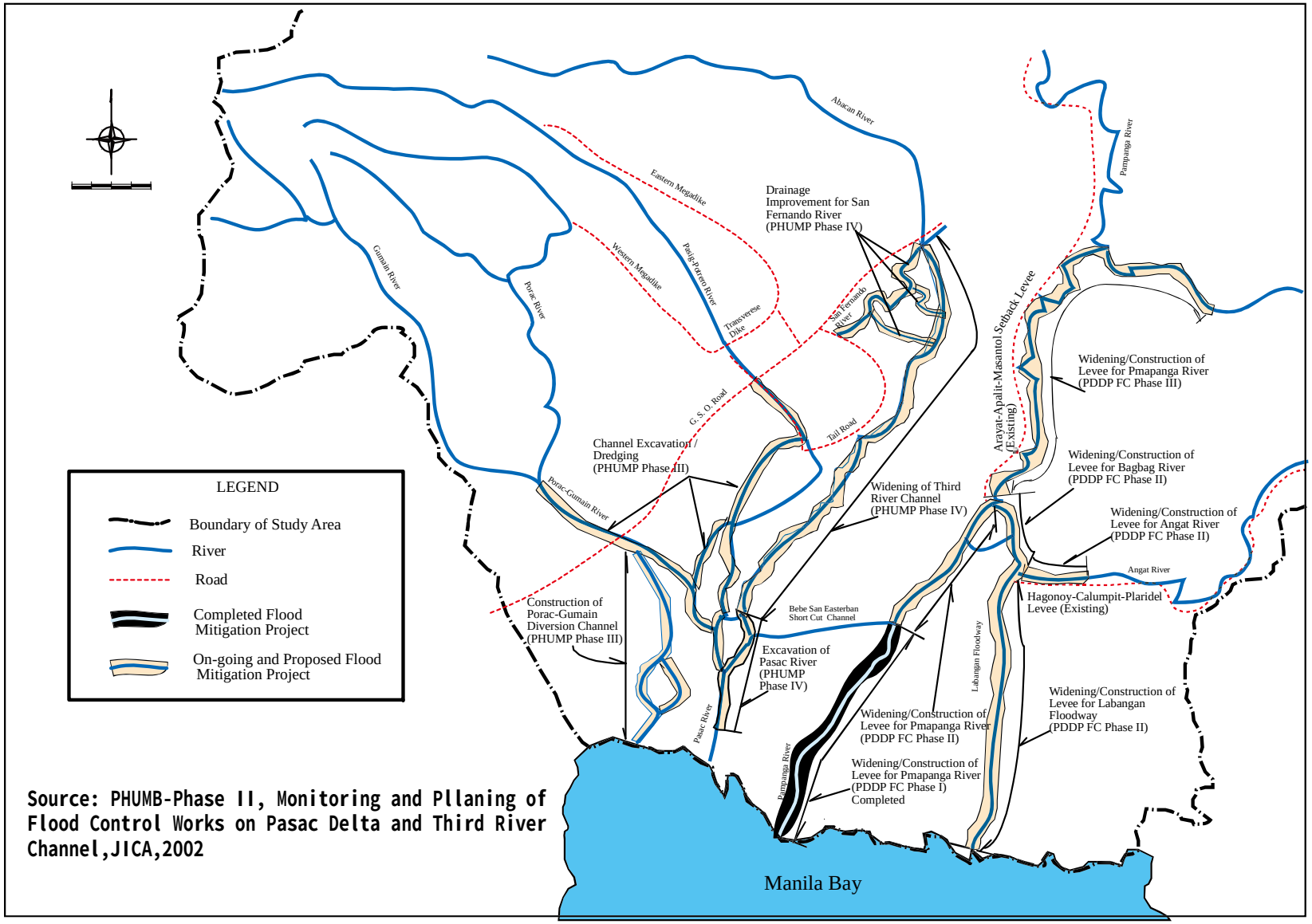
Annex-F 4.3.2 Present Coverage of Level 3 Water Supply Facilities with Safe Water Access



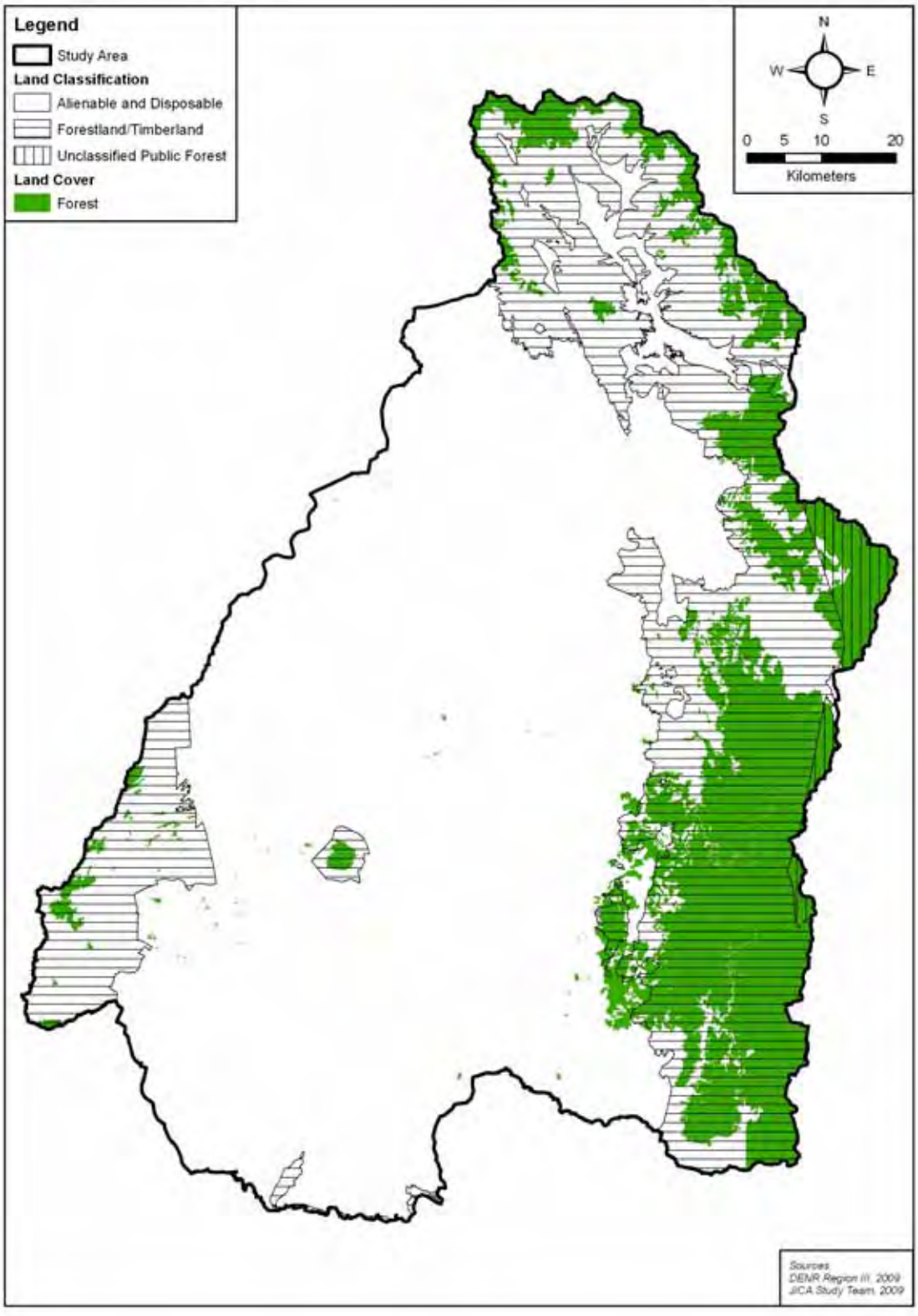
Annex-F 4.3.3 Present Coverage of Sanitary Toilet



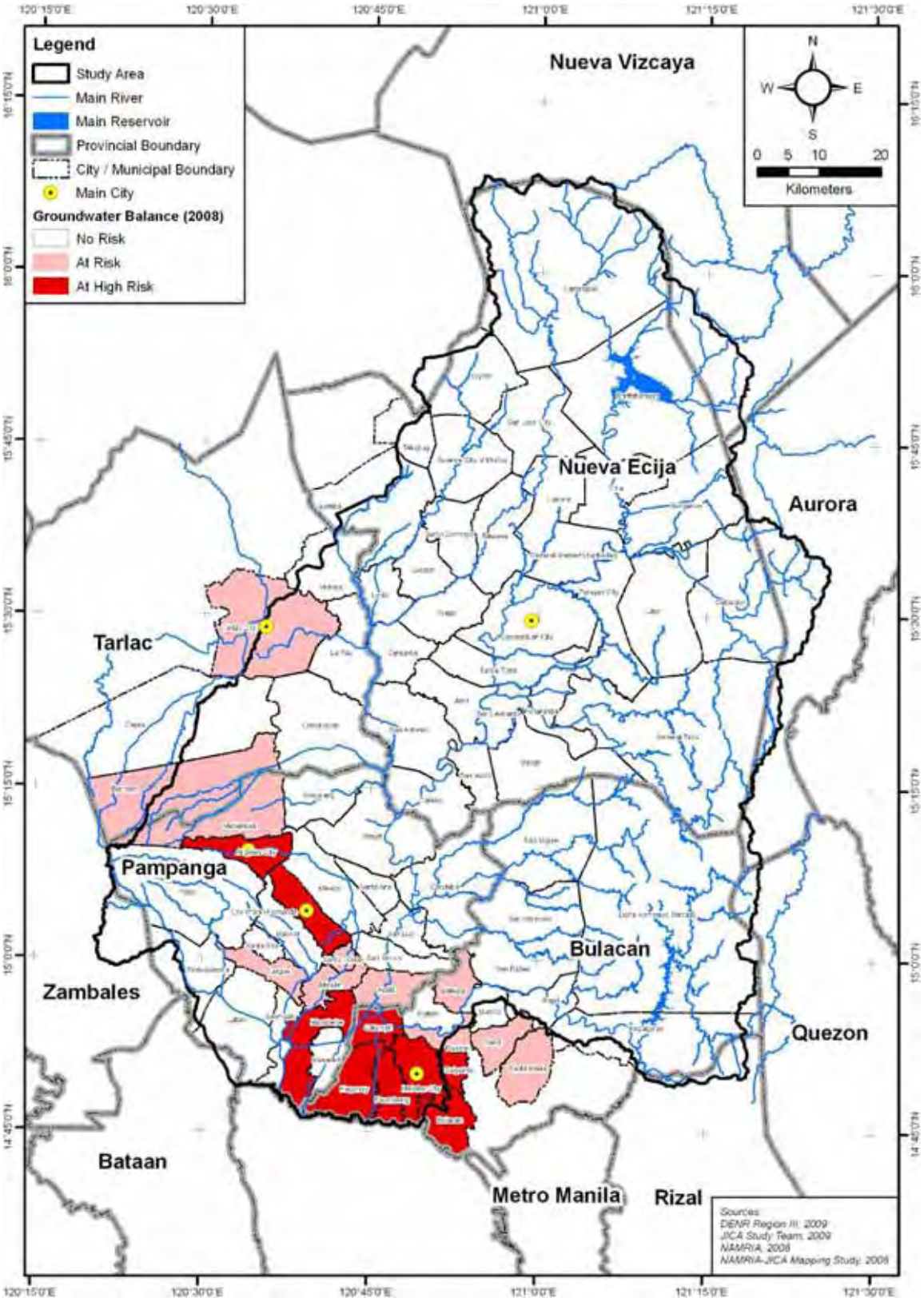
Annex-F 4.5.1 Completed Major Flood and Sediment Disaster Prevention Works



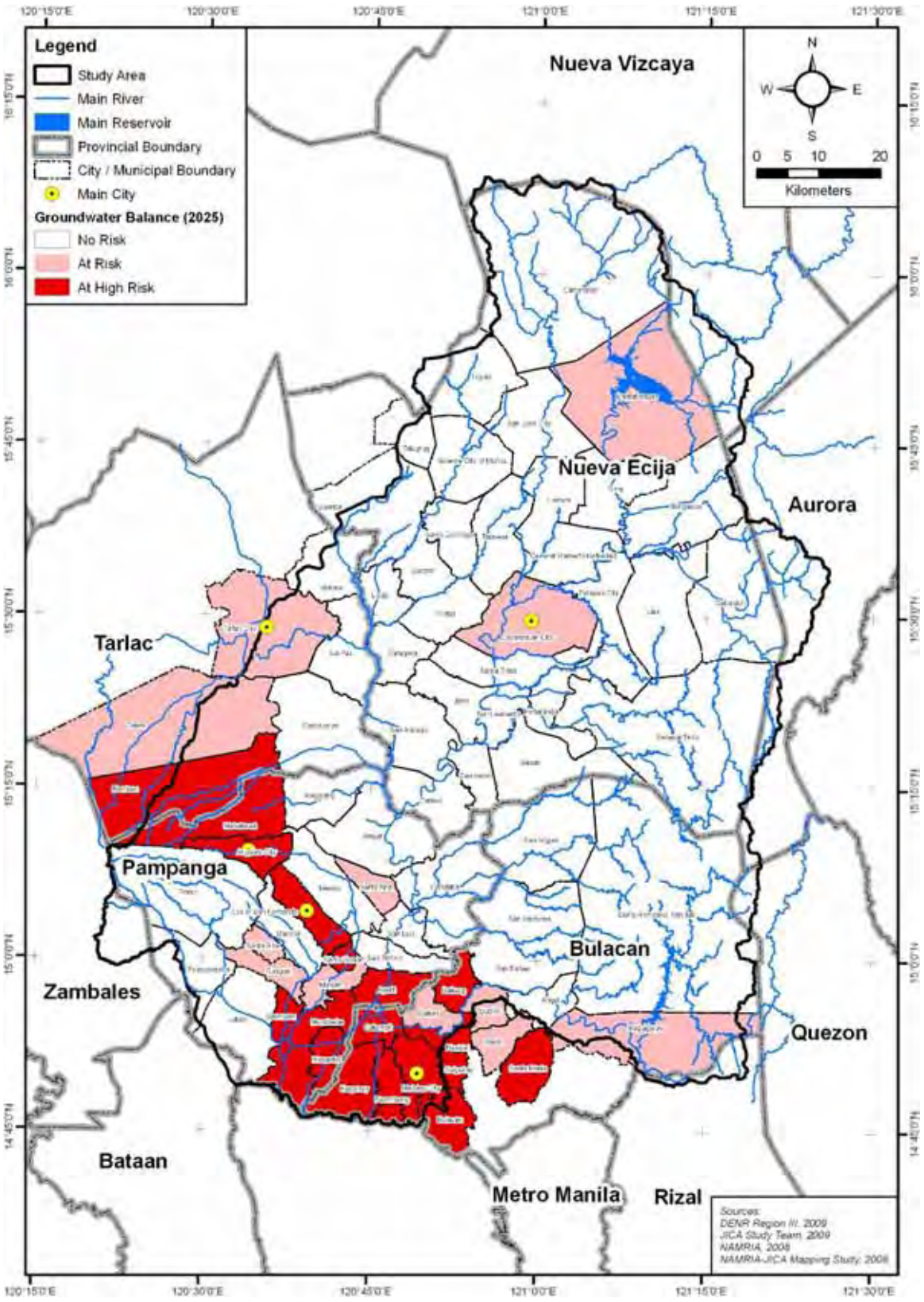
Annex-F 4.5.2 On-going and Proposed Structural Flood Mitigation Works in Pampanga River Basin



Annex-F 6.5.1 Land Classification vs. Land Cover Over Forest Lands in the Study Area 2005



Annex-F 6.7.1 Evaluation of Groundwater Usage Condition in Present Condition (2008)



Annex-F 6.7.2 Evaluation of Groundwater Usage Condition in Future Condition (2025)