DEPARTMENT OF
PUBLIC WORKS AND HIGHWAYS
THE REPUBLIC OF THE PHILIPPINES

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT
PART II-A
FEASIBILITY STUDY ON CAGAYAN RIVER BASIN (TUGUEGARAO AND ENRILE)

JANUARY 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO., LTD.
in association with
NIPPON KOEI CO., LTD

GED
JR
10-012

DEPARTMENT OF
PUBLIC WORKS AND HIGHWAYS
THE REPUBLIC OF THE PHILIPPINES

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT
PART II-A
FEASIBILITY STUDY ON CAGAYAN RIVER BASIN (TUGUEGARAO AND ENRILE)

JANUARY 2010

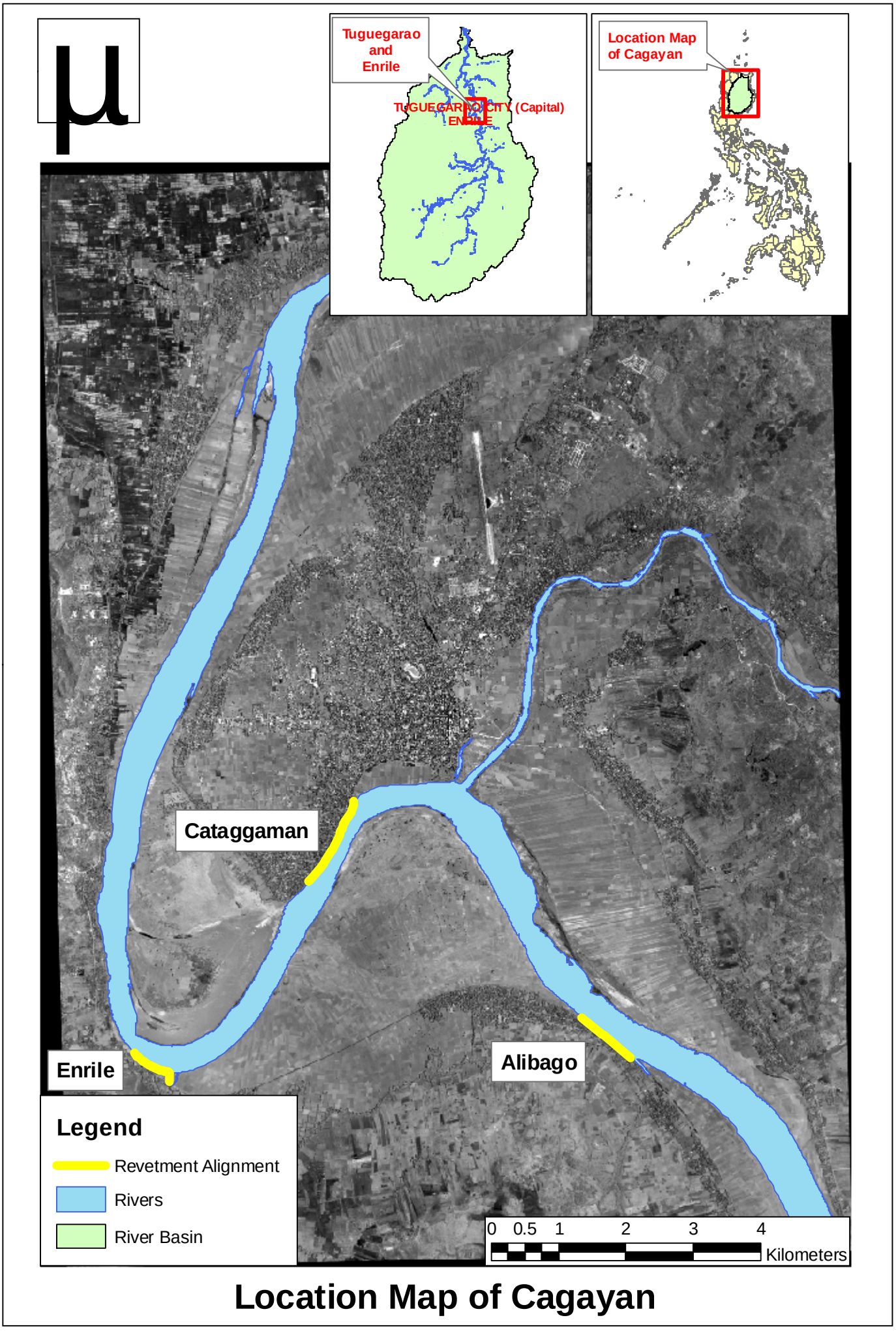
JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO., LTD.
in association with
NIPPON KOEI CO., LTD

Exchange Rate used in the Report is:

US$ 1.00 = PhP. 49.70 = JpY. 93.67
Jp¥ 1.00 = PhP. 0.5306

(as of 31st August 2009)



Location Map of Cagayan

LIST OF REPORTS

Summary

Part I : Main Report

Part II-A : Feasibility Study on the Lower Cagayan River Flood Control Project for the Sector Loan Application

Part II-B : Feasibility Study on the Ilog Hilabangan River Flood Control Project for the Sector Loan Application

Part II-C : Feasibility Study on the Tagoloan River Flood Control Project for the Sector Loan Application

Needs Assessment Study on Flood Disasters Caused by Typhoons No.16 (ONDOY) and No.17 (PEPENG)

THE PREPARATORY STUDY
FOR SECTOR LOAN
ON DISASTER RISK MANAGEMENT
IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT

PART II-A: F/S ON CAGAYAN RIVER BASIN (TUGUEGARAO AND ENRILE)

LOCATION MAP

COMPOSITION OF THE REPORT

TABLE OF CONTENTS

ABBREVIATION (REFER TO MAIN REPORT (PART-I))

TABLE OF CONTENTS

Page

APPENDIX

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Philippines is one of the countries most severely damaged by natural disaster in the East-Asia Region. Among the natural disasters, 92.5% are caused by typhoons that bring heavy rainfall and strong winds. Approximately twenty typhoons a year break out on the sea around the Caroline and Mariana Islands, and most of them pass through the Philippines. These typhoons cause floods, in most cases, by heavy rainfall.

Thus, the Philippines is vulnerable to flood damage. According to the flood damage records from 1970 to 2003, 544 people have died per annum and the number could be 1,487 people per annum if the missing and injured were included. The number of damaged households and disaster-affected persons was 500,000 and 2,800,000, respectively. Out of the 730,000 damaged houses, 70,000 were completely destroyed. The total direct damage was estimated at about 4.6 billion pesos a year; whereas, once in every six years the damage amounts to more than 10 billion pesos.

In the Philippines, master plans for flood control projects of the Major River Basins (12 out of 18) with catchment areas of more than 1,400 km^2 were formulated in 1982. Based on those plans, feasibility studies and projects were implemented with ODA and other international funds together with review on the master plans. Even for the Principal River Basins with catchment areas of more than 40 km^2, urgent flood control projects whenever severe flood damages occurred were implemented. However, the number of river basins where flood control works were so far implemented is very limited.

Under the circumstances, a development study known as "The Nationwide Flood Risk Assessment and the Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines" (hereinafter called as "The Nationwide Flood Risk Assessment Study") was conducted to formulate the national strategy for flood control projects. In this study, 58 river basins in which flood control projects should be implemented for the period of 26 years between 2009-2034 were selected and the implementation schedule was arranged in the order of priority by dividing the 58 river basins into three (3) groups: one group covering the 26 river basins expected to be financed with foreign funds, while the other group of 30 river basins is to be financed with local funds. The remaining 2 river basins is to be implemented as exceptional rivers for which the implementation of flood control project should be commenced immediately at that time.

On the other hand, the prioritized river basins with middle level priorities have to wait for a long time to receive funds for project implementation when each project is intended to protect the assets of the whole river basin with application for individual loans. Even for the flood control projects in highly prioritized river basins, the implementation might wait for some time since the cost for each proposed project may be so high that the implementation of some projects has to be deferred. Therefore, flood control projects for river basins implemented with local funds may also wait for a longer time judging from the previous practices on flood control projects with local funds, because the limited budget for flood control is expensed ad-hoc, only for restoration works when flood damage is observed. In fact, flood disasters may occur in every river basin even for the middle priority river basins, and the stakeholders in each basin may crave for the implementation of flood protection measures against the future disasters.

Under the circumstances, it has been recognized that there is a necessity for the early implementation of flood control projects, not for the whole river basin but only for the selected core areas that are scattered in the basin. For this purpose, the idea of a "Sector Loan" from New

JICA (the merged JICA and JBIC) has been brought up to cover several river basins as a package but only for the protection of core areas. To make arrangements for the Sector Loan, a feasibility study has to be carried out for the selected core area in the each river basin. In line with the above idea, the DPWH has decided to conduct by itself feasibility studies for the 12 river basins belonging to the group financed with local funds.

However, it is required that a conduct or review on the feasibility study has to be executed earlier for the initial implementation of candidate projects for the sector loan. In this connection, a feasibility study for three (3) candidate river basins except the 12 river basins mentioned above is one of the objectives of the Preparatory Study on Sector Loan for Disaster Risk Management conducted by DPWH with New JICA's assistance.

1.2 Objectives of the Study

1.2.1 Objectives of the Sector Loan Project on Disaster Risk Management

The objectives of the sector loan project are to strengthen the capability of Philippine Government agencies concerned in disaster risk management and mitigate flood damage in vulnerable areas through the following:

(1) The implementation of structural and non-structural measures for the improvement of rivers in selected high-risk flood damage areas. Such rivers have been selected as a result of the "Study on the Nationwide Flood Risk Assessment and the Flood Mitigation Plan for the Selected Areas in the Republic of the Philippines."

(2) The improvement of disaster risk management systems, including management of the emergency response fund for flood control.

1.2.2 Objectives of the Preparatory Study

The objective of the Preparatory Study is to prepare the basic materials necessary to implement the projects, including the following:

(1) To select three (3) objective river basins and core areas which really need urgent implementation of a flood control project;

(2) To conduct feasibility studies for the selected core areas in the three (3) river basins;

(3) To arrange the materials for preparation of the Implementation Program (I/P) in connection with the application for a Sector Loan; and

(4) To confirm and recommend, if necessary, the current institutional arrangement to manage the sector loan.

1.3 Composition of the Final Report

The Final Report is to be submitted as the final product of "The Preparatory Study on the Sector Loan for Disaster Risk Management in the Republic of the Philippines" containing the objectives listed above.

In this connection, the Final Report consists of the following six (6) volumes:

Table R 1.1 Composition of the Final Report

Volume No.	Title	Contents
-	Summary	Summary of the results of the entire study
Part I	Main Report	The results of the entire study and the framework and implementing strategy, manner, cooperative agreement and procedure of the Sector Loan.
Part II-A	Feasibility Study on the Lower Cagayan River Flood Control Project for the Sector Loan Application	Results of the review on the Feasibility Study conducted in 2002 and the Structural and Non-structural Measures for the Project Proposed for Sector Loan.
Part II-B	Feasibility Study on the Ilog-Hilabangan River Flood Control Project for the Sector Loan Application	Review of the Master Plan of 1990 and the results of Feasibility Study on the Project Proposed for Sector Loan
Part II-C	Feasibility Study on the Tagoloan River Flood Control Project for the Sector Loan Application	Review of the Master Plan of 1982 and the results of Feasibility Study on the Project Proposed for Sector Loan.
-	Needs Assessment Study on Flood Disasters Caused by Typhoons No.16 (ONDOY) and No.17 (PEPENG)	

As shown above, Volume No. Part II-A presents the result of the Feasibility Study on the Lower Cagayan River Flood Control Project, which will be used for the Sector Loan Application. The result indicates that the construction of revetment works along the critically eroded bank to protect three (3) areas or locations from scouring and erosion is proposed as structural measure for this Sub-Project under the Sector Loan.

CHAPTER 2 NATURAL CONDITION OF THE STUDY AREA

2.1 Location

The Cagayan River Basin, where the largest river in the Philippines is located, has the catchment area of 27,281 km^2 and the river length of 520 km. The river basin is situated in the northeastern part of Luzon Island, bounded by mountain ranges - the Sierra Madre to the East, the Cordillera Central to the West and the Caraballo-Maparang to the South. It faces the Babuyan Channel to the North.

2.1.1 Topography and Geology

The Cagayan River Basin has many sloped areas, with 6,600 km^2 having the slope of less than 8%, 3,400 km^2 between 8% to 18%, and 17,300 km^2 over 18%. The major tributaries are the Magat, Ilagan, Siffu-Mallig, Tuguegarao and Chico rivers. These tributaries flow down the eastern, western and southern slopes of the basin before joining the main course of the Cagayan River. The Main Cagayan River runs from south to north in the flat alluvial plain and finally empties into the Babuyan Channel.

(1) Utilization of Results of Topographic Survey Works in the 2002 F/S

In the 2002 F/S, the following three types of survey works were carried out and the results were used as the basic information in the F/S conducted in this JICA Preparatory Study on Sector Loan for Disaster Risk Management:

Table R 2.1 Summary of Topo-Survey Works conducted in the 2002 F/S

No.	Work Items	Work Period
1	River Profile and Cross Section Survey	From March 31 to June 20, 2000
2	Aerial Photography	From March 31 to June 20, 2000
3	Topographic Mapping	From August 16 to November 30, 2000

(2) Outline of Newly Conducted Survey Works

In the JICA Preparatory Study F/S, the following supplemental surveys were carried out to obtain updated river data around the targeted areas:

Table R 2.2 Summary of Survey Works Newly Conducted in the JICA Preparatory Study F/S

No.	Work Items	Work Contents
1	River Profile and Cross Section Survey	Cagayan River (71 cross sections): 20km
		Tuguegarao River (13 cross sections): 6km
2	Aerial Photography	Area: 192km^2, (12km (E-W), 16km (N-S))

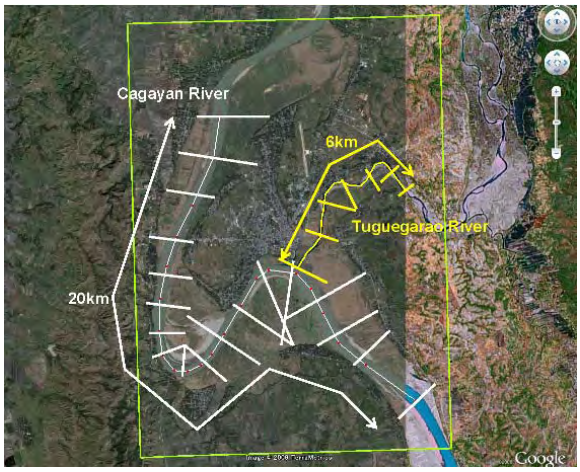


Figure R 2.1 Location of Cross Section Survey

2.1.2 Geology

Rocks of the Cagayan River Basin consist of the metamorphic and plutonic rocks of Pre-Tertiary age, which have been uplifted by igneous intrusions during the Late Tertiary and Quaternary. The Oligocene section consists of basic lava flows, metamorphosed conglomerate, tuff breccia, and tuffaceous sandstone and siltstone. There occurred many earthquakes to the west in northern Luzon, but relatively few in the Cagayan River Basin located in the east of northern Luzon. The Baguio earthquake in July 1990 was the biggest among those recorded in the past and the magnitude was 7.8 on the Richter scale. The earthquake caused the collapse of slopes in the southwestern area of the Cagayan River Basin leading to large increases in sediment yield/load in the Magat River Basin.

In the 2002 F/S, in order to clarify the foundation bed condition in Tuguegarao where the flood control measures are reconsidered as one of the sub-projects in the Sector Loan, three core borings of 20 m in depth each have been carried out. In the bore holes, standard penetration tests and field permeability tests were carried out and undisturbed samples were taken for the laboratory soil test. In addition, to locate the candidate borrow pits for the levee embankment material, five (5) test pits of 3 m in depth were excavated in Tuguegarao and Cabagan where the embankment levees are prospective, to clarify the subsurface condition and to examine the availability of earth material for the levee embankment. From each test pit, samples were taken for the laboratory soil test.

(1) Properties of Foundation Bed in Tugegarao

The geology in and around Tuguegarao consists of the clayey soil in the hilly area and the sand and sand/gravel in the alluvial plain. The sand/gravel is distributed along the Tuguegarao River and the right bank of the Cagayan River at the vicinity of the confluence with the Tuguegarao River.

Three core borings of 20 m in depth each were carried out at the locations shown on Figure 2.1. The boring logs are shown on Figure 2.2.

At Bore Hole TBH-1, the sandy clay layer is distributed from the ground surface to 1.5 m in depth, the sand and gravel layer with some cobbles from 1.5 m to 8 m, and the sand layer from 8 m to 20 m (the hole bottom). At Bore Hole TBH-2, the silty clay layer is distributed from the ground surface to 20 m in depth (the hole bottom) and the silty sand and gravel layer with cobbles and boulders is intercalated from 0.6 m in depth to 1.7 m.

At Bore Hole TBH-3, the silty clay layer is distributed from the ground surface to 2 m in depth and the fine sand layer from 2 m to 20 m (the hole bottom).

The N-values of the sand layer ranges from 9 to 29, most of them have more than 15 and there is no problem for the foundation of the levee embankment as shown on Table 2.1. Depending on the load intensity, however, foundation piles or some special foundation structures will be required for the concrete structures. N-values of the clay range mainly from 11 to 22 and judged to be the stiff base. The clay layer also is judged to be sufficient to support the levee embankment, but foundation piles or some special foundation structures may be required for heavy structures depending on the load intensity.

The permeability coefficients of the sand and sand/gravel layers range from 10^{-3} to 10^{-4} cm/sec as shown on Table 2.2 and is judged to be reasonable. Generally, no seepage measure will be required for the foundation. Those of the clay layer range from 10^{-3} to 10^{-5} cm/sec and are judged to be too high since a considerable number of them are on the order of 10^{-3} cm/sec. This is judged to have been caused by lack of water-tightness between the casing pipe and the original ground. Generally, no seepage measure will be required for the foundation.

The laboratory soil test results are shown in Table 2.3. The index property test result is judged to be reasonable. With regard to the tri-axial compression test result of the consolidated-undrained, however, the cohesions are judged to be too high. For the design values of the design in the feasibility study stage, the following values are recommended.

Table R 2.3 Recommended Values of Foundation Soil in the Preliminary Design F/S

Condition	Cohesion	Internal friction degree
Uncosolidated-undrained	80 kPa	5 degrees
Consolidated-undrained	10 kPa	27 degrees

(2) Properties of Embankment Material in Tuguegarao

Six (6) test pits of 3 m in depth each were excavated at the locations indicated in Figure 2.3. The logs of the test pits are shown on Figure 2.4.

In all test pits except Test Pit TP-T2, the clay layer, which is suitable for levee embankment, is distributed. Among them, the material at TP-T4 is the best since it contains sand and gravel. The soil distributed around TP-T2 also is judged to be usable for the levee embankment, but will require some erosion measure since it is classified under the non-plastic silt which is vulnerable to erosion.

The laboratory test results are shown in Table 2.4. The test results, except the tri-axial compression test under the unconsolidated-undrained condition, is judged to be acceptable since most of the cohesion and some of the internal friction angles are judged to be too high based on previous experiences. For the design parameters, the following values were recommended.

Table R 2.4 Recommended Design Parameters of Embankment Material in the F/S

Condition	Cohesion	Internal friction degree
Uncosolidated-undrained	Each Test Values	
Consolidated-undrained	10 kPa	25 degrees

Abundant fine sand is distributed everywhere along the river. This sand is recommended to be used inside the levee embankment, or as backfill material, to save on the utilization of expensive clay materials because of the longer distance of transportation for the higher levee embankment. The minimum width of the clayey material is recommended to be 5 m on the river side and 3 m on the land side.

(3) Material Sources for Aggregate and Boulder

The material source map for concrete aggregates and boulders prepared by the DPWH Region 2 Office are indicated together with the available quantity in Figure 2.5. Some of them have already been consumed, but according to the site reconnaissance, it appears that the materials are being supplied by the floods every year so that there is an abundant supply at present.

2.2 Meteo-Hydrology and River System of Cagayan River Basin

2.2.1 Meteorology of the Cagayan River Basin

(1) Climatologic Features and Storm/Rainfall

The climate in the Cagayan River Basin consists of two tropical monsoons, i.e., the Southwest Monsoon and the Northeast Monsoon. According to the climate classification by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), climate in the Cagayan River Basin falls under Type III. This climate type is characterized as not having very pronounced seasons with relatively dry weather condition from November to April, while the remaining part of the year is noted as wet weather.

Major storms that have struck the Cagayan River Basin have resulted from typhoons and monsoon in the area. The typhoons normally strike during July to December, with about 8 times a year on the average.

A primal portion of annual rainfall is, however, ascribed to the southwest monsoon. This monsoon is caused by thermal variations of the Asiatic mainland, and accompanies humid air mass to the Cagayan River Basin.

Seasonal extreme climate variability in the Philippines, including the Cagayan River Basin, is associated with the El Niño phenomenon. The most recent strong El Niño phenomenon was observed in 2006-2007, according to PAGASA. In the past, El Niño occurred in 1972-73, 1976-77, 1982-83, 1986-87, 1991-94 and 1997-98, according to the National Oceanic and Atmospheric Administration (NOAA) of the USA. As the records indicate, El Niño occurs almost every three years, while the duration varies. As experienced in the past El Niño-related drought events, these adverse impacts will collectively cause a certain extent of disruption in the socio-economic well-being of the country.

(2) Temperature

Air temperature in the Cagayan River Basin is relatively low in the country due to its location at high latitudes. The hottest month is May or June, while the coldest month is January.

The monthly mean air temperature ranges from 23.1°C in January to 29.0°C in May, and the annual mean air temperature is 26.4°C at Tuguegarao, as shown in Table 2.5.

(3) Relative Humidity

High relative humidity is observed in the basin ranging between 70% and 90%. At Tuguegarao, the monthly mean relative humidity varies from 69% in April/May to 82% in November/December, and the annual mean relative humidity is 76%, as shown in Table 2.5.

(4) Evaporation

Daily evaporation in the basin is measured by the A-pan. Maximum evaporation is recorded in April and minimum is in December. The annual mean daily evaporation was recorded between 3.5 mm at Bontoc (EL. 855 m) and 5.9 mm at Alimanao (EL. 30 m), as shown in Table 2.5.

(5) Wind

Prevailing wind direction is South in May to September and North in October to April. Wind speed is about 10 km/hour at Aparri, 8 km/hour at Iguig and 6 km/hour at Tuguegarao throughout the year, as shown in Table 2.5.

(6) Sunshine Duration

Annual mean daily sunshine duration is 5-6 hours in the basin. The longest duration is shown in April/May and the shortest in December. Daily sunshine duration ranges from 3.1 hours in December to 7.8 hours in April at Tuguegarao, as shown in Table 2.5.

(7) Atmospheric Pressure

Monthly mean atmospheric pressure is relatively high in the dry season and low in the rainy season. At Iguig, the monthly mean atmospheric pressure varies from 1,008 hpa in August to 1,018 hpa in February, as shown in Table 2.5.

2.2.2 River System in Cagayan River Basin

The feather-shaped Cagayan river basin, with its drainage area of 27,281 km^2, is bounded by the Sierra Madre Mountains to the East, the Cordillera Mountains to the West and the Caraballo Mountains to the South, as presented in the Location Map. The annual average rainfall in the basin is estimated to be 2,600 mm. The Cagayan River travels some 520 km in the Cagayan Valley from South to North in the northern part of the Luzon Island. Since the Cagayan River takes a route closer to the Sierra Madre Mountains, the right tributaries are generally of steep slope and small scale.

The major tributaries are the Magat River (5,113 km^2), Ilagan River (3,132 km^2), Siffu-Mallig River (2,015 km^2), and Chico River (4,551 km^2). The river bed slope is 1/8,680 between the river mouth and Tuguegarao in the main river. Average runoff estimated for their basins in the Study are summarized as follows:

Table R 2.5 Summary of River System in the Cagayan River Basin

Tributary	Catchment (km^2)	Annual Average Runoff (m^3/s)
Upper Cagayan River	6,633	291.6
Magat River	5,113	262.6
Ilagan River	3,132	143.9
Siffu-Mallig River	2,015	85.8
Chico River	4,551	251.4
Whole Basin	27,281	1,343.2

The Main Cagayan originates in the Caraballo mountain range. Passing through the mountainous areas towards North-Northeast, it joins the largest tributary, the Magat on the left bank and the right tributary, Ilagan, in succession. The total basin area of the Cagayan at the confluence with Ilagan is around 15,100 km^2. Magat Dam is located in the gorge of the Upper Magat, having two functions namely, irrigation water supply and hydroelectric power generation.

Just downstream of the confluence with the Ilagan River, the Cagayan River changes its direction towards North-Northwest, flows down through the alluvial plain confined by natural levees, terraces, etc., and reaches Alcala. The Cagayan river channel in this reach especially from Tuguegarao to Alcala meanders violently. The major tributaries in this reach are the Siffu-Mallig in the left bank and Tumauini, Tuguegarao and Pared in the right bank. The total basin area at Alcala is around 21,400 km^2.

From Alcala to Magapit, the Cagayan River runs further in North-Northwest direction passing through the valley area in around 30km long gorge called the Magapit Narrows. Particularly, there exist three bottlenecks, at Tupang, Nassiping and Magapit.

In the reach of the Magapit Narrows, the Cagayan River joins its second largest tributary, the Chico on the left bank, and minor tributaries, the Zinundungan on the left bank and the Dummon on the right bank. The total basin area of the Cagayan at Magapit is around 27,100 km^2. After passing through the Magapit Narrows, the Cagayan flows through the flat area changing its direction towards the north, and finally discharges into the Babuyan Channel at Aparri having the total basin area of 27,281 km^2.

2.2.3 General Features of Present River Channel

In the 2002 F/S, based on the longitudinal profile, river widths, channel depths and estimated channel carrying capacities of the Cagayan river channel calculated using the river cross-sections surveyed in the year 2000, the channel features of the Cagayan River were summarized as below.

Average Riverbed Slope

- River mouth to Magapit Bridge: 1/21,000
- Magapit Bridge to Alcala: 1/10,000
- Alcala to Confluence with the Tuguegarao River: 1/9,000
- Tuguegarao River to Cabagan: 1/7,000

Low Water Channel Width

- River mouth to Magapit Bridge: 400 to 2,000 m
- Magapit Bridge to Alcala: 300 to 1,400 m
- Alcala to Tuguegarao: 300 to 1,100 m
- Upstream of Tuguegarao: 300 to 1,000 m

Mean Depth of Low Water Channel

- River mouth to Magapit Bridge: 3 to 12 m

- Magapit Bridge to Alcala: 5 to 20 m
- Alcala to Cabagan: 3 to 15 m

Bankful Carrying Capacity of Low Water Channel

- River mouth to Magapit Bridge: 9,000 to 25,000 m^3/s
- Magapit Bridge to Alcala: 4,000 to 20,000 m^3/s
- Alcala to Cabagan: 2,000 to 9,000 m^3/s

2.2.4 River Morphology

(1) Alluvial Plain formed by Cagayan River

(a) General

A river geomorphologic study was made based on satellite image, aerial photographs, topographic maps, and site reconnaissance. Since rivers have individual characteristics based on the unique natural condition, the Cagayan River also has peculiar characteristics resulting from its prehistoric background through repeated upheavals and lowering ground movement. Notable geomorphologic features of the Cagayan River are the existence of bottlenecks (constricted sections) in the Magapit Narrows stretching 30 km long and river meanders forming in the upstream reaches especially from Alcala to around Tuguegarao.

(b) Characteristics of Alluvial Plain formed by Cagayan River

The geomorphologic survey map of the Cagayan River Basin showing the classification of the flood prone area has been studied in the 2002 F/S. The geomorphologic classifications of the Cagayan River Basin are shown in the following table.

Table R 2.6 Classification of Geomorphologic Features in the Cagayan River Basin

Classification in Geomorphologic Map	Remarks
Mountain, hill and terrace	
Alluvial plain formed by the Cagayan River	- Higher alluvial plain - Lower alluvial plain
Valley plain formed by tributaries	
Steep slope, cliff	
Water surface	

The lower alluvial plain consists of natural levees, back swamps, former river courses, valley plain, etc. The floodwater is principally discharged through the low water channel and the floodplain is limited by natural levees. Further, the inundation area due to floodwaters overflowing from the Cagayan River is confined within the limits of the lower alluvial plain. As the water level in the Cagayan River subsides, the stagnated waters naturally flow back into the main channel. On some natural levees with higher ground elevations, residential areas have been created. Small and low natural levees are occasionally submerged. Likewise the valley plain itself is subject to frequent inundations by the Main Cagayan River.

Ground elevations of the higher alluvial plain are sufficiently higher than flood water levels in the main channel. Therefore, lands on the higher alluvial plain have been developed into village areas, as well as irrigated and rain-fed paddy fields.

(2) Variations of River Channel

Variations of the river channel have been studied from the plan geometric, and longitudinal and cross-sectional viewpoints based on the topographic map, aerial photograph and surveyed cross-section viewpoints as follows.

(a) River Course Shifting

Figure 2.6 shows the historical river course shifting of the Cagayan River studied by using the available topographic maps and aerial photographs. Based on the available data, the following can be said.

Active shifting resulted from river meander is caused by fairly gentle water surface slope due to backwater at the bottlenecks in the Magapit Narrows. Upstream and downstream of Iguig, the extent of shifting reached 5 km in only the past 50 years. Such shifting is generally caused not gradually over the years but suddenly or accidentally in flood time. Except in the above reaches, there was no significant shifting.

(b) Variations of Longitudinal and Cross-Sectional Profiles

Longitudinal and cross-sectional variations of the main Cagayan River channel utilizing available river cross-sections were studied from the available sets of data.

According to longitudinal profile, the general tendency of the longitudinal riverbed elevations is as follows:

(i) River mouth to Magapit Bridge: No significant change

(ii) Magapit Bridge to Alcala: Slightly raised

(iii) Alcala to Confluence with the Tuguegarao River: Slightly raised

(iv) Confluence with the Tuguegarao River to Cabagan: No significant change

From the above, it can be said that the longitudinal riverbed variation is, as a whole, in equilibrium condition.

(3) River Meander

To meander is to move aimlessly and idly without a fixed direction. Therefore, it is very difficult to control river meander. It is a challenging matter in flood control, as well as civil engineering.

(a) Meandering Rate

In this study, the meandering rate that indicates sinuosity (S) applied by Kouichi Yamamoto (1988: Kado Tokuseiron, Public Works Hydraulic Research Paper Vol. 2662) was used as an index classifying the degree of river meander.

For the reach from Alcala to Upstream of Tuguegarao, the meandering rate (S) = actual channel length (km) / straight-line length (km) was checked for four (4) stages from the year 1950 to 2000 as shown in Figure 2.7. High value (S) above 1 means meander, and (S) = 1 means straight river channel.

According to the above figure, (S) has gradually decreased from 2.12 calculated on the maps prepared in 1950 to 1.81 on the aerial photographs taken in 2000.

The degree of meandering of the river course in the Cagayan has thus changed to a straighter river although it is based on a short period of the recent 50 years as described above. For this matter, it could be assumed that upheaval of the Central Mountains is one of the major reasons for the decreased meandering rate and such a tendency may continue in the future. Eventually, the river course in this reach is assumed to move and concentrate eventually towards the present right riverbank line having solid foundation.

(b) Other Studies on River Meandering

Some studies on river meandering have been made. According to such study results, it can be said that a meandering river is theoretically improved by the increase of surface water slope in the meandering reach. The surface water slope is actually increased by the construction of floodway or cut-off channel and by widening of the low water channel.

2.3 Flood

2.3.1 River Overflow Flood

In the Cagayan River Basin, typhoons usually strike during July to December, about 8 times a year on the average. Floods occur during these typhoons which bring abundant rainfall to the basin. Major typhoons that have brought floods to the basin include Typhoons Loleng in October 1998, Rosing in November 1995 and Pepeng in October 2009.

Since the discharge capacity of the Cagayan River is very small, flooding has frequently occurred and people residing along the river have suffered from flood damage. In particular, the major flood disasters occurred in 1973, 1980 and 1998 (refer to Figure 5.16). Typhoons Openg, Aling and Iliang brought these flood disasters, with the flooded areas covering about 1,860 km^2, 1,740 km^2 and 620 km^2, respectively. The 1973 flood, the recorded biggest flood, is estimated to be equivalent to about the 25-year probable flood. The average annual flood damage in the area between Tuguegarao and the river mouth of the Cagayan River is estimated at about 3.6 billion pesos which is equivalent to about 6.6% of the GRDP of Region 2.

2.3.2 Bank Erosion and Sedimentation

Bank erosion has been observed in various places basin-wide and is one of the serious flood control problems involving the Cagayan River Basin. Several sites are being exposed to destructive damage. Based on the inventory surveys conducted by each district office and the Study Team in the 2002 F/S, 73 candidate sites were selected as indicated in Figure 2.8.

According to the 2002 F/S, the average annual bank erosion rate reaches 10 m in the downstream of Magapit Narrows as estimated at 5 serious bank erosion sites. Similarly, that of the upstream of Alcala erosion reaches 24 m per year as estimated at 4 sites. Annual erosion rates at the sites vary from 28 m to 6 m.

	
Scouring Section in Enrile	Scouring Section along Tuguegarao City

Figure R 2.2 Critically Eroded Bank Site around Tuguegarao City

CHAPTER 3 SOCIO-ECONOMIC CONDITIONS

3.1 Population and Economy

Two periods, i.e., 1990-1995 and 2000-2007, are studied to qualify the demographic structure of the Cagayan River Basin Area. For instance, the growth rate of population in Tuguegarao City is 2.51% during the period 1990-95 (CLUP.1998, Framework Plan 1993-2022). However, this rate of population growth accelerated towards 7%, beginning 2000 (**Figure R3.1** and **Table R3.1**). This trend is consistent with the population data of the Province of Cagayan growing at the rate of 7%, as the entire Region I is likewise growing at the rate 8.47%. At this point, the population density of Tuguegarao City is 11,136 per sq.km.

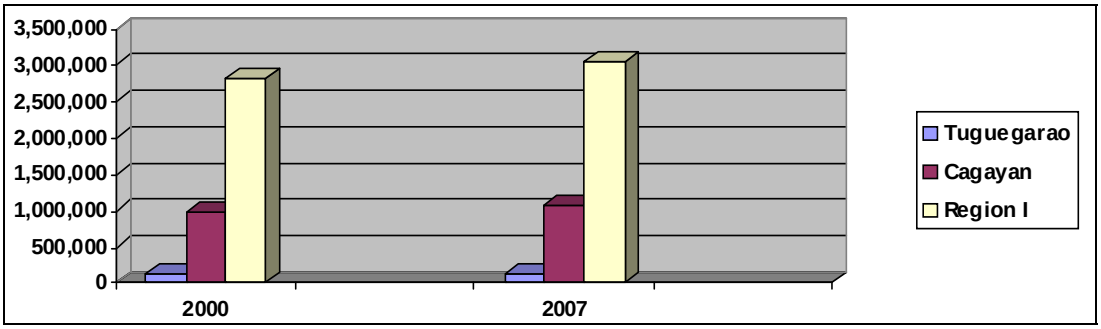


Figure R 3.1 Population Growth Rates (Cagayan River Basin, 2000-2007)

Table R 3.1 Population Data (2000-2007)

Area	2000	2007
Tuguegarao City	120,645	129,539
Cagayan Province	993,580	1,072,571
Region I	2,813,159	3,051,487

This level is already at the threshold of high rate of urbanization similar to Pateros of Metro-Manila. At this scale of population density, the urbanization problems in Pateros became evident and manifested by persistent flooding, urban congestions, poverty, heavy traffic, urban decadence and so forth. The inflection years of 1970-2000 in Pateros saw the acceleration of population growth rate up to 86% in 1970 leveling to 31% by 1990 and back to 8% at the start of the year 2000. After almost 10 years in 2009, the conditions of urban crisis began to set in.

This entire regime in Pateros is already beginning to set in at Tuguegarao City. Incalculable damages and costs are imminent if interventions like Flood Control are not provided at this particular stage.

These changing parameters of economic demography in the Cagayan River Basin Area is triggered by economic acceleration due to the enhanced international link of the region through the Cagayan Economic Zone established in the Sta. Ana area at the Northernmost part of the Province of Cagayan. This is also expected to increase farther as soon as the International Airport Project at the Municipality of Lal-lo (formerly known as Nueva Segovia during the Spanish colonization period) is completed. The investors, experts, and other human resources involved in these economic activities have Tuguegarao City as their favorite destination for rest and recreation after their work.

Acceleration of population is expected to increase farther as the industrialization and urbanization of the entire Cagayan River Basin takes place in the future. At this point in time, however,

acceleration in population is due to in-migration triggered by increased economic activities in the area. It has nothing to do with fertility rate, as the level is very low at 2% (CLUP, Tuguegarao City. 1998).

Before the acceleration of the population of the Cagayan River Basin, the growth rate during the previous period of 1990-1995 was only 1.52%. As such, there were very few opportunities in the region such that there was out-migration at the level of 0.8% (CLUP. Tuguegarao City. 1998).

However, due to recent increase in economic activities the out-migration trend shifted towards in-migration. While the fertility rate in the area was only 1.52%, the population growth rate accelerated to 7%.

Thus, rapid urbanization set in and farther acceleration is expected as the current economic development takes place in the province. Tuguegarao City has now become the city of "overnight" traders and travelers. This trend, which began in 2000 changed into a dimension of rapid urbanization with Tuguegarao City gravitating as the main city center of the area. For instance, the Wholesale-Retail Businesses in Tuguegarao City had grown into commercial establishments recorded at its highest of 4,508 units and the Education Sector contained a total of 115 Education Establishments. The One-stop Shop of Provincial Government Functionaries established in the Tuguegarao City Center also farther enhanced this. There were studies done indicating that high growth rates of urbanization had set in as early as 2000, as proven by the data presented in this study.

From the 1998 CLUP of Tuguegarao City, the population of Tuguegarao is expected to double by the year 2022 based from the current growth rate in population. However, this projection could be shortened by 5 years due to the onset of high phase of industrialization and urbanization in the Province where Tuguegarao City is the center such that by 2015, urbanization problems are expected to grow at alarming levels.

3.2 Land Use Profiles

At present, agriculture is still the dominant sector in Tuguegarao utilizing a total of 73% (113.95 sq.km.) of its land resources. This is followed by the Residential Sector comprising a total of 21% of the entire area, 1% Commercial Sector, 0.4% Industrial and 2% Institutional like Schools and Universities, Government Facilities and so forth. The sectoral distribution is shown in **Table R3.2** and **Figure R3.2**.

Table R 3.2 Sectoral Distribution (Tuguegarao City)

Economic Sector	Percentage Distribution of Land Resource
1. Agriculture	73.0
2. Residential	21.0
3. Commercial	1.0
4. Industrial	0.4
5. Institutional and Others	4.6
Total	**100.0**

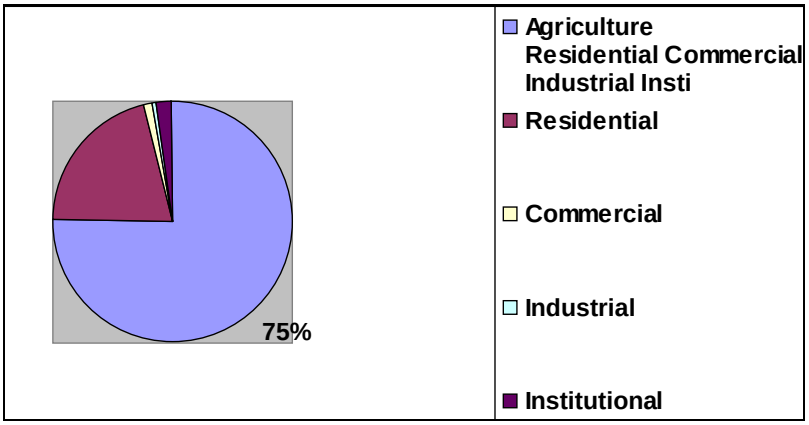


Figure R 3.2 Percentage of Land Distribution

One indicator on the extent of utilization of the land resources is the total dwelling units constructed by each economic sector in the area. For instance, the Residential Sector had a total of 22,311 dwelling units, the Wholesale and Retail has 4,508 units, 23 for Hotels, 6 Real Estate Offices, 115 Educational Institutions, 65 Health and Health Related Centers, 7 Agriculture and so forth.

The following visualization of the Land Use Patterns in the vicinity of Tuguegarao City is shown in **Figure 3.1**

A more detailed representation of the agricultural sector in terms of production is shown in **Table R3.3**.

Table R 3.3 Crop Production, Cagayan Agricultural Sector (Ref. Year: 2008)

Crop	Harvested (Hectare)	Production (Metric Ton)
Irrigated Palay	142,846	570,332
Rainfed Palay	57,249	136,840
Corn	82,428	297,984
Abaca	-	-
Banana	4,805	75,704.59
Cabbage	43	424.61
Calamansi	502	4,546.45
Camote	590	2,944.12
Cassava	983	7,001.72
Coconut	6,564	34,290.28
Coffee	235	54.94
Eggplant	883	7,929.96
Garlic	16	43.36
Mango	1,973	5,459.10
Mongo	1,595	619.07
Onion	10	42.50
Peanut	1,634	1,811.41
Pineapple	-	10,100.17
Rubber	-	-
Sugarcane	-	202,534.95
Tobacco	-	2,226.47
Tomato	-	584.71

The above table shows that the primary crop produced in the Province of Cagayan is Rice (570,332 MT), followed by Corn (297,984 MT) and Sugar Cane (202,534.95 MT) respectively.

3.3 General Economic Profile

The rate of growth in Gross Regional Domestic Product (GRDP) is only 2% (Year 2007 = 27,153,695 and Year 2008 = 27,684,066). This level is within the purview of the acceleration of the National Economy at less than 2%. This data meant that the growth rate pattern in the Cagayan River Basin is dependent upon the mainstream National Economy. This implies that there is still the vertical integration between the local economy and the national mainstream. What is needed in this particular regard is an effort towards the diversification of the local economy.

The current general slowing down of the national economy is effected by the downturn of the global economic system ever since the bankruptcy of the Leman Brothers of the USA in September of 2008. What is needed is to develop local economic capability such that a level is reached that the local economy is no longer primarily dependent upon the National Economy. The general economic profile of the Cagayan River Basin area is shown in **Table R3.4**.

Table R 3.4 General Economic Profile (Cagayan River Basin Area. 2009)

Year	Value
GRDP	
2008	27,684,066
2007	27,153,695
Family Income	
2006	143
2003	126
2000	108

The stability of the local economic system cannot be assured considering the onslaught of Climate Change. However, if the disaster risk is managed at acceptable levels, there could be a certain amount of local stability that is reached in the process. This underscores the importance of the present study.

At this stage, however, the land resource utilization of the industrial sector is only at 0.4%. And, as the biggest sector is still Agriculture at 73% of land use, the value added component of the local economy is largely still unstable. However, as the Cagayan Economic Zone and the International Airport at Lal-lo becomes fully operational, it already depends on the Local Economic Managers on how to infuse strategic intervention for growth accelerations at highest levels like Vietnam and China. This early however, the 7% rate of growth in population will only lead to more socio-economic misery as the rate of growth in the Regional Economy is only 2% as well. In reality, the national average of mal-distribution of national income leads to chronic levels of poverty (45%. NEDA, 2008). What is urgently needed therefore is to infuse more levels of private and public investments into the mainstream of the local economy.

3.4 Water Use

Water in the Cagayan River basin is used mainly for irrigation and municipal water supply. Water to run the turbines for the Magat dam is not categorized as water use *per se* as the real use is for irrigation.

Irrigation systems have tapped surface water through a storage dam such as the Magat, as well as diversion weirs and pumps while municipal for municipal and industrial use have tapped mainly groundwater by means of wells.

The NIA is the biggest water user in the area through its national irrigation systems, followed by communal irrigation systems and pump irrigation systems, which are also either owned or operated by the NIA or by private irrigation cooperatives.

National irrigation systems have a total aggregate area of 94,300 ha for the wet season and 85,200 ha for the dry season while communal/pump irrigation systems have a total of 58,300 ha as reported in the “Master Plan Study on the Cagayan River Basin Water Resources Development-1987”. This hectarage has not changed, as the NIA has not expanded its service area since the completion of the master plan.

For the municipal waterworks, the performance of the water and sanitation sub-sector has continuously improved through the introduction of programs primarily aimed at improving the delivery of potable, safe and clean water, and gradually institutionalizing sanitary practices. While access to safe water has improved by 1.71 percent in CY 2003, the fact remains that more and more households (an average increase of 3.16 percent per annum in the number of households or 18,060 households by 2010) would not be able to have access to safe water without the proper and timely investments by both the national government and the local government units.

In order to adequately address this problem, there is a need for the core area to provide proper and timely investments for waterworks projects.

3.5 Public Hazards

3.5.1 Human-Induced Hazards

Efforts along the protection and advancement of vulnerable groups had steadily made ground with the declining trends in the number of children in need of special protection and children placed under alternative parent care, the number of youth offenders and in the number of PWDs seeking government assistance. The region and its local government units should continue giving priority to the creation of child-friendly societies and the participation of the youth in charting their future to sustain the gains made for the past three years. As for the state of women in the region, the number of reported cases of women in especially difficult circumstances doubled from 166 in 2002 to 258 in 2003. This means that more women who are physically abused, maltreated or battered are coming out into the open to disclose abuses. However, the fact that the reported number of cases had doubled in just a year is a cause for alarm. More troubling, is how many cases still remain. Of the 258 women in especially difficult circumstances, 94 percent are battered, maltreated or abused, and the remaining 6 percent are victims of rape and incest.

The region has to look for ways by which the various advocacy campaigns on programs and services for women such as counseling, the full operationalization of the Protection Services and Crisis Intervention Units, among others would reach the remotest areas of the Region 2 so that a greater number of women would know and fight for their rights. Likewise, the region should see to the completion and full operationalization of the Regional Haven for Women to give sanctuary to those women who have been abused or maltreated and help them overcome the physical and emotional trauma.

Thus, the challenges that the sector faces are:

- Sustain the gains made for the past three years;
- Continue giving priority to the creation of child-friendly; societies and youth participation;
- Provide greater coverage of advocacy campaigns; and
- Complete and fully operationalize the Regional Haven for Women.

3.5.2 Natural Hazards

Earthquakes and floods are the most common natural hazards in the area. Among the visual manifestations of flood is riverbank erosion where it is observed in various places of the main Cagayan River and its tributaries. There exist some bank protection works to protect residential areas, trunk roads, etc., although protected areas are extremely limited. Only bank protection works by spur dike and revetment are major existing flood control works.

Several sites are being exposed to possible destructive damage. Such districts as Cabagan, Namabbalan, Bagumbayan, Cataggaman, Enrille, San Vicente near Iguig, Babuyan etc., are in critical condition. Bank erosion is one of the most serious flood control problems in the Cagayan river basin.

Another calamity brought by floods is damage from inundation. The Cagayan River has about 1,860 sq km of flood prone areas, which are presently used as production areas of rice, corn, legumes and vegetables. The area of 1,860 sq km was estimated from that brought about by the 1973 flood, which was the biggest one in the past. Recently, the flood brought about by Typhoon Pepeng in September 2009 has caused untold damages to the place, which is perhaps the biggest

in the recent history of the area although estimates of actual damages are still incomplete as of this time.

3.6 Past and On-going Public Works Projects

Major public works projects in the core area and its vicinity are as follows:

Table R 3.5 Major Public Works Projects in the Core Area and Its Vicinity

Project/Location	Description	Date	Status
Bridge/Jones, Isabela	6 span 350 m modular steel	Sep 11, 2008	Constructed
Bridge/Tumauini, Isabela	12 span 439 m with I-girder support	Aug 13, 2008	On-going as of date shown
Road Paving/Diadi, N. Vizcaya	4,800 sq m Bambang -San Luis section	Jun 07, 2008	Constructed
Dredging/Lamut River, Bagabag, N. Vizcaya	1.1 km stretch	Jul 30, 2008	90% finished as of Jul 14, 2008
Magapit Suspension Bridge/Lallo, Cagayan	Retrofitting of pony truss	Jul 25, 2008	On-going
Bridge/Cabagan, Isabela	21-span x 15m/span overflow type	May 2008	Constructed
6 bridges/barangays in the provinces of Quirino, Isabela, N. Vizcaya and Cagayan	Aggregate total of 1,2003		Various stages of construction.
Ferry services/Tuguegarao City	Ferry services for commuters in Cagayan due to collapse of bridge going in and out of Tuguegarao City.		Continuous ferry service until bridge is replaced.

CHAPTER 4 ANALYSIS ON FUTURE POPULATION AND LAND USE

4.1 Future Land Use Condition

The future land use of Tuguegarao City and its vicinity will still be predominantly agricultural and institutional (**Figure 4.1**), which are the key sectors occupying greater portions of the land resources in the area.

Table R4.1 shows the change of built-up area based on the CLUP of Tuguegarao.

Table R 4.1 Built-up Area

Name	Present (2009)	Future (2020)	Ratio
Tuguegarao	24.31 [1/]	38.83 [2/]	1.60

[1/] :*Computed by GIS based on satellite image*

[2/]:*Computed by GIS based on CLUP of Tuguegarao City*

Based from the said CLUP, the industrial area will increase from 0.30 sq.km to 0.89 sq. km. However, this tends to be overestimated. It is more reasonable to assume that an incremental value of 50% of the industrial area is in operation as shown in **Table R4.2**.

Table R 4.2 Projected Industrial Area Occupancy

Present			**Future**			**50%**	
Built-up Area (km2)	Industrial Area (km2)	Percentage	Built-up Area (km2)	Industrial Area (km2) [1/]	ratio	Effective I. A. (km2)	Ratio
24.31	0.30	1.23%	38.83	0.89	2.29%	0.60	1.53%

[1/] *Estimated from CLUP by GIS*

Notwithstanding the above explanations, even if the population must have doubled by the year 2020, the major industries will be concentrated outside the City Area, primarily in the Northeastern Part where the Cagayan Economic Zone is located. Moreover, the plan to put up the Modern Airport at Lal-lo Cagayan will definitely put Tuguegarao City on the side where tourism, rest/recreation industry, as well as financial, educational and commercial activities are currently expanding. This, however, is an advantage from the viewpoint of environmental management because the tremendous problems of industrial pollution and population expansions will be minimized in Tuguegarao City.

Most of the highly polluting industries will be located outside the City..As the Huge Centralized Treatment Plants and Settling Ponds to contain industrial pollution will be located somewhere else, the key economic activities in Tuguegarao must be protected specially in the areas of Green Tourism, Financial-Trade-Commercial Activities, as well as educational and government centers of transactions and operations.

The best model herewith could be similar to the relationship between Central District of Tokyo and the Industrial Center of Yokohama City. This is also somehow similar to the Central London District of Commerce, Trade and Tourism with the industrialization centers in the North like Manchester, Liverpool and so forth.

4.2 Population Projections (2010-2020)

The population trend in the province of Cagayan is shown in **Table R4.3**.

Table R 4.3 Projected Population by NSO [1/]

Year	Population	Ratio	Growth Rate
2000	998,600		
2005	1,087,200	8.87%	1.77%
2010	1,182,700	8.78%	1.76%
2015	1,283,200	8.50%	1.70%
2020	1,380,700	7.60%	1.52%
2025	1,473,200	6.70%	1.34%
2030	1,558,100	5.76%	1.15%
2035	1,633,600	4.85%	0.97%
2040	1,701,100	4.13%	0.83%

[1/] Source: NSO website

As shown above, there is a decreasing trend of population in the province from 1.8% in 2005 to 0.8 in 2040.

Results of actual census taken in 2000 and 2007 show that the growth rate for Cagayan Province is averaged at 1.1%, Tuguegarao City at 1.02% and the Municipality of Enrile at 0.32%. Details are shown in **Table R4.4**.

Table R 4.4 Population in Actual Census [1/]

Place	unit	2000	2007	Growth Rate
Cagayan	nos.	993,580	1,072,571	1.10%
Tugugarao	nos.	120,645	129,539	1.02%
Enrile	nos.	29,062	29,719	0.32%

[1/] *Source: NSO website*

In this study, it is assumed that above rate of population growth from 2000 to 2007 will continue until the target year 2020 for the future condition. The projected population based on the said assumption is shown in **Table R4.5**.

Table R 4.5 Projected Population under this Study

Place	2009	2010	2015	2020	Ratio (2009/2020)
Cagayan	1,096,272	1,108,318	1,170,565	1,236,307	1.13
Tuguegarao	132,199	133,549	140,509	147,833	1.12
Enrile	29,909	30,005	30,488	30,979	1.04

As listed above, the ratio of population is only 1.12 even though the ratio of built-up area is 1.60 as mentioned in Sector 4.1.

4.3 Trends of Urban Development and Population Increase

The framework of urbanization is usually characterized by demographic expansions associated with industrial and urban progression. For instance, the normal birth rate of 3% is normally without the capability to sustain rapid urbanization and industrialization such that high growth rates is primarily dependent upon in-migration of human resources from the redundant labor from the agricultural sector in the countryside.

Therefore, the current increase of population growth at 64% already indicates that the inflection period of rapid urbanization is already taking place in the Tuguegarao City Area.

Before the phenomenon of rapid urban growth propels at uncontrollable levels, the time is now to contain and tame the deleterious effects of this expansion to the natural habitat of the communities in the study area, like river systems, water resources and other critical natural resources, which are usually inundated by urbanization and industrialization.

Studies show that there is a tendency for economic expansion to wreak havoc on the natural habitat and cultural values of the communities directly affected by this rapid urbanization, commercialization and industrialization. This is the tall order for economic governance to tackle in order to calibrate development process within the process that will not impair natural ecology and cultural values of the host society.

CHAPTER 5 HYDROLOGIC AND HYDRAULIC ANALYSIS

5.1 General

5.1.1 Summary of Previous Flood Runoff Estimation

Calculations of probable flood discharges for the Cagayan River basin were done by JICA in the "Feasibility Study of the Flood Control Project for the Lower Cagayan River in the Republic of the Philippines" in February 2002. The process was done in three steps, i.e., rainfall analysis, establishment of river system model and flood runoff analysis. Flood runoff of the Master Plan Study in 1987 was adopted in the Feasibility Study as a result of review.

(1) Rainfall Analysis in Previous Study

For the rainfall analysis component, the Thiessen Polygon method was employed. Thiessen weights were derived for polygons that enclose rainfall stations where data are available. Rainfall stations located at Aparri, Tuao, Tugugarao, Naneng, Ilagan, Bontoc, Nayon, Echague, Consuelo and Dakgan were used in the analysis. After adjustment for basin mean elevation, the resulting probable rainfalls at various sub-basins in the Cagayan River basin (as extracted from Table 3.4.3 of the said Study) are shown in Table R 5.1**.**

Table R 5.1 Probable 4-Day Rainfall

Sub-basin	Rainfall (mm)					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Casecnan	133	209	277	360	440	520
Cagayan No. 2	122	200	270	360	420	505
Cagayan No. 1	116	184	247	330	400	470
Diduyon	127	201	268	360	430	520
Addalam (A)	102	156	201	271	333	405
Matuno No. 1	117	152	174	202	222	242
Alimit No. 1(A)	100	141	168	203	230	257
Magat	89	119	139	158	164	200
Ilagan No. 1	132	186	223	273	312	352
Disabungan	141	206	254	319	371	426
Siffu No. 1(A)	81	123	153	194	226	259
Mallig No. 2	90	141	180	234	277	324
Chico No. 2	131	190	237	303	359	421
Chico No. 4	110	160	195	240	275	311
Pinukpuk	104	155	191	238	275	312

A rainfall intensity–duration curve was derived to develop a model hyetograph shown in Figure 5.1.

(2) Establishment of River System Model in Previous Study

For the river system model, the basin subdivisions and river system used in the 1987 Master Plan Study were adopted. This consisted of nine base points, 50 sub-basins, 30 river channels and 15 damsites as shown in Figure 5.2.

(3) Flood Runoff Analysis in Previous Study

The 'Storage Function Model', a conceptual rainfall-runoff mathematical model, was used to analyze flood runoff, following the process flowchart shown in Figure 5.3.

Results of the analysis are shown in Table R 5.2.

Table R 5.2 Probable Flood Discharges

River/Location	Base Point	D.A.	Design Discharge, cum/s					
			2yr	5yr	10yr	25yr	50yr	100yr
Cagayan @ River mouth	BP-1	27,281	6,200	9,900	12,000	15,700	18,100	21,400
Cagayan @ junct. with Chico R.	BP-2	21,437	5,800	9,400	11,500	15,300	17,700	21,000
Cagayan @ junct. with Siffu R.	BP-3	15,334	6,100	10,300	12,900	17,700	20,900	25,300
Cagayan @ junct. with Ilagan R.	BP-4	11,993	5,400	9,300	11,600	16,200	19,300	23,500
Cagayan @ junct. with Magat R.	BP-5	6,633	3,300	5,900	7,200	10,100	12,500	14,700
Chico @ junct. with Cagayan R.	BP-6	4,551	2,000	3,000	3,800	5,200	7,500	8,700
Siffu @ junct. with Cagayan R.	BP-7	2,015	1,200	1,600	2,000	2,700	3,000	3,300
Ilagan @ junct. with Cagayan R.	BP-8	3,132	2,000	3,400	4,700	6,700	7,600	9,400
Magat @ junct. with Cagayan R.	BP-9	5,113	2,700	4,500	6,000	7,200	9,500	10,600

5.1.2 Approach for this Study

The hydrological results and other valuable information presented in the previous sub-section is used in the hydraulic analyses of the present study. This is decided after a careful consideration of the circumstances due to the difficulty of collecting additional rainfall data and obtaining accurate discharge data in such a huge catchment area, which could have been used in updating the studies.

The general considerations for discussion under this chapter are therefore outlined as follows:

Table R 5.3 Approach for Sector Loan Study

Item	MP / FS [1/]	This Study	Remarks
Report	FS by JICA in 2002		
Rainfall Data Period	1949-1999	Use of previous study result	
Rainfall Analysis	4-day rainfall, Thiessen method	Use of previous study result	
Runoff Analysis	Storage function method	Use of previous study result	
Flood Runoff	Review of M/P results and use it	Use of previous study result	
River Cross-section	250 or 500m interval surveyed in 2000	200 or 500m interval surveyed in 2009	Along city area : 200m
Initial Water Level	2.35m at the river mouth	Decided under present river channel condition	Design HWL is too high for this project.
Flood Analysis	One-dimensional non-uniform flow	One-dimensional unsteady flow	Vicinity of Tuguegarao City only
Grid Size	1km	100m	-

[1/] ***MP – Master Plan; FS – Feasibility Study***

For the hydraulic analyses, new mathematical modeling runs are conducted considering the physical changes on the alignment and cross-section of the Cagayan River channel particularly the 22km river reach in the vicinity of the Tuguegarao City core area. The hydraulic mathematical

modeling runs are performed using the HEC-RAS Model of the U.S. Hydrologic Engineering Center.

The initial modeling runs consist of determining the extent of inundation under different return periods or flood scales, which are presented and discussed towards the end of the chapter.

5.2 Hydrology

The probable flood discharges at different points along the Cagayan River and other rivers in the basin, as extracted from the said feasibility study mentioned above, were calculated. These are reviewed on the basis of their completeness and accuracy and are deemed adequate for purposes of the present undertaking.

Probable flood discharges of Cagayan River reckoned at the Tuguegarao City core area are shown in Table 5.1 and summarized below:

Table R 5.4 Probable Discharge in Cagayan River

Return Period	Flood Discharge (m3/s)	
	Cagayan River	Tuguegarao River
2-year	6,200	800
5-year	10,400	1,100
10-year	13,400	1,300
25-year	17,800	1,600
50-year	20,600	1,800
100-year	24,300	2,000

Figure 5.4 shows the flood hydrographs for 2, 5, 10, 25, 50 and 100-year return periods at the downstream of Cagayan and Tuguegarao river confluence, which are used for design.

5.3 Hydraulic Analysis

5.3.1 Target Area

The target area covers the vicinity of the Municipality of Enrile and the city of Tuguegarao particularly those located along the riverbanks and the immediate left and right-side flood plains.

5.3.2 River Cross-section Survey

The cross section geometry for the main river channel is obtained from actual field survey using GPS, Total Station, Transit Level and Echo Sounder survey instruments. The cross sections on the flood plains and/or 'dry' ground (similarly located as those taken from the actual field surveys) are derived from a triangular irregular network (TIN) of digital elevation database downloaded from the Shuttle Radar Topography Mission (SRTM). Such information is available from the website of "Global Land Cover Facility (GLCF)" which is accessed electronically through the Earth Science Data Interface (ESDI) of the said website.

5.3.3 Initial Boundary Condition

(1) Difficulties of determination of initial water level

Existing data of Cagayan river basin regarding water level under present river channel condition is as follows:

- Design high water level (25-yr return period, result of F/S study in 2002)

- River cross-section surveyed in 2000

- Runoff result of M/P study (River discharge data at each point)

River water level is calculated by flood routine computation from rive mouth usually. However, initial water level has to be set at the midstream of the river in this study because the target of this study is a part of Cagayan River Basin (Tuguegarao City and the vicinity area) under the concept of core area protection, and then flood inundation analysis should be carried out.

In this study which concept is core area protection, initial water level should be determined based on the present river channel condition. However, the initial water level is not able to be set from the above data.

Normal depth is set as initial water level at the section where we can't set initial water level and the flow condition seems to be normal flow. However, normal depth is not available as a initial water level because Cagayan River has a gentle slope and the influence of back water in the downstream reaches Tuguegarao city.

(2) Determination of initial water level

First, flood inundation analysis was conducted based on the design water level of 25-year return period in previous F/S study, but the inundation depth was much deeper than the result of F/S study. Considering present river channel condition, initial water level is assumed to be lower than the design water level.

Second, flood inundation analysis was conducted based on the normal depth. The inundation depth near Buntun bridge was shallower but the extent of inundation area and the depth around and upstream of Tuguegarao City went well with the result of F/S in 2002.

Then, initial water level was set by design water gradient of 25-year flood in 2002 F/S from confluence with Tuguegarao River. The result of the simulation was almost corresponding to the result of 2007 F/S.

Therefore, the water level set here is applied as an initial water level in this Study.

5.3.4 Flow Capacity

Minimum flow capacity is less than 2-year return period as shown in Figure 5.5. The section along Tuguegarao city area where is the core area in this study posses higher flow capacity of more than 10-year return period.

5.4 Flood Inundation Analysis

5.4.1 General

(1) Concept and Outline of the Flood Inundation Model

The effect of high tide is still felt in the core area although it is far from the coastal plains of the Babuyan Channel. With this situation, combined with wide and relatively flat flood plains, the area is prone to the effect of floods in terms of inundation and channel erosion.

The area also suffers chronically from inland floods due to complex factors such as flat channel gradient and inadequate flow capacity of drainage channels. Therefore, it is necessary to accurately analyze and simulate the flood phenomena using one-dimensional steady and unsteady flows considering:

- River flow affected by tidal fluctuations.
- Inland flood.
- Combination of river overflow and inland flood.

(2) Description of Software

HEC-RAS is an integrated system of software for interactive use in a multi-tasking environment. It is designed to perform one-dimensional hydraulic calculations for a full network of natural, artificial or constructed channels. It is comprised of a graphical user interface, separate analysis components, and data storage and management capabilities. The system contains a) steady flow water surface profile computation intended for steady gradually varied flow b) unsteady flow simulation primarily for subcritical flow and mixed flow regimes b) movable boundary sediment transport computation resulting from scour and deposition over moderate time periods and d) water quality analysis wherein the current version (Ver 4.0) can perform detailed temperature analysis and transport of a limited number of water quality constituents.

5.4.2 Flood Inundation Model

(1) Model Setup

The flood simulation is generally conducted in three steps; namely, calculation of flood runoff from the sub-basins, channel flood routing, and determination of flood inundation on the flood plains. The structure of the HEC-RAS model is shown in Figure R 5.1

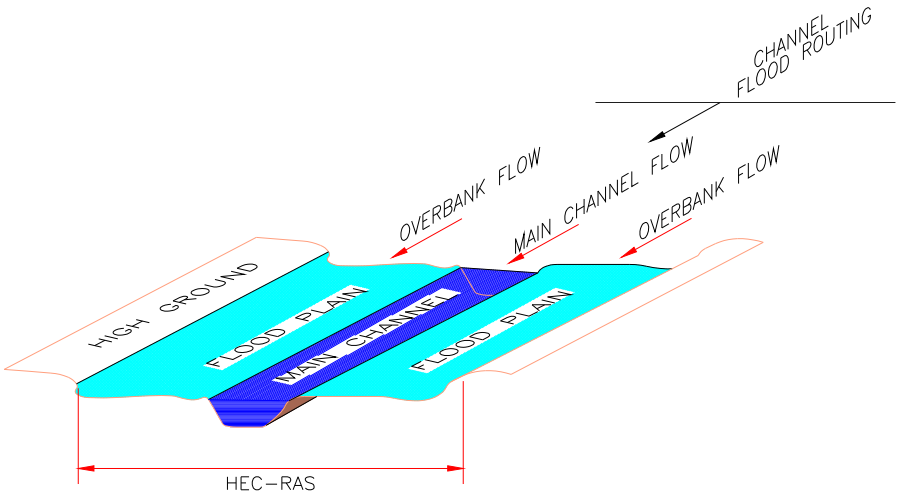


Figure R 5.1 Structure of HEC-RAS Model

(2) Methodology

The basic inputs to the HEC-RAS model are stream discharge, cross sections perpendicular to the flow direction along the river channel and flood plains, geometry of bridge or other cross channel structures, Manning's roughness coefficients (n values) as well as upstream and downstream channel boundary conditions.

Hydraulic calculations of flow in channels and overbank areas require an estimate of flow resistance, which is generally expressed by the Manning's roughness coefficient, n. The effect that roughness coefficients have on water surface profiles is that as the n value is increased, the resistance to flow also increases, which results in higher water-surface elevations. The assumed roughness, n, considered for the main channel and overbank areas under this study are 0.040 and 0.060 to 0.100, respectively.

Water surface profile calculations are computed from one cross-section to the next by solving the energy equation with an iterative procedure called the standard step method. The energy equation is written as follows:

$$Z_2 + Y_2 + \frac{a_2 V_2^2}{2g} = Z_1 + Y_1 + \frac{a_1 V_1^2}{2g} + he$$

Where:

Z1, Z2 = elevation of the main channel inverts at section 1 and 2

Y1, Y2 = depth of water at section 1 and 2

a1, a2 = velocity weighing coefficients at section 1 and 2

g = gravitational acceleration

he = energy head loss

A diagram showing the terms of the Energy equation is shown below.

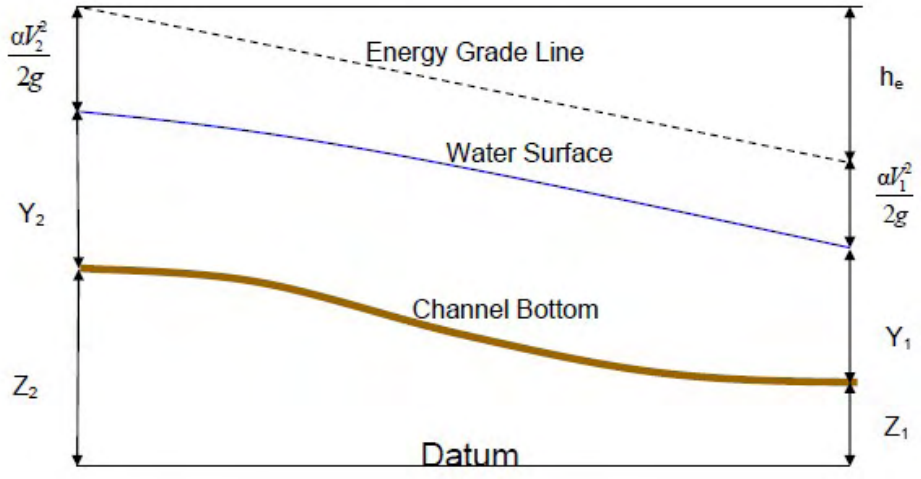


Figure R 5.2 Representations of Terms in the Energy Equation

The energy head loss (he) between the two sections is comprised of friction and contraction/expansion losses and is expressed as follows:

$$he = L\bar{S}_f + C\left|\frac{a_2 V_2^2}{2g} - \frac{a_1 V_1^2}{2g}\right|$$

Where:

L= Weighted reach length

$\bar{S}_f$ = Friction slope between two sections

C = Expansion/contraction loss coefficient

The weighted reach length is calculated as:

$$L = \frac{L_{lob}\bar{Q}_{lob} + L_{ch}\bar{Q}_{ch} + L_{rob}\bar{Q}_{rob}}{\bar{Q}_{lob} + \bar{Q}_{ch} + \bar{Q}_{rob}}$$

Where:

L_{lob}, L_{ch}, L_{rob} = Reach lengths for flow in the left overbank, main channel and right overbank, respectively.

$\bar{Q}_{lob}, \bar{Q}_{ch}, \bar{Q}_{rob}$ = Arithmetic average of the flow between sections for the left overbank, main channel and right overbank, respectively.

The total conveyance and velocity coefficient for a cross section requires that the flow be subdivided into units for which the velocity is distributed uniformly. The approach is to subdivide the flow in the overbank areas using the cross section n-value breakpoints (i.e., where n values change) as the basis for subdivision as shown in Figure R 5.3.

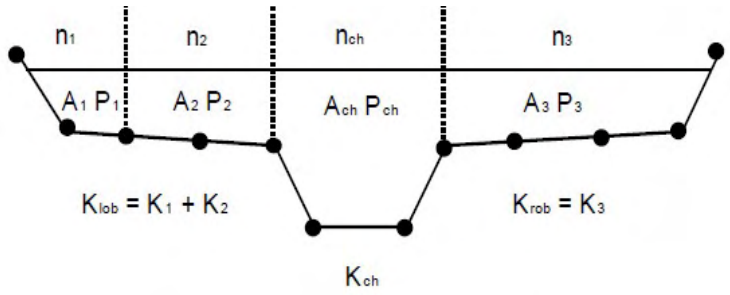


Figure R 5.3 Default Conveyance Method in HEC-RAS

Conveyance is calculated within each subdivision from the Manning's formula:

$$Q = K\sqrt{S_f}$$

$$K = \frac{1}{n}AR^{2/3}$$

Where:

K = conveyance for the subdivision

n = Manning's roughness coefficient for the subdivision

A = flow area for the subdivision

R = hydraulic radius (A/P) for the subdivision

P = wetted perimeter

HEC-RAS sums up all the incremental conveyances in the overbanks to obtain a conveyance for the left and right overbank while the main channel is computed as a single conveyance element. The total conveyance for the cross section is obtained by summing the left, channel and right subdivision conveyances.

(3) Model Network

The model consists of a simple singular line of the Cagayan River reach of about 22.5 km as shown schematically in Figure R 5.4.

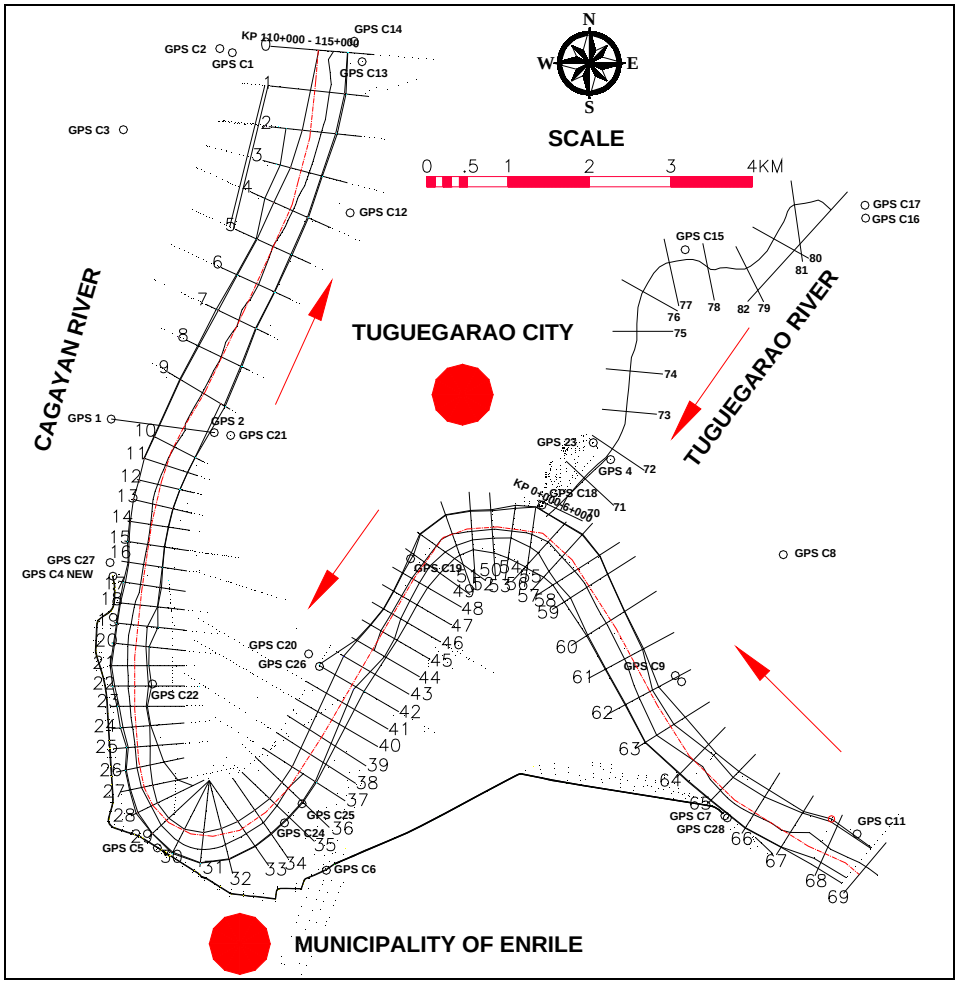


Figure R 5.4 River Model

CHAPTER 6 PLANNING FRAMEWORK

6.1 Basic Concepts on Planning Framework

6.1.1 Summary and Outline of Current M/P and F/S

The Master Plan on the Cagayan River Basin Water Resources Development was first formulated in 1987 (1987 M/P) by Japan International Cooperation Agency (JICA) based on the mutual agreement between the Government of the Philippines (GOP) and the Government of Japan (GOJ). The GOP has endeavored to implement the projects proposed in the said Master Plan but no project has been realized for reasons beyond the government's control, such as political disturbance, insecure peace-and-order situation in the objective area, financial constraints, etc.

Under the above circumstances, frequent flood inundations had been a main constraint in the promotion of sustainable socio-economic development and improvement of the living condition of the people in the Cagayan River basin. In view of this and realizing the priority of the flood control project proposed in the 1987 Master Plan, the GOP made a request to the GOJ in May 1999 for technical assistance to conduct the feasibility study of the flood control project for the Lower Cagayan River. In response to the request, the Implementing Arrangement on the technical cooperation for the Study was agreed upon between the Department of Public Works and Highways (DPWH) and JICA on December 17, 1999. The Study was conducted in conformity with the Implementing Arrangement (2002 F/S).

The 1987 M/P Study for the Cagayan River basin was conducted by JICA from 1985 to 1987. The objective of the 1987 Study was to formulate a Master Plan for water resources development in the entire Cagayan River basin covering an area of 27,281 km^2. The target of regional economic development was set to raise the per capita GRDP of Region 2 by the year 2005 up to that of the national average excluding the highly industrialized National Capital Region (NCR) and Region 4.

Framework Plans and Long-term Plans were formulated for each sector of the water resources development, which composed of Flood Control Plan, Agricultural Development Plan, Hydropower Scheme, Municipal Water Supply and Multipurpose Dams Schemes. The Framework Plan was defined as a potential development plan prospecting indefinitely for an ideal future development. The Long-term Plan was defined as a plan being more economically effective within the target period. The Framework and Long-term Plans in Flood Control Plan are presented below respectively:

(1) Frame Work Plan for Flood Control Plan in 1987 M/P Study

- The framework plan aimed at alleviating floods along the Cagayan River against a 100-year probable flood;
- Flood control dams were planned in the upstream reaches to reduce flood magnitude;
- Widening of the Magapit Narrow was contemplated to increase its discharge capacity;
- Dike systems were planned along the middle and lower reaches of the Cagayan River to prevent flooding of low areas;
- Tributary areas were planned to retain natural flood retarding effect as much as possible.

(2) Long-term Plan for Flood Control Plan in 1987 M/P Study

(a) The long-term plan was formulated on the basis of the framework plan by reducing the design discharge to a 25-year probable flood as a more economically effective scale.

(b) The long-term plan consisted of;

(i) Dike embankment including revetment and sluice along the main Cagayan River and major tributaries (the Siffu, Ilagan and Magat),

(ii) Excavation at Nassiping along a portion of the Magapit Narrows,

(iii) Cut-off channel works (Gabut and San Isidro),

(iv) Bank protection,

(v) Flood control dams (Cagayan No.1 and Ilagan No.1),

(vi) Flood control function in the multipurpose dam projects (Siffu No.1, Mallig No.2, and Magat) in addition to the above.

(3) Master Plan for Flood Control Plan in 1987 M/P Study

The following projects and schemes for Flood Control were selected for inclusion in the proposed Master Plan:

- Tuguegarao Dike,
- Cabagan Dike,
- Narrows Improvement (Nassiping Lower-Left Bank, NLL),
- Narrows Improvement (Nassiping Lower-Right Bank, NLR),
- Bank Protection Works, and
- Allocation of flood control space in Dams

(4) Short-term Plan for Flood Control Plan in 1987 M/P Study

The 1987 Master Plan also proposed a Short-term Plan to be implemented within 10 years. Schemes proposed for the Short-term Plan were selected among the projects for flood control in the Master Plan as follows:

(a) Tuguegarao dike,

(b) Narrows improvement (Nassiping Lower-Left bank, NLL),

(c) Bank protection works, and

(d) Modification of the Magat Dam operation for flood control

6.1.2 Current Status in the Basin and Recommendation of 2002 F/S Study

(1) Basin Status in 2000 and the Needs of Review of 1987 M/P

There are no remarkable changes or improvement in the river conditions in the past. Riverbank erosion from several meanders has been a serious problem. Serious riverbank erosion was identified at 75 sites in the 1987 Master Plan and even in 2000, 73 such sites still exist. Heavy erosion and large damages have occurred in 73 places where the average annual lateral bank erosion movement have reached 6 m to 28 m. Low-lying

areas along the Cagayan River have suffered from frequent inundation as serious as ever, especially in the upstream reaches of Alcala. The JICA study in 1987 recommended the implementation of the urgent flood control works as priority projects selected from the said Master Plan to mitigate flood damage in the basin. However, they have not yet been realized.

In 2000, around 14 years had passed since the 1987 Master Plan was formulated for the Cagayan River basin. Differences between the projected socio-economic bases of the 1987 Master Plan such as population, GVAs or GRDP and current values had developed during these 14 years. No major flood control projects proposed in the 1987 Master Plan had been implemented. Only 8,000 ha of irrigation area had expanded since the year 1987 in the national irrigation system and communal irrigation system in the basin. Watershed conservation had been recognized as one of the important sectors in the basin development plan. The abovementioned facts meant there was a necessity to review the 1987 Master Plan.

(2) Basic Concept of 2002 F/S

Flood damage mitigation measures consist of structural measures, non-structural measures and supporting measures. Stage-wise development of the flood control projects has been contemplated from technical and financial viewpoints aiming at the target year of 2020.

(3) Frame Work Plan

The framework plan of flood control proposed in the 1987 Master Plan was also applied for the Reviewed Master Plan without modification, because the fundamental relevant characteristics of the Cagayan River and its basin have not changed since the 1987 Master Plan was formulated.

(4) Reviewed Long-Term Plan

To cope with flood control problems involved in the basin, the long-term flood control plan proposed in the 1987 Master Plan was reviewed through a comparative study. The target area was the whole Cagayan River basin and its major tributaries. The review was made for a 25-year probable flood as a more economically effective scale for development.

The identified structural measures in the reviewed plan are shown in **Figure 6.1** and summarized below.

(a) Dike embankment

- In the main Cagayan River,
- In the major tributaries, the Siffu, Ilagan, and Magat Rivers

(b) Cut-off Channel Works

- In the main Cagayan River at Gabut, San Isidro and Tuguegarao
- In the Magat, Siffu and Mallig Rivers

(c) Bank protection at 73 sites

(d) Flood control dams

- Cagayan No.1 dam

- Ilagan No.1 dam

The major modification of the long-term plan between the 1987 Master Plan and 2002 F/S Study are as enumerated below.

(a) Magapit Narrow Improvement Scheme, which had been proposed in the 1987 Master Plan, was reviewed in detail by using river cross sections and topographic maps surveyed in this Study. It was concluded that this scheme showed lower economic efficiency, hence was discarded in the reviewed long-term plan.

(b) The Gabut Cut-off Channel and San Isidro Cut-off Channel had been included in the 1987 Master Plan. The Tuguegarao Cut-off Channel was newly proposed in the reviewed long-term plan.

(c) Bank protection works were counted for 75 sites in the 1987 Master Plan. In this Study, 73 sites needing bank protection works were identified and included in the long-term plan.

The non-structural measures to be incorporated in the long-term plan are as follows:

(a) Evacuation system including flood forecasting and warning system and evacuation centers, and

(b) Resettlement including resettlement area development.

A hazard map was also prepared in terms of flood inundation, riverbank erosion and soil surface erosion for the whole Cagayan River basin.

The supporting measures to be incorporated in the long-term plan are as follows:

(a) Strengthening of funding for flood control works,

(b) Strengthening of river administration including organizational improvement and capacity building, and

(c) People's awareness building.

All these supporting measures are essential for the implementation of flood control projects. However, these supporting measures should be contemplated as a nationwide program separately from this Study since those are related to the nationwide institutional aspects.

(5) Reviewed Master Plan in 2002 F/S

In the review of the 1987 Master Plan, the sectors of flood control, irrigation, watershed management, water supply and power generation, water quality management and river environment management were contemplated.

In order to select the projects for the Reviewed Master Plan among the candidate projects of the flood control plan and land use plan, seven (7) project packages were constructed combining a multipurpose dam with flood control and irrigation projects relating to the multipurpose dam. The packages were then compared with respect to economy, urgency, equitable development and environment to select the most suitable package.

The seven packages consist of the Siffu No.1 Dam or Alimit No.1 Dam with flood control and irrigation projects located downstream of the dam. The projects of flood control and irrigation are those identified in the reviewed long-term plan.

Among the seven packages, the package consisting of the Siffu No.1 Dam and related flood control and irrigation projects has the highest EIRR of 19.7%. The Siffu No.1 Multipurpose Dam is expected to augment irrigation water to the part of the irrigation command area of the existing Magat Dam that presently cannot be supplied because of insufficient supply capacity. The supply of irrigation water from the Siffu No.1 Dam will lead to an increase in agricultural production to the level of the Magat command area. There are no serious environmental issues among the seven packages.

(a) Flood control schemes

(i) Dike embankment including revetment, sluice and riverbank tree zone

- in the main Cagayan river from river mouth to Tuguegarao

(ii) Cut-off Channel Works

- Gabut, San Isidro and Tuguegarao

(iii) Bank protection works

- 21 sites from river mouth to Cabagan in the main Cagayan
- 52 sites upstream from Tumauini in the main Cagayan, Siffu, Mallig, Ilagan, and Magat Rivers

(iv) Evacuation system including FFWS and evacuation center

(v) Resettlement

(vi) Strengthening of institution and organization

(b) Watershed Management Scheme

(i) Reforestation plan (Reforestation area 3,188 km2)

(ii) Sabo works plan (26 Sabo dams)

(6) Evaluation of Reviewed Master Plan

(a) Natural and Physical Environmental Impact Evaluation

Dam construction will cause the area of the reservoir to be submerged resulting in the loss of all vegetation and disturbance on migration of some aquatic organisms owing to the disconnection of the special connectivity of the river system. The proposed dam schemes encompass some protection areas. Hence, an EIA study is necessary for dam projects at the feasibility study (FS) stage thereof. Flood control projects may not bring about source of environmental pollution in principle, however may cause turbid water flow, air pollution and noise in and around the construction sites and transportation routes. These effects, however, will not last but will be confined within the construction phase.

The flood control projects are planned to contribute or improve social environment such as flood damage mitigation, protection of life and property as a project nature. Therefore, no social environmental adverse impact may be considered in principle. However, there are some issues to be considered. The navigation existing in the lower Cagayan River is so important for the people that river planning should be done in order to prevent or minimize the lowering of the water level of the river to secure existing navigation system. Regarding the existing items of cultural and

historical heritage, there will be no impacts on them because of adequate distance between them and the planned projects. There would be no significant impacts on minority tribes along the Cagayan River because they have already been assimilated with the majority people in the Region.

(b) Economic Evaluation

The projects were evaluated under present socio-economic conditions in general. However, socio-economic conditions will be enhanced in accordance with the economic development scenario by the various target years.

In this Study, the projects are evaluated under the enhanced socio-economic conditions, referred to as “under future conditions”. The project features of the Reviewed Master Plan and its economic effect in terms of EIRR are summarized below.

Table R 6.1 Summary of Economic Evaluation of Reviewed Master Plan

Project	Major Works Component	Project Cost (Mill. Pesos)	EIRR (%)
Flood Control			
Structural Measures			
1) Dike Embankment	Embankment incl. Revetment, sluice and riverbank tree zone in the Main Cagayan from river mouth to Tuguegarao		
-River Mouth~ Nassiping	L=82.7 km, Em.V=9.3mill. m3	2,844	28.1
-Alcala~ Tuguegarao	L=57.5 km, Em.V =8.5 mill. m3	2,891	27.0
2) Cut-off Channel（COC）			
- Gabut COC	L=0.9km, Em.V =4.0 mill. M3	1,008	16.6
- San Isidro COC	L=2.1 km, Em.V =7.4 mill. M3	1,722	18.8
- Tuguegarao COC	L=6.7 km, Em.V =17.5 mill. m3	4,662	15.0
3) Bank Protection	73 sites in total		
-River Mouth~ Cabagan 21 sites	Total L=18.8 km, Revetment A=514,900 m2	726	19.2
-Main Cabagan: Upstream of Tumauini, Tributaries:Siffu, Mallig, Ilagan, Magat 52 Sites	Total L=51.9 km, Revetment A=931,000 m2	3,657	15.1
Non-structural Measures			
1) Evacuation System			
- FFWS	Improvement of facilities Strengthening Tuguegarao Sub-center	242	
- Evacuation center	Strengthening evacuation center& DCC	152	18.0
2) Resettlement	Number of Households: 2,776 Land Acquisition: 7,468 ha	1,185	—
Suuporting Measures			
1) Strengthening intitution & Organization		150	
Watershed Management			
1) Restoration	Area: 3,188 km2	5,000	16.3
2) Sabo Dam	26 Sabo Dams in Magat River basin	5,472	16.8
Multipurpose Dam	Purpose: Flood Control, irrigation & hydro power		
1) Siffu No.1 Dam Project	Dam Type: Earthfill Dam H=58m, Em.V.=1.7Mill.m3	3,172	28.3

(7) Implementing Structure in Reviewed Master Plan in 2002 F/S

(a) Implementing Structure of Multi-purpose Projects in the Philippines

There is no unified agency to handle overall water resources development and management in the Philippines. In the case of implementing multi-purpose projects, the following three forms/systems have been adopted to meet to the requirement of the projects.

(i) Coordination Committee System

This system may be applied to such projects that may have a comparatively high level of independence among the individual components and extending

over 2-3 agencies only. The Coordination Committee may be formed with mutual agreement among the agencies concerned.

(ii) Commission System

This system may be applied to such projects that would be rather hard to coordinate among the agencies concerned in the case that the projects are related to many agencies. The Commission under this system has its own staff and budget for project implementation, and may be established with a Presidential Order.

(iii) Authority System

This system may be applied to such projects that may encompass many factors/purposes with many agencies to be involved, including in the operation and maintenance of the project after its completion. This may be established by an act passed the congress

(b) Implementing Structure of the Reviewed Master Plan Projects

The implementation of the Master Plan is scheduled to start with flood control projects and irrigation projects. At this stage, it is assumed that a Coordination Committee System will be sufficient for implementation. This may be transformed to a Commission System in such time that the projects will be expanded to full-scale development with the other components such as watershed management, water quality management, and river environment management. Furthermore, the implementing system may be reformed to an Authority when the basin-wide economic development will be geared to full-scale economic development, including CEZA and AFMA, which will bring the entire implementation together. This strategy of step-wise transformation of implementing structures was agreed on by the Steering Committee of this JICA Study.

(8) Basic Approach of Feasibility Study

The Reviewed Master Plan has proposed the projects in the sectors of a) Flood control, b) Irrigation, c) Watershed management, d) Water supply and power generation, e) Water quality management and f) River environment management. Among the proposed sector projects, flood control and irrigation projects have been given priority for implementation in view of the development policy of the Government, regional economic target and results of the workshops conducted during the Study period.

The Reviewed Master Plan reveals that the flood control projects are prerequisites for the development of the Cagayan River basin, and that the flood control projects of the Lower Cagayan River should be implemented first from the viewpoints of engineering and economical effectiveness.

The feasibility study was conducted for the following flood control projects in the Lower Cagayan River. Figure 6.2 shows the general locations of each flood control project including urgent bank protection works in the Lower Cagayan.

Table R 6.2 Priority Projects selected as Priority Project in 2002 F/S

No.	Stretch	Description
1)	Left dike systems in the reach from the river mouth to Nassiping	Mabanguc dike, Catugan dike, Lasam dike
2)	Right dike systems in the reach from the river mouth to Nassiping	Camalaniugan dike, Lal-lo dike, Gattaran dike, Nassiping dike
3)	Left dike systems in the reach from Alcala to Tuguegarao	Alcala-Buntun dike, Enrile dike
4)	Right dike systems in the reach from Alcala to Tuguegarao	Tuguegarao dike, Amulung dike, Iguig dike along national highway
5)	Cut-off channels (COCs) in the reach from Alcala to Tuguegarao	Gabut COC, San Isidro COC, and Tuguegarao COC
6)	Urgent bank protection works	at 21 sites in the Lower Cagayan
The non-structural measures		(1) an evacuation system including the flood forecasting and warning system and evacuation center, and (2) resettlement area development

(9) Summary of Preliminary Design on Flood Control Projects in 2002 F/S

The feasibility study is conducted for all the flood control projects in the Lower Cagayan River identified in the Reviewed Master Plan. The 25-year probable flood is applied for the design of facilities. The location of the 16 proposed river improvement works is shown in Figure 6.2.

The design river width is set to be 1.5 to 2.0 km for the design flood of 100-year probable flood in order to avoid difficulty in widening in future.

Major work quantities are estimated as follows:

(a) Total excavation volume: 33.3 million m3 of the three cut-off channels

(b) Total embankment volume: 18.2 million m3 of the dike

(c) Total bank protection area: 306,000 m2

(d) Total tree zone area: 1.8 million m2

The following non-structural measures are studied:

(a) Improvement of existing flood forecasting and warning system facilities, Tuguegarao sub-center and disaster management capacity in Tuguegarao in association with Consultancy and Engineering Services. Total cost of 242 million Pesos is estimated.

(b) Improvement of evacuation center, strengthening of Disaster Coordinating Councils (DCCs) and people's awareness/capability building. Total cost of 152 million Pesos is estimated.

(c) Resettlement area development at 6 sites with the area of 58.7 ha in total.

(10) Summary of Construction Plan, Schedule and Cost Estimate in 2002 F/S

Major construction works required for the Lower Cagayan River Flood Control Project are 1) bank protection works, 2) dikes construction including maintenance roads and tree

zones, 3) construction of cut-off channels and 4) related river structures such as culverts and sluices. Urgent implementation is required for the urgent bank protection works at 21 sites. Planting the riverbank tree zones of 70 km is to be started at an early stage of implementation by LGUs.

Flood control structural measures are planned to be implemented in 4 phases aiming at the target year of 2020 commencing in the year 2002 in order from river mouth toward upstream, as presented in the table below.

Table R 6.3 Implementing Program for Priority Project in 2002 F/S

Phase	Year (Term)	Description of Works
1	2002－2007	Urgent bank protection works, Lower Cagayan River bank tree zones, Lower Cagayan Left and right dike systems, river mouth to Magapit
2	2004－2011	Left and right dike systems, Magapit to Nassiping Amulung dike system Gabut cut-off channel
3	2007－2015	Alcala-Buntun and Iguig dike systems San Isidro cut-off channel
4	2011－2020	Tuguegarao and Enrile dike systems Tuguegarao cut-off channel

The improvement of the evacuation system including flood forecasting and warning system is planned to implement in the 1st Phase. The resettlement area development is planned to implement well in advance in concurrence with the implementation of related structural measures.

To ensure the construction time schedule and the quality of structures, mechanized construction system should be applied for the construction of the huge amounts of dike embankment of 18.2 million m3 and excavation of 33.3 million m3 for cut-off channels at 3 sites in Gabut, San Isidro and Tuguegarao. The excavated soils in the construction operation are to be used effectively for dike embankments and improvement of low-lying land in the basin.

The project cost in the priority projects of the Lower Cagayan River Flood Control Project was estimated as presented in the table below including the structural measures, non-structural measures, and supporting measures:

Table R 6.4 Summary of Cost Estimate of Priority Projects in 2002 F/S

Phase	Construction Period	Total	FC	LC
1	(2002-2007)	2,786	1,448	1,339
2	(2004-2011)	2,828	1,445	1,383
3	(2007-2015)	4,420	2,337	2,087
4	(2011-2020)	5,347	3,156	2,190
	Total	15,381	8,385	6,996
	US$ equivalent	308	168	140

Note: FC: Foreign Currency Portion, LC: Local Currency Portion

Annual Operation and Maintenance Costs (O&M Costs) for the priority flood control projects were estimated at Pesos 7.93 million or US$ 158,600 equivalent covering the structural and non-structural measures.

6.1.3 Core Areas to be Protected by Structural Measures in the Sector Loan Project

Flood Control Projects as sub-projects in the Sector Loan Project on Disaster Risk Management aim to alleviate flood damages in "core areas" in which the cities or municipalities have played as center of economic, political and administrative activities in the basin or the development potential is higher than that of circumjacent areas. It refers to the high and prompt onset of flood control effectiveness and benefits.

As shown in Sub-section 6.1.2, the candidate flood control structural measures proposed in 2002 F/S are planned to be implemented in 4 phases to aim at flood damage mitigation for four (4) areas in Lower Cagayan River, namely Phase 1: river mouth to Magapit, Phase2: Magapit to Amulung, Phase3: Amulung to Tuguegarao and Phase4: Tuguegarao to Cabagan. In this connection, Phase 4 for protection of Tuguegarao City should be considered as a sub-project in the Sector Loan on Disaster Risk Management taking into consideration density of population, recognition of the regional importance that safety level of the political and economic center in the region enhances against river flood. In this connection, the core areas to be protected firstly for Cagayan River refer to the Tuguegarao City and the suburbs. Furthermore, the Core areas refer to the following classified land zone in the Comprehensive Land Use Plan 2000-2005 prepared by the Tuguegarao City,

- Residential Areas (Built-up Area),
- Commercial and Industrial Area, and
- Administrative and Educational Area

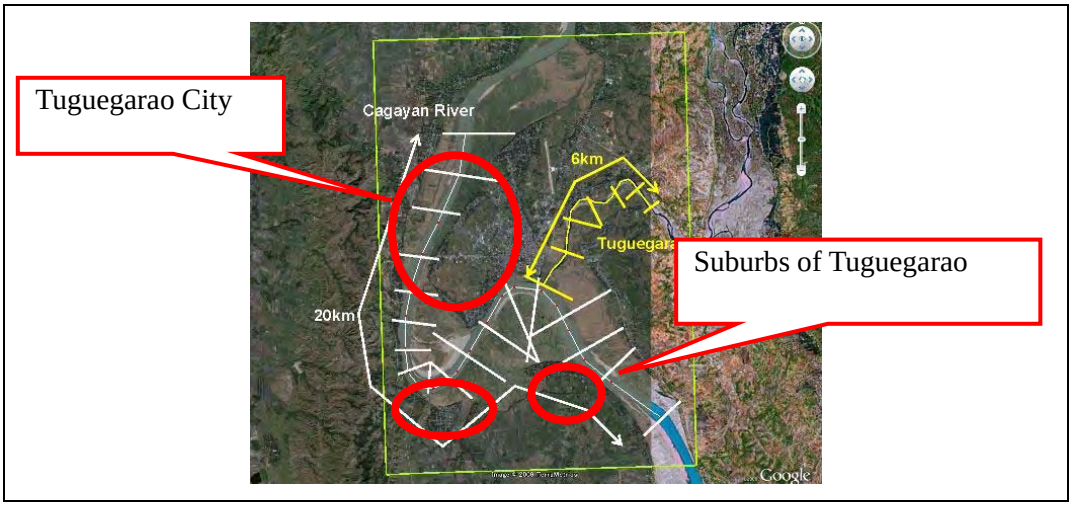


Figure R 6.1 Core Areas to be Protected in the Cagayan River Project

6.1.4 Basic Concept for Flood Control

As described above, the Cagayan River Basin encompassing the study area flows through the major granary area as a key area for the development of the Philippines. However, the Study Area suffers from habitual inundation by storm rainfalls and typhoons as well as significant bank erosion problems causing considerable loss of high-economic lands, which deteriorate the regional economy and the living standards of the residents due to huge energy of the floodwater attributable to the largest river basin in the Philippines. Under these circumstances, the Study being conducted aims at the minimization of damage caused by the said serious bank erosion and/or habitual inundation by river-overflow through the reconsideration of proposed flood mitigation plans in the 2002 F/S.

The flood mitigation plan consists of the structural and non-structural components. Both measures would have the functions to increase the flood flow capacity of the waterway, to control

the flood runoff discharge from the river basin, and at the same time to protect the locations from serious bank erosion and scouring as listed in Table R6.5. Moreover, in order to minimize the damage cause by the flood, which exceeds the design capacity of the structural measures, the flood warning and evacuation system is highlighted as the eligible non-structural flood mitigation measure.

Table R 6.5 Functions of Conceived Structural and Non-structural Flood Mitigation Measures in the Study Areas

Item	Function	Structural Measures	Non-Structural Measures
Basic Concept	Areas to be Protected	Tuguegarao and the suburbs referring to the center of the Cagayan River as "Core Areas" is selected to firstly consider the flood mitigation plan in the Sector Loan project.	In addition to core areas for extraordinary flood, non-structural measures are considered to alleviate /minimize the flood damage basin-wide.
	Intention of Stakeholders	Flood mitigation structural and non-structural measures to be selected should be considered and subject to the consents from the stakeholders since their consents are absolutely imperative to construct smoothly and execute effectively for the implementation of river works and O&M Activities.	
Basic Policy	Basic Plan	This Project shall basically be considered in accordance with the Results of 2002 F/S.	
Specific Flood Control Measures	Increment of Discharge Capacity in Waterways	• Construction of Dike • Construction of Cut-off Channel (Measures to be proposed shall be design not so as to affect flood condition to other areas.)	• FFWS proposed in 2002 F/S • Tree Zone Concept proposed in 2002 F/S • Prevention of encroachment to river area • Legal arrangement for construction of structural measures
	Prevention of Erosion on Bank	• Construction of Strong Revetment/Bank Protection.	• Early Flood Forecasting and Evacuation system
	Flood control / retention capacity in the basins and the application in the project	Measures, such as construction of dam in upstream, proposed in 2002 F/S are remained as basic plan. However, these plans are not selected in the Sector Loan Project due to the huge cost and long term for the construction.	• Watershed management proposed in 1987 M/P and 2002 F/S. (Measures as much as possible shall be adopted in the project.)
Mitigation measures in the extraordinary flood beyond design discharge		—	• FFWS proposed in 2002 F/S • Early Flood Forecasting and Evacuation system as community-base measures
Concept of Climate Change Adaptation	Increment of Rainfall intensity and design discharge	• Heightening of Dike • Dredging and widening of low-water channel	• Enhancement of measures proposed for other functions to minimize the damages • Enlightenment Activities to stakeholder for adverse effects of climate change.
	Sea Level Rising	The Study Area (Tuguegarao) have little influence on sea level rising.	

There are several distinct merits and demerits of the above structural and non-structural flood mitigation measures. The merit of structural measures is such that they could almost completely get rid of any damage of the flood, whenever the flood is less than the design scale adapted to them. Meanwhile, the structural measures would possess the demerits such that they hardly mitigate the damage of the flood, which exceeds the design scale adapted to them, and they may cause the negative environmental impacts such as a large number of house relocation and felling of the mangrove forest. Moreover, it may take a time and a large cost to complete the construction of the structural measures, and during the time of construction, the effect of the flood mitigation is hardly expected.

As for the non-structural measures, the merits are such that they could bring about the early effect of flood mitigation with less cost of implementation as compared with the structural measures, and at the same time, they could contribute to a certain range of flood mitigation effect for every scales of flood.

On the other hand, the demerit of the non-structural measures is such that the quantitative estimation on the flood mitigation by them is hardly made. The target design level for the structural measures is, in general, determined as precondition according to recommendations in the relevant guideline and/or the design levels applied in the similar flood mitigation projects in the Philippines. Moreover, the design level in the study area has been proposed in the previous study (1987 M/P and 2002 F/S) and then, these proposed design levels at each period (frame work, long-term and short-term master plan and priority project level) shall usually be applied to the target area.

In this Study, however, the above design level as precondition might be hardly applied due to the particular physical, social and financial constrains of the Study Area such as: (1) Expected change in hydrological condition of downstream due to drastic river improvement works in middle stretch as the study area, which impose adverse effects on the downstream flood condition, (2) existing densely packed houses along the river/drainage channel, which lead to difficulties in executing a large-scale river/drainage channel improvement and (3) the budgetary constraint for construction and maintenance of the structures.

In due consideration of the particular conditions of the Study Area, the plan for structural components would be examined with assuming the various different options of design level. It is further noted that the plan for the structural flood mitigation components would be separately formulated for the following two components, and the optimum design scale for each of the components would be separately determined based on the particular physical, social and financial constrains of each target area of the components.

(1) Plan for the flood damage mitigation of Tuguegarao City on Right Bank, and

(2) Plan for the flood damage mitigation of Enrile Municipality on Left Bank

The above concepts on the design level applied in the Study could bring out the minimum negative environmental impact and the most economical and affordable structural flood mitigation plan, while they also cause the regional gap in flood safety level, which lead to the regionally different allowable extents of flood inundation. Moreover, adaptation to climate change, of which the adverse effects are seriously concerned worldwide, shall be taken into consideration. Hence, the stakeholder meetings are indispensable in order to attain the adequate understandings of the stakeholders on the proposed flood mitigation plan and the unavoidable regional gap in the flood safety level. At the same time, the importance of the non-structural components is highlighted in order to minimize such regional gap inflicted by the structural components.

As described in Main Report (Part-A), the delay of the project implementation resulting in the decrease of the benefit of overall project's objectives might be induced due to the delay of the procedure of ROW acquisition and/or opposition from communities as before unless the consensus of stakeholders is obtained. In addition, it is, by good right, desirable that the works in downstream portion should precede works in middle or upper stretches in terms of river improvement works as designed in 2002 FS Report. Therefore, it is also concerned that the river works in the sector loan project aiming to improve flood conditions in Tuguegarao located in middle stretch in the Cagayan River Basin should be carefully elaborated.

6.2 Planning Framework

Planning frameworks will be set up as the bases for plan formulation taking the results of the previous study, the baseline study and basic analysis into account. The objective planning frameworks will include: (1) the target project completion year; (2) the socio-economic framework; and (3) the design frameworks. The details of these items are as described in the following subsections.

6.2.1 Target Project Completion Year

The flood mitigation project contains both structural and non-structural measures. Based on the results of 2002 F/S, the Project is to be categorized into the short-term and long-term projects. The short-term project consists of structural and non-structural flood mitigation works urgently required as the priority project expected to produce immediate flood mitigation effects within a short period based on urgent works of Pahse-4 in the 2002 F/S.

The target completion years of the short-term will be finally determined through discussion with the counterpart agencies in accordance with the Implementation Schedule of Sector Loan Project. The Study Team preliminarily presumes that the following target years will be the basis of discussion:

(1) The target year for the short-term project will be clarified through the succeeding study stages that the structural flood mitigation measures in particular will involve a large volume of work, which will lead to difficulties in completing any priority project by several years. In addition, the schedule of the progress of the conditionality and status of Sector Loan Project should be considered. Based on the clarification, it is proposed that the target year for the priority structural and non-structural flood mitigation plan should be set in 2020

(2) The target year for the long-term project shall be re-considered on the premise that the whole project of the Lower Cagayan River Basin has obtained ICC-CC Approval. The Sector Loan Project is a part of the said Lower Cagayan Flood Control Project.

6.2.2 Social Framework

Tuguegarao City have prepared its own land use plans with 2010 as the target year. The Study Team will delineate the overall land use plan for the Study Area based on these plans, and further estimate the population as well as land use conditions of the Study Area for the target year 2020 based on the factors mentioned below.

(1) Zoning plans projected by the municipal governments;

(2) Past trend of regional economy and population;

(3) Existing land use and economic conditions; and

(4) Ongoing and projected large-scale land development plans.

The basin flood runoff conditions will be seriously influenced by the basin land use conditions. Moreover, the flood damage potential could increase as the basin population and assets increase. From this point of view, the flood mitigation plan is formulated on the premise of social conditions in the years 2010 and 2020.

6.2.3 Design Framework

The design framework shall include the target design level and its corresponding standard discharge. Of these items, the target design level is expressed in terms of return period, and the standard discharge means probable peak discharge in natural basin runoff conditions without any control by basin flood storage facilities such as flood regulation pond and other off-site flood detention facilities proposed in 2002 F/S.

In this connection, the Study should adopt 25-year return period for basic design level to protected the targeted areas since the said protection level has been set in 2002 F/S as priority and urgent flood control plan.

The target design scale to be selected for the Sector Loan Project is determined taking the following alternatives into account:

(1) Basic Flood Peak Discharge of 25-year flood is set as basic targeted flood mitigation level;

(2) In case the scale of structural measures against the basic flood peak discharge is quite large attributing to the huge social and environmental issues and/or opposition of stakeholders, far lower viable design scales shall be considered based on the status of regional economic, investment conditions, possible areas to be acquired and other restrictions for implementation of the project; and

(3) The conditions after climate change shall be considered for design of structural measures.

As Design Scale for the Lower Cagayan River Basin, 100-year return period for Frame Work Plan and 25-year return period for long-term Mater Plan have been confirmed in the 1987M/P and the 2002 F/S. Based on the concept (1) mentioned above, flood scale at 25-year return period will be selected.

However, the existing structural flood mitigation capacity in the Study Area was evaluated to be small and could hardly cope with peak discharge of 25-year probable flood, as described in the hydrological analysis in Chapter 5. Moreover, the area along the river channel is densely packed with houses and the river channel improvement with the design scales set up under the above Items (1) would cause serious conflicts in house evacuation. Due to these points of view, the above Item (2) is applied as the base for determination of target design scale or structural flood mitigation measures in the Study. The flood over the design scale and under the condition of climate change described in (3) above would be dealt with by non-structural measures such as the flood warning and evacuation system and the dissemination of flood risk maps to the residents.

Confirmed framework of Cagayan River improvement policy and the relevance with the Sector Loan Project are summarized as follows:

Table R 6.6 Summary of Framework of the Mitigation Measures in the Study Areas

Target	Item	Achievement	Countermeasures	Relativeness to Sector Loan
River Flood	Urgent Plan	25-year return period flood	Structural Measures	For core areas, Sector Loan shall implement the suitable and viable scale flood control works (max. 25-year retrun period).
			Non-structural Measures	In/around core areas, suitable and viable mitigation measures shall be designed based on the 2002 F/S as well as newly created community-based measures and their activities shall be assisted throughout the Sector Loan.
		Erosion Problem	Structural Measures	In/around Core Areas, critical eroded stretches shall be protected in the Sector Loan.
			Non-structural Measures	Early warning and evacuation system will be considered.
		Together with climate change adaptation		
	Framework Plan	100-year return period flood	Structural Measures	No consideration (formulation of plan / approval of M/P)
			Non-structural Measures	No consideration (formulation of plan / approval of M/P)
Tidal Flood	Urgent Plan	- (Tidal Flood will not be considered in Cagayan River Basin in the Study.)		
	Framework Plan			

CHAPTER 7 STRUCTURAL FLOOD MITIGATION PLAN

The structural flood mitigation plan would include components against river-overflow and inland floods caused by storm rainfall and high tide. These structural plan components against both types of floods are examined in this Chapter based on the results of the flood simulation analysis described in Section 4 of Chapter 5.

7.1 Structural Flood Mitigation Plan against River-Overflow Flood

7.1.1 Maximum Design Scale Examined in the Study

Most flood mitigation projects for large-scale river basins in the Philippines employ the design scale of 100-year return periods for structural measures against river-overflow floods in long-term or frame work plan. On the other hand, as described in Subsection 6.2.3 of Chapter 6, 25-year return period probable flood has been set for priority flood projects in the Lower Cagayan River Basin in the 2002 F/S. Considering these precedents, the design scale of 25-year return period is provisionally assumed as the maximum design scale to be examined in the Study.

The potential flood mitigation measures and the alternative flood mitigation plans consisting of combinations of potential measures are firstly examined within the scope of the above maximum design scale. Then, the optimum design scale as well as the optimum combination of flood mitigation measures will be selected based on the synthetic evaluation of socio-economic impacts, natural environmental impacts, financial affordability and technical viability.

7.1.2 Potential Measures

River-overflow flood is herein defined as the flood runoff from a large catchment area that spills over the inland due to the overflow over the riverbanks and inflicts significant damage over a wide area. In accordance with this definition, the objective rivers for which measures against river-overflow flood will be proposed are the Cagayan River which have a catchment area of more than 27,000 km2, which refers to the most largest river basins in the Philippines, including the merging area of the Tuguegarao River. The existing channel of the Cagayan River around targeted areas has been proven through the hydraulic simulation that it possesses a channel flow capacity of more than 5-year return period.

According to the field reconnaissance and the interview survey with the residents, the flood overflow of the Cagayan River has the following particular characteristics:

(1) Flooding inundated in low-lying areas annually occurred together with typhoons passing through the region. River overflow flood occurred once a ten years so that residential areas of a part of core areas are inundated with 20~30cm in depth along the river course.

(2) Core areas of Enrile are also hampered by flood inundation once a several years.

(3) According to city/municipal officers and residents, the most critical condition due to flood in both core areas is bank erosion seen along the concave bank in the channel bends. As described in the 2002 F/S Report, the high quality lands have been lost by bank erosion and the annual speed of erosion was estimated at 6~28m per every year.

(4) In the 2002 F/S, there identified at 70 locations to be retrofitted. Presently, DPWH-Region II Office pointed out 43 locations as the most critical location for bank erosion by floodwater in the Lower Cagayan River. These phenomena affect the

livelihood and human lives around erosion sites. In and around Tuguegarao Area, there are eight (8) sites defined as the most critical locations by DPWH.

(5) Mayors of LGUs concerned stressed in the Second Stakeholders Meeting in the Study that a Cut-off Channel, which has been proposed by the 2002 FS, should be constructed in the Sector Loan Project. However, the expected costs for the construction of the said cut-off channel has been estimated beyond 30 billion pesos which cannot be accepted and is not affordable to implement the works as a part of sub-projects in the Sector Loan Project.

Taking the above items into consideration, the following four measures are contemplated as the eligible potential measures against river-overflow flood in the Study Area: (1) Excavation and Construction of Tuguegarao Cut-off Channel; (2) Construction of Flood Protection Dike to protect Tuguegarao Area; (3) Construction of Flood Protection Dike to protect Enrile Area; and (4) Construction of Strong Revetment at Critical Areas. The details of these potential measures are as described below.

(1) Excavation and Construction of Tuguegarao Cut-off Channel

Hydrological condition, such as preferable and adverse effects, for the Tuguegarao Cut-off Channel, which has been proposed in the 2002 F/S, shall be evaluated together with the cost estimates.

(2) Construction of Flood Protection Dike to protect Tuguegarao Area

The flood protection dike against 25-year flood shall be studied with the alignment and dimension where the dikes are designed based on hydraulic analysis, the needs by LGUs concerned and economic points of views.

(3) Construction of Flood Protection Dike to protect Enrile Area

Opposite side on Tuguegarao of the Cagayan River has been affected by certain scaled floods. The flood protection dike against 25-year flood for the Enrile area shall also be studied. Likewise in Tuguegarao Area, the alignment and dimension of the dike shall be designed based on the results of hydraulic analysis, the needs by LGUs concerned and economic points of views.

(4) Construction of Strong Revetment/Slope Protection Structures to prevent the affected areas from erosion

The Strong and durable revetment which most residents and LGU's officials are anxious to construct shall be included in the Sector Loan Project. The locations where the new revetments should be constructed are basically eight (8) sites (out of 43 sites) pointed out by DPWH around Tuguegarao. These will be evaluated throughout the Study from the effectiveness, cost and social and environmental points of view.

Critical Erosion Site in Enrile

Critical Erosion Site in Tuguegarao

Figure R 7.1 Critical Erosion Sites in/around Tuguegarao Area

7.1.3 Alternative Flood Mitigation Plans against River-overflow

The combination of potential flood mitigation measures is proposed as alternative flood mitigation measures against river-overflow flood, as described in the preceding Subsection 7.1.2. The alternative measures thus proposed are as listed below.

Table R 7.1 Alternative Flood Mitigation Plans against River-Overflow

Alternatives	Cut-off Channel	Tuguegarao Dike	Enrile Dike	Revetment
Alt-C1	●	●	●	●
Alt-C2		●	●	●
Alt-C3	●			

Note: ● : Adoption in the Alternative

The concepts for each alternative are shown in Figure 7.1 to 7.3.

7.1.4 Flood Simulation Analysis

(1) Purpose of Analysis

The flood inundation analysis was carried out on several scales of flood, aiming mainly as follows:

(a) To define the probable flood inundation extent, inundation area, inundation depth and inundation duration that could be used as essential information for evaluation of the effect of alternative flood mitigation plans for river overflow.

(b) To estimate flood damage based on the results of hydraulic and land use analyses.

(2) Simulation Results

As the result of flood inundation analysis, the maximum extent and depth of inundation under the without and with-protection situations are as summarized in the table below. Simulation results are shown in Table 7.1 and Figure 7.4 to 7.7 attached.

Table R 7.2 Flood Inundation Area

	Extent of Inundation Area (km2)					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
Without Project	30.22	56.64	75.30	91.57	94.28	96.15
Alt-C1 (W/ COC & Dike)	23.45	35.17	38.64	40.58	93.39	95.60
Alt-C2 (W/ Dike)	28.34	41.18	44.97	46.49	94.28	96.15
Alt-C3 (W/ COC)	23.16	53.06	65.62	89.47	93.39	95.60

7.1.5 Applied Structural Measure

(1) Difficulties in Adoption for the Construction of COC and Dike Protection System

As shown in Flood Simulation Analysis, it is absolutely apparent that Alt-C1, composed of COC with dike, is the most suitable for flood mitigation measures since Alt-C1 has effectiveness in all magnitude of flood occurrences. In addition, Alt-C1 combining excavation works (COC) and embankment (Flood Protection Dike) has an advantage in terms of the economic aspects.

In this connection, the effectiveness of the construction of Cut-Off-Channel and the linear Embankment Dike System surrounding Tuguegarao and Enrile areas have been evaluated. As a result, these flood mitigation system proposed in F/S 2002 has been confirmed and demonstrated to have very beneficial effects on flood damage mitigation. However, its construction costs largely exceeds allowable amount to be adopted in the Sector Loan project due to the huge quantities to be constructed as follows:

Table R 7.3 Estimated Quantities to be Constructed and Assumed Construction Cost of COC and Diking System

Structure Item	Major Work Item	Estimated Approx. Quantity	Assumed Cost (Million Pesos)
COC	Excavation/Backfill	15 million m3	2,700
	Revetment (Riprap)		700
Subtotal			3,400
Flood Protection Dike	Embankment	7 million m3	2,400
	Drainage Sluice	49 Units	200
Subtotal			2,600
Total			6,000

Note: Assumed cost refers to "Direct Cost" excluding any contingencies and ancillary facilities and appurtenant works, such as price/physical contingencies, grass sodding, preparation works, mobilization, temporally works and treatment of disposal soil

Approximate 6 billion pesos of construction cost without contingencies would amount for 80% of total considerable budget of the Sector Loan Project if these structural measures are applied for the Sector Loan Project. In this connection, these effective flood mitigation measures proposed in 2002 F/S shall be considered as Stand-alone Project in the future.

(2) Concentration of Works by Attention to Issue on Critical Erosion

As explained in Sub-section 7.1.2, one of critical issues as well as flood damage in the targeted areas is bank erosion seen along the concave bank in the channel bends to lose

valuable and precious land and lots. Such bank erosion issues have jeopardized the life of a number of residential people who are living along the Cagayan River and largely hampered the economic activities in the region.

As demonstrated in Subsections 7.1.8 and 7.1.9, such as Cost Estimate and Economic Evaluation hereafter, the construction of revetment to alleviate bank erosion at Alibago, Enrile and Cataggaman Sites would be within acceptable cost which can be adopted as one of the sub-projects in the Sector Loan Project and has high economic viability.

Hence, the construction of erosion-protection revetment works for the most serious sites, namely Alibago, Enrile and Cataggaman, are selected as the adopted structural measures (as Alternative C-4 for comparative study) for the targeted areas in the Sector Loan Project.

The following table shows the summary of comparative study for the selection of structural measures to be applied as sub-projects under the Sector Loan Project for Cagayan River Basin.

Table R 7.4 Summary of Comparative Study on Alternative Flood Mitigation Plan for the Tuguegarao Area in Cagayan River Basin

Item	Without Project	Alternative C-1	Alternative C-2	Alternative C-3	Alternative C-4
Project Objective	-	Flood protection for 25-year Erosion Control	Flood protection for 25-year Erosion Control	Flood mitigation Erosion mitigation	Erosion Control
Const. Cost	-	8 billion	7 billion	5 billion	2.3 billion
Land Acquisition	-	Approx.5,000ha	Approx.5,000ha	Approx.1,000ha	Approx.53ha
House Relocation	-	Approx. 300	Approx. 300	0	More or less 10
Advantage	No. L/A H/R	Whole area will be protected.	Whole area will be protected.	No house relocation	the Lowest cost
Disadvantage	No improvement against flood and erosion	Huge Cost Huge Social Issues due to project.		Small effect to flood damage	No improvement against flood damage
Evaluation	Not recommend	Not recommend	Not recommend	Not recommend	Recommended as compromise
	For ultimate project to mitigate flood damage and erosion control, Alternative C-1 is recommended as a part of whole lower Cagayan River Basin Flood Control Project. However, Alternative C-1 cannot accord with the policy, affordability and applicability to the Sector Loan Project. In this connection, the construction of revetment at critical eroded sites is applied to the Sector Loan Project as Alternative C-4.				

(3) Alignment of Revetment to Protect Bank Erosion

As described in the previous sections, the most serious eroded areas of land by river flow are namely Alibago, Enrile and Cataggaman Sites. Figure 7.8 shows the location of three sites. The features and alignment to be protected of these sites are described below:

(a) Alibago Site

Alibago site is located at Sta.128K~129K on left bank of the Cagayan River. On the bank where the severe erosions are occurring, the linear residential houses along regional key road connecting between Municipality of Enrile and Sta. Maria. The alignment to be protected against severe erosion is approximately 950 linear meters.

(b) Enrile Site

Enrile site is located at Sta.120K of left bank where low water channel meanders adjacent to municipal proper of Enrile. In this site, key regional road connecting from Enrile to Tuguegarao is located posterior to eroded bank. Should this key road be washed away, serious damage would be caused into not only Enrile's economy but also regional economy. The length of revetment to be installed will be approximately 800 meters.

Satellite Image in 2003	Satellite Image in 2008

Source: Google and Worldview

Figure R 7.2 Comparative Photos for Progress of Erosion at Enrile

(c) Cataggaman Site

Cataggaman Site is located at Sta.121~122K on right bank where there are built-up areas behind the bank. The revetment structures with 500 linear meters have been constructed to prevent high velocity in flood flow from scouring the bank since 1985. However, these structures have been deteriorated at present and the bank erosion has consequently set back the river shore line. A number of residential people have been obliged to move out.

Estimated length of the revetment to be constructed will be approximately 1,400 linear meters including re-construction stretch of existing deteriorated revetment structures.

Satellite Image in 2003	Satellite Image in 2008

Source: Google and Worldview

Figure R 7.3 Comparative Photos for Progress of Erosion at Cataggaman

(4) Summary of Project Component

Based on the optimum measures for the structural measures to mitigate flood in the core areas under the Sector Loan Project are summarized in table below.

Table R 7.5 Summary of Proposed Work

Component	Length (m)	Elevation of Revetment (EL+ m)	Type of Structure	
			Lower Portion	Upper Portion
Alibago Revetment	900	EL+21.0	SSP Revetment with Foot Protection	Wet Stone Masonry
Cataggaman Revetment	1,400	EL+20.0		
Enrile Revetment	800	EL+15.0		
Total (Revetment)	3,100	-	-	-
(Excavation)	860 thousand m3			
(Backfill/embankment)	860 thousand m3			

7.1.6 Preliminary Design of River Facilities

(1) Adoption of Steel Sheet Pile (SSP) Footing

(a) Necessity of SSP Type Footing

Even in the dry season, the foot of eroded bank slope is always submerged in river water with 3~5m in depth. The wet masonry type or grouted riprap type revetment cannot be adopted since it is impossible to sustain the dry condition on the riverbed elevation. In this connection, Steel Sheet Pile revetment shall be applied to footing structure.

(b) Riprap for Scouring Protection

Riprap or equivalent souring protection structures, such as concrete blocks or gabions, shall be put on the roots of SSP to prevent water flow from scouring of riverbed materials adjacent to SSP revetments.

(2) Top Elevation of Revetment

Repeated overflow on the revetment by floodwater would cause the damage and deterioration of revetment. In this connection, top elevation of revetment should be secured at certain level to avoid the frequent overflows.

In view thereof, the top elevation of revetment shall be set at the level equivalent to 10-year return period flood level. However, the location where the revetment structures set in the Enrile has been affected by floodwater behind the bank and the high-elevated revetment installed might hamper the smooth drainage of floodwater into the original river course. Therefore, the elevation of Enrile revetment should be curtailed by the original ground level around the area.

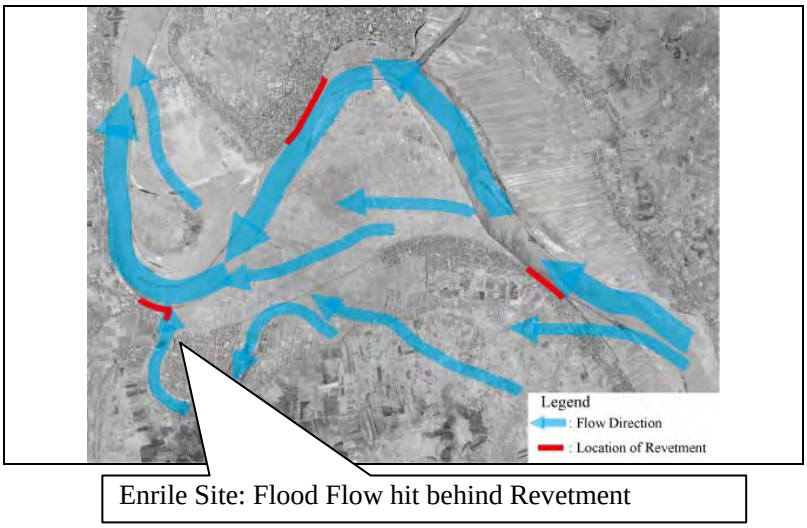


Figure R 7.4 Flood Condition around Enrile Site

The elevations of the top of revetments for each site are tabulated below:

Table R 7.6 Top Elevation of Revetment

Site	Elevation of Top	Remarks
Alibago	EL+15.0m	Consistent with original ground surface
Enrile	EL+20.0m	Equivalent to 10-year Probable Flood Water Level
Cataggaman	EL+20.5m	Equivalent to 10-year Probable Flood Water Level

Therefore, Enrile site would be liable to overflow on the new revetment. Taking into consideration such frequent overflow of flood water on the crown of the revetment, the top of revetment at Enrile site should be protected and covered with stiff gabion mattress structure.

(3) Wet Stone Masonry Revetment

Wet stone masonry (grouted riprap) 250mm~300mm in thickness shall be adopted for upper structure. The gradient of revetment slope is applied for 1:3.0 (V:H) in accordance with the proposed dimension of flood protection dike in 2002 F/S in addition to the reason for the alleviation of stress to SSP structure below wet stone masonry revetment.

(4) Typical Cross Section

The integrated standard design cross sections for each site are illustrated in Figure 7.9 respectively.

(5) References

In sub-section "7.1.4 Flood Simulation Analysis" and sub-section "7.1.5 Applied Structural Measures", Cut-Off Channel proposed in 2002 F/S as Alternative has been evaluated. The effectiveness of typical cross section shown in Figure 7.10 against certain magnitudes of floods has been confirmed.

7.1.7 Construction Plan

(1) Basic Policy of Construction Plan

(a) Scope of Works for Construction of Proposed Structural Plan

Proposed structural component is manly composed of the construction of the revetment structure against bank erosion, such as SSP with riprap or gabion for counter weight and scouring protection at foot of SSP, wet stone masonry (grouted riprap). Their works aims to safely flow the floodwater without critical erosion and scouring.

The work items consists of five (5) majors; namely backfilling work together with excavation work on opposite side of low water channel, furnishing and driving of SSP, riprap work, concreting works for coping concrete of SSP and base, top and partition concrete, wet stone masonry work for upper revetment.

These works will ideally be undertaken during 2011-2013 as shown below.

(b) Major Features of Facilities and Construction Procedure/Method

Major requirements for the works are as follows.

- The type of revetment proposed is mainly embankment (backfill) type with SSP and masonry protection on river side slope.
- The excavation works in opposite side of low water channel is attendant works on backfilling works.
- Riprap work is implemented to protect the foot of SSP.

Major part of construction work will be embankment (backfilling works), SSP driving work and masonry work. Construction procedure/method of SSP and Masonry shall be as follows.

SSP Driving and RiprapWorks

- At first, SSP should be driven straight without bending and deformation complying with designed length and specification.
- Driving works are undertaken by the proper driving equipment, such as Vibro Hammer matching site condition, type of SSP and the required length to be driven.
- Riprap works are sent to the bottom on river side of SSP utilizing suitable wheel crane or equivalent equipment.
- Riprap works shall be carefully executed so as not to cause damage to SSP revetment.

Backfilling Works

- After completion of certain length of SSP Driving, backfill work shall be commenced with dewatering works inside SSP.
- As for backfilling works, it is necessary to make sure that the compaction retains the required consistency. Earth fill work should be implemented in accordance with the compaction regulations to maintain such strength against settlement, shearing force and piping.
- Basically, backfilling material will be obtained on opposite side of low water channel to secure original low water channel area and to shift the flow.
- Earthwork equipments are bulldozers and backhoes for excavation, dump trucks or barges for transport, and tamping rollers or tamping machine approved by the client for compaction.

Masonry and Concreting Works

- After completion of backfilling works till the top of SSP, masonry and concreting works will be commenced in association with the backfilling works.
- Grouted cement mortar plugged between each cobble stone shall be put correctly in a courteous manner.

(c) Backfilling Material Sites

Basically, backfilling material should be obtained from the opposite side of low water channel to secure the flow area equivalent to original extent at each site.

Location map of borrow sites is shown in Figure. 7.11 attached.

(2) Basic Condition of Construction Schedule

The construction schedules to be prepared are based on the scope of works defined above with the working quantities for the each work item through the feasibility study. Each of the scheduled activities contains labor to be assigned and equipment resources considered with the most appropriate method to the particular site conditions and requirement of the work.

In F/S study, unit construction schedules for each work item has been analyzed and fixed in this section hereinafter.

(a) Work Quantity of Major Construction Work Items

The major construction work items are divided into following five (5) main work items: (1) Earth Works (i.e. Excavation and Backfilling), (2) Driving of SSP, (3) Riprap Works, (4) Masonry Works, and (5) Concreting Works. The work items and their work volumes are as listed below:

Table R 7.7 Major Construction Works for Alibago Site

Alibago Revetment Project *Major* Work Description		Quantity	Unit
Earth Work			
	Clearing and Grubbing	12,206	m^2
	Removal and Stripping of Topsoil	12,206	m^2
	Excavation and Loading -1	301,563	m^3
	Hauling - 2 km -1	301,563	m^3
	Dike Embankment	301,563	m^3
Revetment Works			
	Stone Masonry/Wet Stone Masonry-1	34,817	m^2
	Gravel Bedding and Backfill	5,223	m^3
	Gabion Mattress, w/ Filter Cloth Bedding	0	m^3
	Riprap (Boulder, 30~50cm Dia.)	5,776	m^3
	Furnishing Steel Sheet Pile	2,498	ton
	Vibro-Hummer Piling of SSP Type IV-w	10,349	m^2
	Concrete Work for Small Structure-2	1,637	m^3
	Formwork F2 (for Small Sized Structure)	4,658	m^2
	Reinforcing Bar (Grade 60)	131	ton

Table R 7.8 Major Construction Works for Enrile Site

Enrile Revetment Project *Major* Work Description		Quantity	Unit
Earth Work			
	Clearing and Grubbing	10,014	m^2
	Removal and Stripping of Topsoil	10,014	m^2
	Excavation and Loading -1	97,528	m^3
	Hauling - 2 km -1	97,528	m^3
	Dike Embankment	97,528	m^3
Revetment Works			
	Stone Masonry/Wet Stone Masonry-1	19,608	m^2
	Gravel Bedding and Backfill	2,941	m^3
	Gabion Mattress, w/ Filter Cloth Bedding	5,022	m^3
	Riprap (Boulder, 30~50cm Dia.)	12,432	m^3
	Steel Sheet Pile Type IIIA, Furnishing and Driving	12,255	m^2
	Concrete Work for Small Structure-2	1,091	m^3
	Formwork F2 (for Small Sized Structure)	3,505	m^2
	Reinforcing Bar (Grade 60)	87	ton

Table R 7.9 Major Construction Works for Cataggaman Site

Cataggaman Revetment Project *Major* Work Description		Quantity	Unit
Earth Work			
	Clearing and Grubbing	3,778	m^2
	Removal and Stripping of Topsoil	3,778	m^2
	Excavation and Loading -1	458,815	m^3
	Hauling - 2 km -1	458,815	m^3
	Dike Embankment	458,815	m^3
	Grass Sodding	4,465	m^2
Revetment Works			
	Stone Masonry/Wet Stone Masonry-1	51,615	m^2
	Gravel Bedding and Backfill	7,742	m^3
	Gabion Mattress, w/ Filter Cloth Bedding	0	m^3
	Riprap (Boulder, 30~50cm Dia.)	72,413	m^3
	Furnishing Steel Sheet Pile	3,704	ton
	Vibro-Hummer Piling of SSP Type IV-w	10,372	m^2
	Concrete Work for Small Structure-2	2,427	m^3
	Formwork F2 (for Small Sized Structure)	6,905	m^2
	Reinforcing Bar (Grade 60)	194	ton

(b) Climate Condition

The characteristic of climate at the project area is dominated by the rainy season from May to October and dry season for the rest of the months. The total rainfall from May to October accounts for about 80% of the annual rainfall.

(c) Available Working Time

In determining the number of working days available for construction activities, the following factors are considered:

- Working day per week, Working hours per day
- Public Holiday
- Rainfall
- Type of Construction Activity

(i) Working Day per Week, Working Hours per Day

The normal workweek consisting of six (6) working days is adopted for developing all calendars in the sure track program. All construction schedules are based on an 8-hour per a working day.

(ii) Public Holiday

The following days are excluded from the working calendars as public holidays:

Holiday	Date
New Year's Day	January 1
Maundy Thursday	On day in March / April
Good Friday	On day in March / April
Labor Day	May 1
Independence Day	June 12
National Heroes Day	August 30
All Souls Day	November 1
Bonifasio Day	November 30
Christmas Day	December 25
Rizal Day	December 30
Special Holiday	December 31
Sub-total of Public Holiday	11 days

In addition, an allowance is made for four (4) extra days that may be declared non-working by government on account of special events. Thus, total number of non-working days accounts for 15 days in this study.

(iii) Daily Rainfall and Annual Working Day

The time lost due to rainfall was based from the rainfall data and the number of rainy days. It is recognized that the effect of rain on different types of construction activities will vary.

Based on the previous construction plans under JICA or JBIC projects, the total number of working days available annually for different activities is established by incorporating all assessed time losses into the eight (8) items shown in the following table:

Table R 7.10 Annual Working Day for Major Work Items

Work Item	Sunday	Public Holiday	Rainy at Weekday	Suspension Day	Annual Working day
Structural Excavation	52	15	51	12	235
Gabion Works	52	15	51	12	235
Embankment /Backfill	52	15	51	12	235
Concrete Work	52	15	51	-	247
Revetment Work	52	15	51	-	247
Grading Works	52	15	51	-	247
Canal Facility Work	52	15	51	12	235
Road Work	52	15	51	12	235

(d) Works Productivity

Major equipment items were selected based on the equipment capacity quoted from the publication of the Association of Construction and Equipment Lessors, Inc. (Equipment Guidebook 2001, edition 22, ACEL). Labor requirement were assessed using a mix of productivity rates provided through the current practice and the rates recorded on similar overseas projects.

(i) Earth Works

The performance of the construction machine is assumed as listed in the flowing table taking the most suitable machine combination and the reuse of the excavation soil.

Based on the performance of the construction machine, the construction period of earthwork was estimated. Due to huge volume of earth work, critical paths are attributed to the construction schedule of earth work for each retarding basin.

Table R 7.11 Performance of Construction Machines in Earth Work

Item of Earth Work	Major Equipment	Performance Capacity	Remarks
Common Excavation	Bulldozer (32t)	146 m^3/hr	
Loading	Backhoe (1.0m^3)	104 m^3/hr	
Hauling	Dump Track (10t)	30.8 m^3/hr	Distance: 0.5 km.
	Dump Track (10t)	8.0 m^3/hr	Distance: 8 km.
	Dump Track (10t)	6.7 m^3/hr	Distance: 12 km.
Grading & Compaction	Bulldozer (21ft)	100 m^3/hr	Disposal site, Road work
Compaction of Embankment	Tamping Roller	55 m^3/hr	Road Work

(ii) Concrete Work and Revetment Work

Concrete works and revetment (masonry) works are also main construction works other than earth work. The construction period of concrete of the small structure and placing work of masonry are estimated on the basis of the following assumptions:

Table R 7.12 Performance of Main Construction Work

Item of Work	Daily Capacity	Remarks
Concrete Work	60 m^3/day/party	Depending on Concrete Pump
Gabion Work	75 m^3/day/party	t=500 mm, Equivalent to 37 m^3/day/party
Revetment Work (1:2.0)	38 m^3/day/party	Wet Stone Masonry
Revetment Work (1:2.0)	13 m^3/day/party	Concrete Block
SSP Driving Works	10 m/day/party	Type III~IV

(3) Construction Schedule

In accordance with the program and strategy mentioned above, the entire construction period for the major work components of the optimum structural plan was assumed as shown in the following table.

Table R 7.13 Construction Schedule for Cagayan River Revetment Construction Project

Working Item	Unit	Q'ty	Year : 1 (1–12)	Year : 2 (13–24)	Year : 3 (25–36)
Mobilization & Preparatory Work	L.S.	1			
Earth Work					
Clearing & Grubbing, Stripping of Top Soil	m^2	25,998			
Excavation	m^3	857,906			
Backfill	m^3	857,906			
Revetment Work					
Stone Masonry/Wet Stone Masonry-1	m^3	106,040			
Gravel Bedding and Backfill	m^3	15,906			
Gabion Mattress, w/ Filter Cloth Bedding	m^3	5,022			
Gabion Mattress for SSP Protection	m^3	90,620			
Steel Sheet Pile Furnishing and Driving	m^2	47,295			
Concrete Work	m^3	5,155			
Reinforcing Bar (Grade 60)	ton	412			
Others					
Grass Sodding	L.S.	1			
Other Reinforced Concrete Work	L.S.	1			
Site Clearance / Cleaning	L.S.	1			
Demoblization	L.S.	1			
Completion					

7.1.8 Cost Estimation

(1) Constitution and Conditions of Project Cost

Project cost has been estimated under the following conditions:

(a) Construction Base Cost

Construction base cost is composed of direct cost estimated based on the work quantities multiplied by unit cost, and indirect cost which is estimated in percentage.

(b) Price Level

Price level is as of August 2009.

(c) Contingencies

Price escalation and physical contingencies are assumed as follows:

Annual Price Escalation: 5.20% for Local Currency Portion;
2.10% for Foreign Currency Portion

Physical Contingency : 10% of the sum of construction base cost, compensation cost and engineering service cost

(d) Currency Conversion Rate

Currency conversion rates are assumed at USD1.00 = JPY93.67 = PHP49.70 as of the end of August 2009.

(e) Compensation Cost

Compensation cost consists of the costs of house evacuation and land acquisition. These costs are estimated on the basis of actual market value obtained from the Interview Survey in Tuguegarao and Enrile of land and properties assessed for taxation purposes in the locality and the actual cost of past or ongoing house evacuation activities, as well as the ongoing projects of similar nature under JBIC and DPWH such as the Iloilo Flood Control Project and the Pasig-Marikina River Channel Improvement Project (River-Overflow Flood Mitigation Projects).

The compensation unit costs are enumerated below.

Table R 7.14 Adopted Compensation Cost for F/S Study

Item of Cost	Site/Condition	Unit Cost Php/ha for Land , Php/(house/family) for House		
		Zonal Value*1	Market Price *1	Adopted Price
Land Acquisition	Alibago	200,000	200,000~300,000	300,000
	Enrile	200,000	200,000~300,000	300,000
	Cataggaman	200,000	200,000~300,000	300,000
House Relocation	Formal Residents	-	-	350,000
	Informal Dwellers	-	-	50,000
Support Activities	All Concerned Families	-	-	50,000

Note *1 : Results of hearing survey with Officers concerned based on in-real land sale.

(f) Administration Cost

Administration Cost (Project Owner's Expense for management) of the Project is estimated at 5% of the total sum of construction cost and compensation cost.

(g) Engineering Service Cost

Engineering service cost is prepared for the detailed engineering design and construction supervision services at 6% and 10% respectively of construction base cost.

(h) Tax, etc.

12% of the sum of construction base cost and engineering service cost is added to project cost for VAT, etc.

(i) Constitution of Project Cost

Based on conditions described above, the constitution of the project cost is given a below:

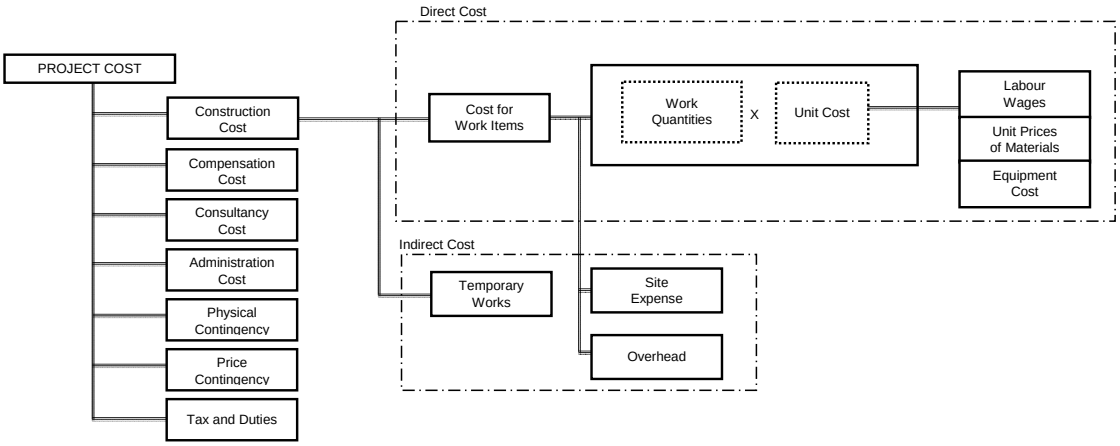


Figure R 7.5 Constitution of Project Cost

(2) Construction Base Cost

The construction base cost is estimated as the sum of the direct cost and the indirect cost.

(a) Direct Cost

The estimate for direct costs is performed based on the quantities of all construction tasks shown on figures and described in the project requirements. The direct cost includes all of countable element due to the type, size, design, construction procedures and quality of the intended structure, which are taken into account when deriving the cost for each work item. The costs are estimated on the unit cost basis as shown below:

Direct Cost = ∑(Unit Cost for a Payment Item x Work Quantity for a Payment Item). The unit cost can be estimated based on the basic costs such as labor wage, unit prices of materials and equipment cost.

In direct cost, "Overhead & Profit" shall be included. "Overhead" is the expense for the main and branch office support of the Contractor composed of director's remuneration, retirement allowances, communication fee, advertising, research activities, social expense, profit and insurance. "Profit" is the profit of the contractor. 16 % of the sum of the direct cost, "Overhead & Profit" is adopted.

(b) Indirect Cost

The indirect cost on the project is an integral part of each estimate. "Temporary works", "Site expense" and "Mobilization & Demobilization" are considered as the indirect cost.

"Temporary works" includes items such as temporary buildings, electrical facilities, water supply system, access road construction and maintenance, and temporary utilities. 10 % of the sum of the direct cost is adopted.

"Site expense" includes the cost items such as salary and allowance of the Contractor's employee, job office expenses, consumables, small tools and insurance at site. 10 % of the cost for the direct cost and "Temporary works" is adopted.

"Mobilization & Demobilization" includes the costs such as the movement of the contractor's equipment, facilities and man powers at the commencement and retreat of the Project. 1 % of the cost for the direct cost and "Temporary works" is adopted.

(3) Project Cost

Based on the above assumptions, the project cost estimated for the optimum structural flood mitigation plan is estimated at Php. 3,163 million in total, which is divided into (1) Php. 1,871 million for the construction base cost, (2) Php. 20 million for the compensation cost and (3) Php. 299 million for the consultancy service, (4) Php. 117 million for the administration cost, (5) Php. 554 million for the contingencies and (6) Php. 324 million for the value added tax, etc. The breakdown of the project cost is given in Tables 7.2 to 7.4, and as tabulated below:

Table R 7.15 Project Cost for the Proposed Structural Erosion Mitigation Measures

Objective	Item	Description	Cost (mil. P)
Cagayan River Improvement Project			
	Construction Base Cost	Civil	1,871
	Compensation Cost	House/Support	4
		Land	16
	Consultancy Services	D/D & S/V	299
	Administration	5% of Civil& Compensation	95
	Subtotal		2,285
	Contingencies	Physical for Civil, D/D & S/V	217
		Physical for Compensation	2
		Price for Civil, D/D & S/V	311
		Price for Comp. & Admin.	24
	Value Added Tax, etc	12% of Civil & Consultancy	324
Grand Total			3,163

(4) Operation and Maintenance Cost

The operation and maintenance cost mainly consist of costs for Patrol/Inspection Work, Maintenance Work and Operation Work. These costs include facility maintenance cost, cost for the administrative and logistic support, cost for operation cost in case of flooding, cost for repair of the structures, and other miscellaneous expenses but exclusive for heavy damage due to calamities, such as seismic forces and huge flood.

The annual operation and maintenance cost is estimated at Php 5.31 million upon completion of the three retarding basin as listed in the table below.

Table R 7.16 Project Cost for the Proposed Structural Flood Mitigation Measures

Work Item	Annual Cost (mil. P)	Remarks
Patrol/Inspection	0.02	Inspection & Preventive
Maintenance	5.25	Annual Repair
Operation	0.04	During Flood (Mean Annual Amount)
Total	5.31	

Details of operation and maintenance cost for the structural plan are given in Table 7.5. The necessary annual budget proposed should be assured from both budgets of DPWH, Province and LGU with approval and concurrence of FMC or similar mandatory committee for flood mitigation activities.

7.2 Economic Evaluation of Project

7.2.1 Methodology

Taking NEDA policy into consideration, economic evaluation is made according to the following steps in this kind of project:

1) Identify the most likely damage item.
2) Estimate the basic unit value per unit and/or unit area (amount/unit, or amount/ha) for each damage item.
3) Evaluate the damages of existing floods to be the basis of evaluation.
4) Estimate the annual average flood damages by means of probability analysis for each return period under the “With-” and “Without-Project” concept.
5) Identify the economic benefit as differences of damages in the “With-” and “Without-Project” conditions.
6) Compare the economic benefit with the economic cost of project, and evaluate project feasibility by means of some indices such as the economic internal rate of return (EIRR), the net present value (B – C), and the B/C Ratio.

The Economic Internal Rate of Return (EIRR) is calculated using the cash flow of economic cost and economic benefit during the project life. This EIRR is defined by the following formula:

$$\sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t} = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t}$$

Where, T = the last year of the project life;

Ct = an annual economic cost flow of the project under study in year t;

Bt = annual benefit flow derived from the project in year t; and

Re = the EIRR (a discount rate to be used for costs resulting in the same amount of benefit in terms of present value).

When the resulting EIRR is of the same rate as or higher than the discount rate applied for the calculation of present value of both the benefit and cost, the project has the feasibility for execution.

The NPV is expressed as "B-C" and defined by the following formula:

$$NPV = B - C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} - \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

If "B-C" (subtract present value of cost from present value of the benefit) would become positive, it means that the project under the Study will have a reliability to execute.

The B/C Ratio is defined by the following formula:

$$B/C = \sum_{t=1}^{t=T} \frac{B_t}{(1+R_e)^t} \Big/ \sum_{t=1}^{t=T} \frac{C_t}{(1+R_e)^t}$$

It means that, if the rate of the present value of the benefit divided by the present value of the cost would become more than "1.00", then the project under study will have a reliability to execute.

Project life is assumed at 50 years after completion of river channel improvement works and 30 years after completion of inland drainage works for the Project. Cash flow of the economic cost and economic benefit should be made from the first year of the construction works to the end of each project life.

In this case, annual operation and maintenance cost (O&M Cost) should be taken into account, and some amount of replacement cost, if any, should also be taken into consideration since some parts of the initial works for the facilities may not be durable during the project life.

7.2.2 Basic Unit for Estimation of Economic Benefit

(1) Damages to Buildings, Household Effects, Durable Assets and Inventory Stocks in Built-Up Area

First of all, the number of buildings is counted by City Profile according to the type of building, i.e., (1) Residential/Housing units; (2) Manufacturing; (3) Wholesale and Retail Trade (Shops); (4) Hotels and Restaurants; (5) Real Estate and Business Activities (Offices); (6) Education Facilities; and (7) Buildings for Health and Social Works, because property values vary according to the type of building. In this case, the share rate of each type of building to the total number of buildings is assumed in the Study.

The following table shows the share rates of each type of building per unit area:

Table R 7.17 Share Rate of Buildings by Type

Kind of Building	Share Rate
Total	100.00%
1. Housing Units	86.58%
2. Manufacturing	0.10%
3. Wholesale & Retail Trade	12.65%
4. Hotels & Restaurants	0.06%
5. Real Estate & Offices	0.05%
6. Education Facilities	0.36%
7. Health/Medical Facilities	0.20%

Source: Tuguegarao City

As basic units for the estimation of damages, the figures shown in the following table are to be applied. These figures are based on the said similar projects in the Philippines modified by the magnitude of buildings, the ratio of gross regional domestic product (GRDP), results of site investigation and interview with the officials concerned city/municipality of Tuguegarao and Enrile.

Table R 7.18 Economic Basic Units for the Estimation of Flood Damage

(Unit: Pesos/unit)

Assets	Building (*1) (Pesos/ unit)	Durable Assets (Pesos/unit)	H. Effects/ Inv. Stock (Pesos/unit)	Value Added (*2) (Pesos/day)	Damageable Value (Pesos/ha)	Daily Amount (*3) (Pesos/day)
1. Residence						
a. Residential Unit	151,532		101,793			621
2. Industrial, Educational and Medical Facilities						
a. Manufacturing	3,780,000	12,962,009	2,454,666	11,680		
b. Wholesale & Retail Trade	653,850	1,594,476	3,005,608	2,682		
c. Hotels & Restaurants	1,252,200	759	14,895	2,071		
d. Real Estate & Business Activities	799,200	544	65,706	10,239		
e. Education	2,991,600	717,984	13,857	0		
f. Health & Social Work	1,866,900	481,781	43,392	0		
3. Crop Production						
a. Palay						
b. Corn					36,151	
c. Sugarcane						

Note: *1: Per square meter cost is derived using 1st quarter 2009 index of construction cost of NSO, formula used based on NEDA guidelines

*2: VA is calculated based on not actual business days of 250 days but 365 calendar days.

*3: In residence, the daily amount for cleaning damaged house is equivalent to daily income of an average family because they should stop working for cleaning.

Furthermore, the following table shows the damage rates for the estimation of damages according to inundation depth. In this case, inundation duration is already taken into consideration assuming it to be 2 days on average for agricultural crops.

Table R 7.19 Damage Rate by Inundation Depth

Item		Inundation Depth					
		Below Floor/Ground Level	Over Floor/Ground Level				
			Less than 0.5m	0.5-0.9m	1.0-1.9m	2.0-2.9m	More than 3.0m
1	Building						
	a Building*[1]	0.000	0.092	0.119	0.266	0.380	0.834
2	Residence						
	a. Household Effects	0.000	0.145	0.326	0.508	0.928	0.991
3	Industrial, Educational and Medical Facilities						
	a. Depreciable Assets	-	0.232	0.453	0.789	0.966	0.995
	b. Inventory Stock	-	0.128	0.267	0.586	0.897	0.982
4	Crop Production *[2]						
	a. Lowland Crop	-	0.210	0.240	0.370	0.370	0.370
	b. Upland Crop	-	0.200	0.310	0.440	0.440	0.440

Note: *1 In case of all buildings, floor level is 15cm higher than the ground level, because t almost all buildings have the threshold of around 15cm in height in front of their entrances according to the field investigation.
*2 Assuming that inundation duration is 2 days on average.

(2) Income Losses due to Cleaning of Building and/or Houses and Business Suspension

Once flood occurs and houses are inundated, several days will be needed for cleaning the houses. In case of business activities, they should be suspended for several days. During these days, people's income is decreased because they stop working or businesses are suspended.

Average daily income per household (HH) is estimated at 621 pesos/day as of 2009 (estimated based on CPI) in Region II (CAGAYAN Region) according to the "Philippine Yearbook 2008" and as shown in Table R 7.17 above together with the average daily amount of value added tax for business activities. The average number of days needed for cleaning and business suspension are estimated, as shown in the following table.

Table R 7.20 Estimated Days for Cleaning and Business Suspension by Inundation Depth

Item	Inundation Depth					
	Below Floor Level	Above Floor Level				
		Less than 0.5m	0.5-0.99m	1.0-1.99m	2.0-2.99m	More than 3.0m
1. Residence						
Cleaning (days)	-	7.5	13.3	26.1	42.4	50.1
2. Business Facilities						
Suspension of Business (days)	-	4.4	6.3	10.3	16.8	22.6
Stagnant Days of Business after Suspension*[1]		2.2	3.2	5.2	8.4	11.3
Total		6.6	9.5	15.5	25.2	33.9

Note: *1 Businesses shall be suspended during the stagnant days.

(3) Damage to Industrial Estates

There are several large industries besides a small and medium-sized manufacturing. Damages due to floods also extend over these industrial areas. The damages are estimated as the statistical decrease in "value added" corporate income and the amount of value added income which is estimated for small scale and micro scale industries in the built-up

areas. The following table gives a summary of the basic unit for estimation of damages. In this case, the industrial area is estimated by means of GIS.

Table R 7.21 Basic Unit for the Estimation of Damages to Industrial Estates

Unit Value Added of All Commercial Sectors in Built-Up Area (Pesos/ha./day)	Unit Value Added in Large-Scale Industries in Industrial Estate (Pesos/ha./day)
3,433 Pesos/ha./day (*1)	631,675 Pesos/ha./day (*2)

Remarks: (*1) [Unit value added of all commercial sectors in built-up area]
= [26,671 Pesos/day/unit (total of "value added" of all commercial sectors, 2.a~d in Table R 7.16)]
x [0.1287 unit/ha (total number of unit of all commercial sectors per area, b~e in Table R 7.15)]

(*2) [Unit value added in large-scale industries in industrial estate]
= [3,433 Pesos/ha./day (Unit value added of all commercial sectors in built-up area)]
x [184 = (value added of industries in industrial estate) / (value added of small/micro scale industries in built-up area)] (*3)

Source: (*3) 2008 Annual Survey of Philippine Business and Industry (by NCSO)

(4) Damage to Agricultural Crops

It is assumed that the damaged agricultural crops in irrigated areas are mainly "corn" based on statistical records and the results of field investigation, while the damaged upland crops are mainly corn.

Farm gate prices of corn are mentioned in Table R 7.16 as 36,151 pesos/ha estimated in the table below, and their damage rates are already indicated according to inundation depth in Table R 7.17.

Table R 7.22 Damageable unit price of Agriculture

	Crop Production (metric tons)	Area Harvested (ha)	Crop Yield (kg/ha)	Farmgate Prices (Pesos/kg)	(Pesos/ha)
Irrigated Palay	570,332	142,846	3,993		
Rainfed Palay	136,840	57,249	2,390		
Corn	297,984	82,428	3,615	10.00	36,151
Sugarcane	202,535	6,227	32,525		
Coconut	34,290	6,564	5,224		
Banana	75,705	4,805	15,755		

Source: Bureau of Agricultural statistics website, (www.bas.gov.ph)
*: Total in Cagayan Province

(5) Damage to Social Infrastructures (Roads, Bridges, Drainage Ditches)

Once flood occurs, social infrastructures such as roads, bridges, drainages sustain heavy damages. This is the other kind of damage to be checked. According to some previous flood control projects in the Philippines, the damage of social infrastructures is approximately 10% of direct damage. Therefore, the damage is assumed to be 10% of total amount of item (1) to (4) above in this Study.

(6) Other Indirect Damages

Following items can be considered as indirect damage.

- Losses due to interruption of transport service and/or detour losses,
- Saving of expenses for the support of evacuees,

- Losses due to interference of supply from lifeline facility such as water, gas and electricity,
- Medical expenses (medical cost and/or fees for some of waterborne diseases may be people's burden), and
- etc.

However, further basic data such as traffic volume, estimation of evacuees including food, water, medicines, tents, blankets, dishes, etc are required for the estimation of above indirect damage requires.

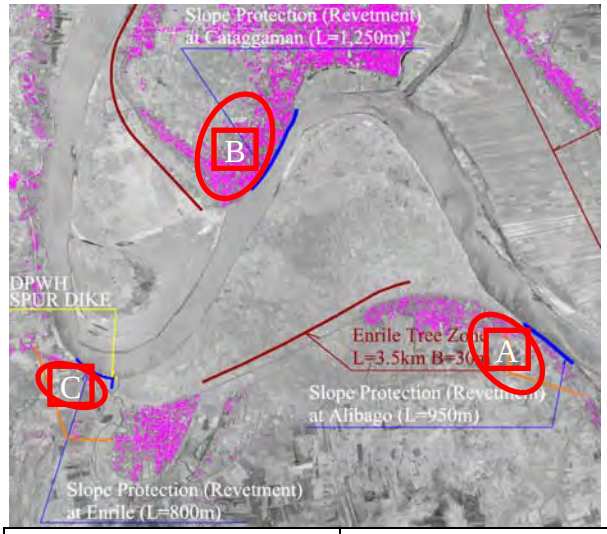
In a previous flood control project report in the Philippines, indirect damage is approximately 10% to 30% of direct damage. Then, it is assumed to be 20% of the above total amount of item (1) to (4) as indirect damages in this Study.

(7) Damages due to the Losses of Properties of Individuals, Infrastructures and Land by Scouring and Erosion

As described in Section 7.1, the proposed structures for Sector Loan are revetments at three (3) locations, namely Alibago, Cataggaman and Enrile. Therefore, it is necessary to estimate the damages unless the revetment structures are constructed.

(a) Areas to be Protected

As shown in Figure below, the protected areas (beneficial areas) for revetments are as follows:



Location	Area to be Protected (has)
Alibago	40
Cataggaman	80
Enrile	30

Figure R 7.6 Areas to be Protected by Revetment

(b) Items of Damages due to the Losses of the Land by Erosion

It is expected that the following damages should be shouldered by affected stakeholders, such as residential peoples, city and municipal governments and national agencies, as collateral costs for damage restorations and loss of territory:

- Construction Costs for Alternate Road due to disappearance of existing roads by erosion,
- Losses of Residue Values for Infrastructures, such as road, water utility, electrical facilities, drainage facilities, etc.,
- Improvement Losses of Existing Houses, Buildings
- Costs for preparation of new houses and buildings in other lots,
- Property Losses of Land,
- Cost for purchasing new lots for housing and buildings

In addition to the collateral costs aforementioned, the lots/lands lost by erosion have brought forth the productivities and contributed the regional economy as high efficient locations. Therefore, the following productivities will be charged off as losses of lands.

Table R 7.23 Assumed Annual Negative Profit for Productivities due to loss of the land by Erosion in Tuguegarao City

Land Area	km^2	Remarks	Source
Administrative	113.95	-(A)	*1
Developed Area	20	-(B)	*2
Urbanized	2.45	-(C)	*1
City Product	million pesos	Remarks	Source
Primary Sector	3,778.15	-(D)	*1
Secondary Sector	5,486.05	-(E)	*1
Tertiary Sector	12,406.17	-(F)	*1
Total	21,670.37	-(G) : (D)+(E)+(F)	*3
Index	pesos/ha	Remarks	Source
Mean	1,901,743.75	-(H) : (G) / (A)	*3
Developed Area	8,946,110.00	-(I) : ((E)+(F)) / (B)	*3
Urbanized Area	73,029,469.39	-(J) : ((E)+(F)) / (C)	*3

Source : *1 : http://www.tuguegaraocity.gov.ph/urban.html
*2 : Estimated by the Study Team
*3 : Calculated by the Study Team

In this regard, the following values are applied to the annual negative profits at each location:

Table R 7.24 Adopted Unit of Annual Negative Profit

Site	Applied unit
Alibago	1.90 million pesos / year / ha
Cataggaman	8.95 million pesos / year / ha
Enrile	1.90 million pesos / year / ha

7.2.3 Identification of Economic Benefit

The economic benefit is given as the difference between annual average damages in cases of "with project" and "without project," i.e., the economic benefit is to be the value of "average expected damage to be mitigated". For this purpose, annual average damages "with project" and "without project" should be estimated and the target year is set at the year 2020. In this

connection, therefore, the said annual average damage is estimated in both cases of "2009 Land Use Status" (hereinafter referred to as "Present") and "2020 Land Use Status" (hereinafter referred to as "Future").

(1) Estimation of Erosion Damage

The following table shows a summary of the total damage during 30 years caused by erosion on each property item mentioned above Sector 7.2.2. Detail estimation sheet is tabulated in Table 7.6 and Table 7.7.

Table R 7.25 Estimated Damage

Name of	Without Project		With Project (Revetment)	
Property	Accumulated	Annual	Accumulated	Annual
House	1,236	-	0	0
Other Building		-	0	0
Infrastructures	502	-	0	0
Lots/Lands	1,542	849	0	0
Total	3,280	849	0	0
Annual Average during 30years	109	849 (28 per anum)	0	0

Note: Unit : million pesos

(2) Estimation of Annual Average Expected Damage to be mitigated

The annual damage caused by scouring and erosion refers to the annual benefit to be mitigated by the construction of revetment at three (3) locations. Therefore, the annual benefits are estimated as shown in Table R7.21 above. If the project is executed, these figures will be the economic benefit in each project scale corresponding to flood return period.

In the future, namely in 2020, the land use status will have changed as projected by the CLUP, and urbanization will have increased. In case none of the measures for the mitigation of erosion damage as indicated in the above table has been executed, losses or damages will greatly exceed the damage under the present land use status.

7.2.4 Estimation of Economic Cost

(1) Standard Conversion Factor (SCF)

The Standard Conversion Factor (SCF) has been estimated as 0.97166 based on the international trade statistics, as shown in the table below.

Here, SCF is calculated by the following formula.

$$SCF = \frac{\sum I + \sum E}{(\sum I + \sum I_{customs}) + (\sum E - \sum E_{tax} + \sum E_{subsidy})}$$

Where,

SCF	=	Standard Conversion Factor
I	=	Import Amount
E	=	Export Amount
Icustoms	=	Import Duties (Custom Duties)
Etax	=	Export Tax
Esubsidy	=	Export Subsidy

The following table shows the calculation of the Standard Conversion Factor (SCF).

Table R 7.26 Calculation of Standard Conversion Factor

(million Pesos)

Year	Export in Mil Pesos	Import in Mil Pesos	Import Duties (Customs Duties)	Export Tax	Export Subsidies
2002	1,803,362	2,045,007	96,835	0	0
2003	1,948,514	2,214,951	100,694	0	0
2004	2,215,363	2,501,868	122,715	0	0
2005	2,255,393	2,637,873	151,474	0	0
2006	2,414,597	2,680,841	190,797	0	0
Total	10,637,231	12,080,540	662,515	0	0
				SCF =	0.97166

Source: Philippine Year Book 2008 and NSO website

(2) Personal Income Tax

Usually, project cost consists of cost for equipment and materials, and cost for manpower as personnel expenses and labor cost. For the cost of manpower, personal income tax is one of the transfer items. Therefore, the amount of personal income tax should be deducted from the project cost. Of course, personal income tax may consist of several levels in percentage. In this Project, the rate of 5% is applied for labor and 12% for consulting (engineering) services as the minimum rates according to the Tax Code of the Philippines.

(3) Shadow Wage Rate

Based on similar projects in the Philippines, the shadow wage rate of 0.60 is applied to unskilled labor employed for the Project.

(4) Shadow Price of Land

Also based on the said similar project in the Philippines, the rate of 0.50 is applied as the conversion factor for making clear the shadow price of land needed to be acquired for the Project.

(5) Taxes

All kinds of taxes are transfer items. Therefore, the taxes, if any, should be deducted from the financial cost for the conversion into economic cost. In the Project, the value added tax (VAT) of 12% is applied according to the said Tax Code of the Philippines.

(6) Corporate Profit Tax

In the Philippines, the net profit of corporations as contractors is estimated as 10% to 20% or more of the contract price. In this Project, the net profit is assumed at 15% as the reasonable level.

Corporate income tax is levied against the said net profit, and this corporate income tax is also one of the transfer items. Therefore, this tax should be deducted from the financial cost of the Project. There should be several levels of rates of the corporate income tax, but for the Project, 32% is applied based on the said Tax Code of the Philippines.

(7) Economic Cost

Under the conditions and assumptions, the economic cost is converted from the financial cost, as shown in the attached Table R7.23 below. Details of the Financial Cost are as described in the preceding subsection.

Table R 7.27 Economic Cost for the Proposed Structural Measures

Item	Financial Cost (million Pesos)	Economic Cost (million Pesos)
Construction Base Cost with Physical Contingency	2,058	1,801
Compensation Cost with Physical Contingency	22	20
Administration Cost	95	89
Engineering Service Cost with Physical Contingency	329	299
Price Contingencies for All	335	-
Value Added Tax, etc	324	-
Total	3,163	2,210
O&M Cost	5	5

7.2.5 Results of Economic Evaluation for the Project and Conclusion

(1) Estimation of NPV, EIRR and B/S

The economic evaluation for the Project has been made by using a cash stream as indicated in Table 7.8 taking certain conditions and assumption into account. In this case, project life is set at 50 years after completion of the works for river channel improvement. The evaluation process is shown in the attached Table 7.9. The following table shows the results of the economic evaluation.

Table R 7.28 Economic Evaluation Results

Indices	
NPV (million Pesos)	441
EIRR	18.64%
B/C	1.34

As indicated in the above-said table, the Ilog-Hilabangan River Flood Control Project is viable for execution without any problem based on the Economic Internal Rate of Return (EIRR).

(2) Sensitivity Analysis

According to NEDA guidelines, sensitivity analysis shall be carried out using the following scenarios:

Case I : Increase in projected costs by 10% or 20%
Case II : Decrease in revenues by 10% and 20%
Case III : Combination of Cases I and II

From the point of views, the sensitivity analysis was made. The results of the analysis are as summarized below:

Table R 7.29 Result of Sensitivity Analysis

	Case I		Case II		Case III			
Cost	+10%	+20%			+10%		+20%	
Benefit			-10%	-20%	-10%	-20%	-10%	-20%
NPV	312	183	268	95	139	-34	10	-163
EIRR	17.37%	16.29%	17.24%	15.81%	16.07%	14.73%	15.07%	13.82%
B/C	1.22	1.12	1.21	1.07	1.10	0.98	1.01	0.89

As listed above, EIRR fell below 15% under the condition of Benefit -20% and Cost +10% or +20%. In another words, the economic viability of the project could be verified under these pessimistic cases except for the extreme cases.

CHAPTER 8 NON-STRUCTURAL FLOOD MITIGATION PLAN

8.1 Overview of Eligible Measures

In 1976, PD 1566 was enforced to pursue pre-disaster planning, community disaster preparedness and positive, precise disaster control action for rescue evacuation, relief and rehabilitation against natural disaster including floods. In 1988, National Disaster and Calamity Preparedness Plan (NDCPP) was prepared to ensure effective and efficient implementation of civil protection program thru an integrated, multi-sectoral and community based approach and strategies for the protection and preservation of life, property and environment. Based on PD 1566, Disaster Coordination Councils (DCCs) have been organized from the national level to LGU level. In the core area of Tuguegarao City in the Cagayan River basin, which is targeted for Feasibility Study, the Tuguegarao CDCC is undertaking several flood preparedness activities such as designation of evacuation centers, implementation of evacuation and rescue and relief.

In the Philippines, PAGASA is an agency in charge of flood forecasting and warning activities. In 1973, PAGASA commenced operation of the first Flood Forecasting and Warning System (FFWS) in the Pampanga River and at present operates 4 FFWS in Luzon including the Cagayan River Basin. At present, the PAGASA plans, designs and assists the operation of the Community-based Flood Early Warning Systems (CBFEWSs). By the end of 2011, CBFEWSs assisted by the PAGASA will commence operation in 27 provinces.

In the Feasibility Study, inundation conditions are analyzed for floods with several probabilities in the Core Area. Flood preparedness activities for people in the Core Area is conducted based on experienced floods as people in such area will surely encounter much wider and deeper floods exceeding their preparedness. Therefore, it is necessary to formulate a Flood Preparedness Plan in consideration of the probable floods analyzed in the Study. The flood warning under FFWSs by the PAGASA at present aims to disseminate occurrence of flooding and information does not cover magnitude and/or degree of flooding. CBFEWSs operated by cities/municipalities intend to disseminate simpler information to inhabitants.

Under these circumstances, a project using the results of the Feasibility Study for the Core Area of Tuguegarao City is proposed; composing of 1) preparation of flood preparedness plan against estimated probable floods, and 2) establishment of CBFEWSs to provide necessary information for the flood preparedness plan to be implemented.

8.2 Practice of Non-structural Measures in the Philippines

8.2.1 Preparedness Plan

In the Philippines, flood preparedness plans are prepared by Disaster Coordinating Councils (DCCs) organized from the national level to LGUs. Hereunder, DCCs and National Disaster and Calamities Preparedness Plan (NDCPP) are first explained. Then, one project is explained to assist preparedness planning so as to understand/evaluate the existing organization and activities in the Tuguegarao City Core Area.

(1) DCCs and National Disaster and Calamities Preparedness Plan (NDCPP)

On October 19, 1970, after the wrath of Typhoon "Sening" which affected most specially the Bicol Region and caused flooding for almost three (3) months in Metro Manila, President Ferdinand E. Marcos approved the Disaster and Calamities Plan prepared by an Inter-Departmental Planning Group on Disasters and Calamities. This plan includes among others, the creation of the National Disaster Control Center. On June 11, 1978

through Presidential Decree (P.D. 1566), the National Disaster Coordinating Council (NDCC) replaced the National Disaster Control Center as shown in **Figure R 8.1**.

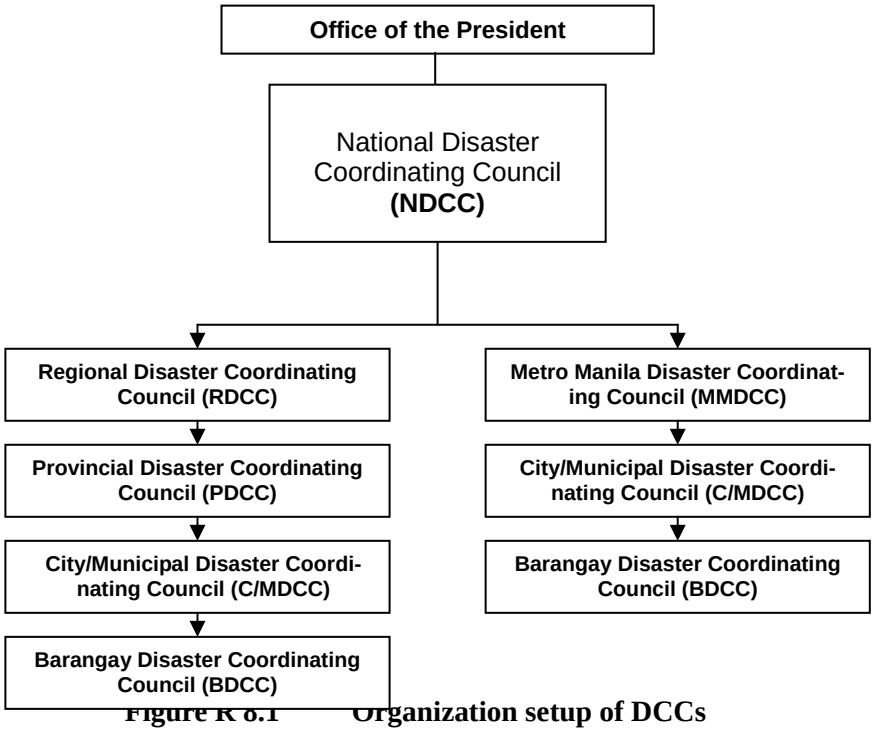


Figure R 8.1 Organization setup of DCCs

In accordance with P.D. 1566, the Office of Civil Defense (OCD) prepared a National Disaster and Calamities Preparedness Plan (NDCPP) in 1988 and implementing plans by NDCC member-agencies. The primary objective of NDCPP is to ensure effective and efficient implementation of civil protection program thru an integrated, multi-sectoral and community based approach and strategies for the protection and preservation of life, property and environment.

To ensure the activities, organizations of national level, regional level and local government level (Figure 8.1) were established. The establishment of the National Disaster Coordinating Council (NDCC) embodies PD 1566. The Secretary of National Defense heads the NDCC with the heads of 18 departments/ agencies as members including Executive Secretary and the Administrator, Office of Civil Defense (OCD) who is the Executive Officer of the Council. The OCD functions as the operating arm or secretariat of the NDCC. The Members of DCCs of Regional and LGU levels are as follows.

(a) Regional Disaster Coordinating Council (RDCC)

- Regional PNP Director - Chairman;
- Heads of Regional Offices and Field Stations – Member;
- National Agencies and Selected Non-Government Organizations (NGOs) – Member

(b) Provincial Disaster Coordinating Council (PDCC)

- Provincial Governor – Chairman;
- Provincial Director of the PNP – Vice Chairman;
- All Organic Provincial Officials – Member; and
- National Officials – Member

(c) City/Municipal Coordinating Council (C/MDCC)

- City/Municipal Mayor – Chairman;
- City/Municipal Director of PNP – Vice Chairman;
- All Organic City Officials – Member; and
- National Officials – Members

(d) Barangay Disaster Coordinating Council (BDCC)

- Barangay Captain – Chairman; and
- Leading Persons in the community - Members

Each Council shall have the following staff elements:

- Damage Assessment and Needs Analysis Unit;
- Emergency Management Information Service Unit;
- Vulnerability Risk Reduction Management Unit;
- Plans and Operations Unit;
- Resource Unit
- Communication Transportation Service and Early Warning Service; and
- Relief and Rehabilitation Service;

(2) Hazard Mapping and Assessment for Effective Community-Based Disaster Risk Management (READY Project)

(a) Outline

The project, supported by the UNDP, AusAID and ADB, aims to address the problems of Disaster Risk Management (DRM) at the local level. At the national level, it aims to institutionalize and standardize DRM measures and processes. At the community level, the project aims to empower the most vulnerable municipalities and cities in the country and enable them to prepare disaster risk management plans. Target areas of the Project are 27 provinces vulnerable to national hazards. The project will be implemented from 2006 to 2011. Responsible agencies are; PHIVOLCS (DOST), PAGASA (DOST), MGB (DENR) and NAMRIA (DENR).

(b) Main Project Components

(i) Multihazard Identification and Disaster Risk Management

MGB made hazard maps on floods and flashfloods on 1: 50,000 scale based on geomorphologic analysis. **Figure R8.2** shows an example for Negros Island. PAGASA will make past flood inundation maps for the flood prone areas covered by the existing 10,000 maps made by the NAMRIA.

(ii) Community-based Disaster Preparedness

- Development of Community-based early warning system for floods/flashfloods by the PAGASA and for Tsunami by PHIVOLCS
- Conduct of Information and Education Campaign (IEC) and distribution of related pamphlets, flyers and posters

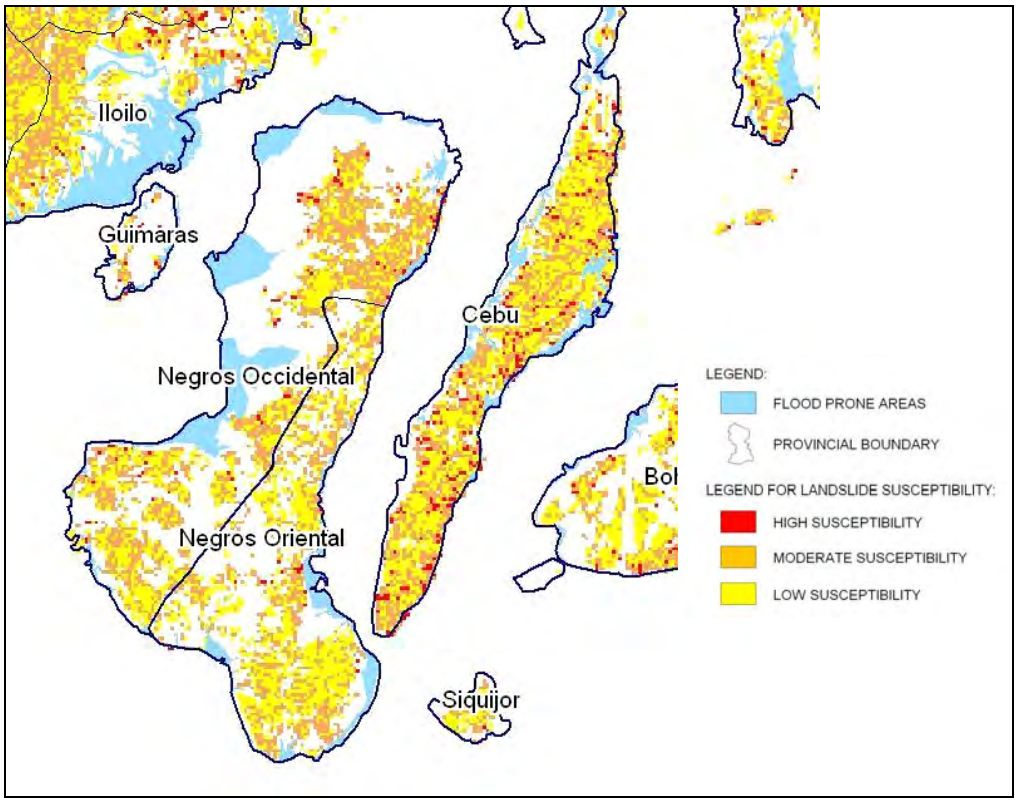


Figure R 8.2 Floods and Landslide Hazard Map for Negros Island

(3) GTZ – Dipecho Disaster Preparedness Project

(a) Outline of Example River Basin

Target river basin is the Pagsangaan River Basin in Ormoc City. Catchment area of this river basin is 551.84 km^2. Flooding occurs 2-3 times a year and lasts between 1-3 days. Population affected by flooding totals 17,400, equivalent to 62 % of the total population in the basin. In two barangays, the barangay hall could be used as evacuation sites/centers, but in most cases inhabitants stayed in their houses or moved to elevated areas, if there are.

As part of the engagement of the project, Participatory Disaster Risk Assessments (PDRA) was done in eleven (11) barangays within the Ormoc part of the Pagsangaan River Basin. Five (5) of these (11) barangays were PAGASA-identified monitoring area for the Flood Early Warning System that the Project installed in 2007 in partnership with the City Government and PAGASA.

(b) Barangay Disaster Preparedness Plan

In addition to the EFW, Barangay Disaster Preparedness Plan (BDPP) was formulated as the results of the PDRA for Barangay Lao of Ormoc City, which was identified as Resettlement Area for those affected by 1991 flash flood in Ormoc City. The total population is 3,746. Estimated land area is 750.3 ha with rice fields comprised of 61.2 ha as its major land use. Major source of income of its residents is farming.

Following is the contents of the BDPP for Barangay Lao for CY 2008 - 2012. Chapter 1 of the BDPP describes the Barangay Profile and members of the Barangay Disaster Coordinating Council (BDCC) as shown below

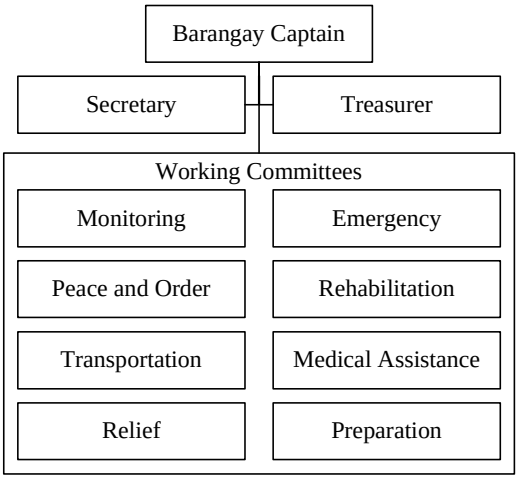


Figure R 8.3 Organization of BDCC

Chapter 2 of the BDPP contains the Profile of hazard flooding. This includes the historical background of the barangay on major/worst flooding that had happened in the barangay over the years. Hazard Profile includes the following information:

(i) A table containing the year, the catastrophe, disasters, and casualties affected;

(ii) Historical Transect provides and recalls information on records and occurrences of flooding that had happened years ago. Including reasons and suggestions;

(iii) Quantitative Description of Flooding Hazards; describes the path or direction and height of floodwater in the event of flooding; and

(iv) Worst Case Scenario illustrates what will happen in worst case including natural and social impacts, if flooding problems are not resolved

Chapter 3 of the BDPP contains the Profile of Vulnerable Sectors. This chapter comprises the list and number of disabled persons, infants/children who are prone to sickness/illness, farmers whose major income is from crops and households who have continuously experienced flooding. Statistics on the types of materials used for housing, sources of drinking water and types of comfort rooms in the community, details and summary of coping mechanisms are also included.

The last Chapter of the BDPP (Chapter 4) contains the Disaster Preparedness Programs, Projects and Annual Investment Programs for flood mitigation in the Barangay. The Community Disaster Preparedness Action Plan contains the following information:

(i) A five-year Disaster Preparedness Plan involving the following sectors:

Social Sector

This includes purchase of medicines to insure good health and prevent sickness of the barangay people particularly the children.

Economic Sector

This provides other sources of income such as livelihood programs, training/seminars on farming technologies, marketing support and tree planting.

Infrastructure Sector

Development of a safe infrastructure in the barangay to provide evacuation and security to the community against flooding including dike construction (3 kms) and desilting of drainage channel (more or less 3 kms).

In addition, the technical materials for construction and other support needed for the project such as agencies or organizations will be included.

(ii) Five-year Annual Investment Programs (AIP)

This comprises the annual budget and sources of fund for flood mitigation projects.

8.2.2 Flood Early Warning System

Flood early warning is conducted by the PAGASA. The System is classified into three sub-systems, namely, PABC FFWS, FFWSDO and Community-based FEW System.

(1) PABC FFW System

(a) Outline of System and Warning

The PAGASA is conducting flood forecasting and warning operation in the four major rivers in Luzon, namely, Pampanga, Agno, Bicol and Cagayan Rivers. These are called as PABC Flood Forecasting and Warning (FFW) Systems. Pampanga FFWS commenced in 1973, while the other three FFWSs started in 1982. Field Flood Forecasting and Warning Center (FFWC) is located at San Fernando City for Pampanga FFWS, at Rosales City for Agno FFWS, at Naga City for Bicol FFWS and at Tuguegarao City for Cagayan FFWS.

PAGASA analyzes the runoff characteristic of the respective rivers using the storage function model. FFWCs forecast WLs after 24 hours using present WLs and rainfall with forecasted rainfall. When the forecasted WL exceeds the warning WL, a warning is issued and transmitted as a Flood Bulletin.

Table R 8.1 Flood Warning Level and Definition

Flood Warning Level	Discharge Criteria	Definitions	Suggested Actions
Flood Outlook	40 % of flow capacity	There is possibility of flooding within the next 24 hours	Awareness
Flood Alert	60 % of flow capacity	There is threat of flooding with the next 12 hours	Preparedness
Flood Warning	100 % of flow capacity	Flooding is expected within the next 12 hours, or flooding has occurred	Response

The PAGASA issues Flood Bulletin two times a day at 4:00 am and 4:00 pm. Intermediate flood bulletins are issued at 11:00 am and 11:00 pm, if necessary. Furthermore, an auxiliary bulletin is issued when sudden flood is expected. Draft Bulletin made by the FFWC is sent to the Hydro-Meteorological Division (HMD) of Data Information Center (DIC) at Manila through facsimile. The chief of HMD signs the Bulletin and sends back to FFWC. The HMD sends the Bulletin to the OCD. FFWC also sends the Bulletin to the RDCC and the PDCC. The flow of the Flood Bulletin dissemination is shown in **Figure R 8.4**. **Figure R 8.5** shows the Flood Bulletin for Cagayan River Basin

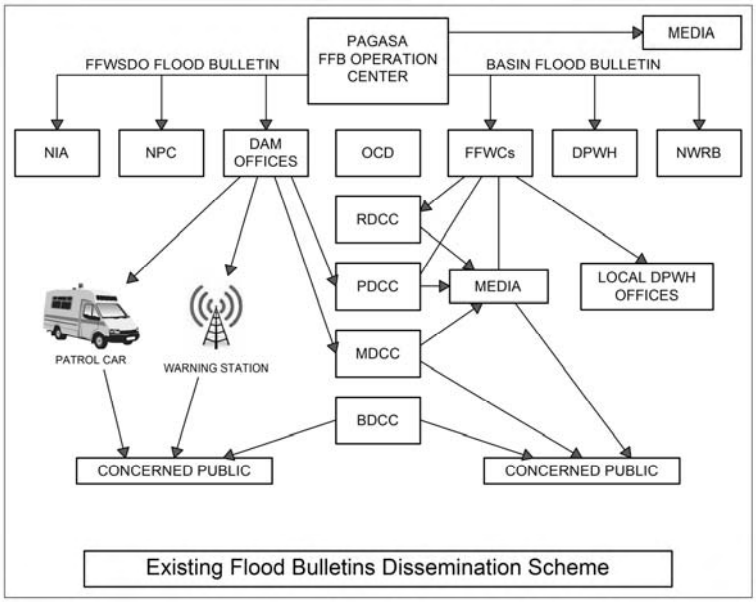


Figure R 8.4 Flood Bulletins Dissemination Scheme

(b) Upgrading of Pampanga and Agno FFWS

After 30 years of operation, the PABC FFWSs encountered difficulties as well as deterioration and shortage of spare parts which were seriously damaged by volcanic mudflows caused by the eruption of Mount Pinatubo and Baguio Earthquake.

Under these circumstances, the Project for Upgrading of Flood Forecasting and Warning System in the Pampanga and Agno River Basins commenced on January 2008 through a JICA grant aid scheme. The items to be upgraded are as follows:

(i) Installation of Additional Gauging Stations

Existing stations are removed due to the present river conditions and new stations are added in consideration of the social and technical needs as well as the development situation in the cities in the basins. **Table 8.2** shows the number of stations before and after the upgrading.

REPUBLIC OF THE PHILIPPINES
Department of Science and Technology
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Tuguegarao PAGASA Complex, Tuguegarao City

FLOOD BULLETIN NO.5
ISSUED AT 4:00 AM, 19 AUGUST 2000
(VALID UNITL THE NEXT ISSUEANCE AT 4:00 PM TODAY)

AVERAGE BASIN RAINFALL(mm):
PAST 48 HOURS ENDING AT 2:00 AM TODAY = 200 mm
FORECAST FOR THE NEXT 24 HOURS = LESS THAN 60 mm

EXPECTED HYDROLOGICAL RESPONSE:

1. FURTHER RISE OF THE FLOODWATERS FROM UPPER CAGAYAN RIVER AND TRIBUTARIES DIADI AND ILUT RIVERS.
   FLOODING IS EXPECTED TO PERSIST: IN THE LOW LYING AREAS OF CAUAYAN, BANQUERO, ECHAGUE AND ALICIA UNTIL TOMORROW MORNING.

2. RAPID RISE AND OVERFLOWING OF MIDDLE CAGAYAN RIVER AND TRIBUTARY MAGAT RIVER.
   FLOODING IS EXPECTED TO OCCUR: IN THE LOW LYING AREAS OF AURORA, LUNA, NAGUILIAN, GAMU, ILAGAN, SARAGAN, SAN PABLO AND TUMAUINI BEGINNING THIS AFTERNOON.

3. GRADUAL RISE OF LOWER CAGAYAN RIVER AND TRIBUTARIES PARET, PINACANAUAN, AND CHICI RIVERS.
   FLOODING IS THREATENING: IN THE LOW LYING AREAS OF SOLANA, IGUIG, AMULUNG, ALCALA, MINANGA NORTE, TUGUEGARAO, GATTARAN, LAL-LO AND APARRI BEGINNING LATE THIS MORNING.

THE RESIDENTS IN THE LOW LYING AREAS AND THE DISASTER COORDINATING COUNCILS CONCERNED ARE STILL ADVISED TO TAKE APPROPRIATE ACTION.

PREPARED BY: NOTED BY:

LLB/ ACP/AEB A LAN L. PINEDA
Chief , FFB

Figure R 8.5 Flood Bulletin for Cagayan River Basin

Table R 8.2 Number of Stations

Type	River basin	No. of station	
Rainfall gauging station	Pampanga	6 (4)	8 (4)
	Agno	2 (0)	
WL and rainfall gauging station	Pampanga	10 (8)	18 (15)
	Agno	8 (7)	
Repeater station with rainfall gauge	Pampanga	1 (1)	2 (2)
	Agno	1 (1)	

Figures in parentheses are those before upgrading

(ii) Improvement of Multiplex Radio Network

Existing multiplex radio network with 2 GHz, which is developed for the communication between Science Garden with FFWCs and also with the relevant agencies, has fatal interference due to the mobile phones. New multiplex radio network will be established with 7.5 GHz and 18 GHz. 7.5 GHz to be used between Science Garden and Pampanga FFWCs and Agno FFWCs, while 18 GHz is applied to NIA and ODC, which are near to the Science Garden.

(iii) Upgrading of Equipment for Flood Forecasting and Warning Operation

- Equipment at DIC, Pampanga FFWC, Agno FFWC and monitoring stations such as OCD, NPC, NIA and DPWH are upgraded or newly installed.
- Present runoff model used by DIC is improved and inundation model will be applied to accurately estimate areas to be flooded.

(2) FFWSDO

Flood Forecasting and Warning System for Dam Operation (FFWSDO) aims to: 1) effectively utilize the six dams located in Luzon Island by the NAPOCOR and/or the NIA which operate the dams; 2) issue dam discharge warning to the related agencies and inhabitants along the river reaches that are likely to experience sudden water rise due to dam water release; and 3)notify PAGASA to issue flood warning using the released discharge data from NAPOCOR or NIA..

Originally, dams included in the FFWSDO System are Angat Dam on the Angat River, Pantabangan Dam on the Pampanga River, Binga/Ambuklao Dam on the Agno River and Magat Dam on the Magat River. In August 2002, San Roque Dam was completed on the Agno River and included in the FFWSDO System.

Through the FFWSDO Project, Data Information Center (DIC), Dam Offices and Multiplex Network connecting DIC and Dam Offices have been completed. **Table R 8.3** summarizes the number of stations under the FFWSDO.

Table R 8.3 Number of Stations and Facilities under FFWSDO

Location	Angat	Panta-bangan	Bin-ga/Ambuk lao	San Roque	Magat
Dam Office	1	1	1	1	1
Rainfall Sta.	4	4	4	8	5
WL Sta.	2	1	1	4	1
Combined Rain/WL Sta.			1	1	1
Warning Sta. (A)	7	6	7	7	9
Warning Sta.(B)	10	13	11	11	6
Patrol Car	6	6	6	6	6
Walkie-talkie	21	18	21	21	27

The NAPOCOR is responsible for the operation and maintenance of the FFWSDO system and gate operation of the Angat, Binga, Ambuklao and San Roque Dams, while the NIA is responsible for the Pantabangan and the Magat Dams.

Dam offices forecast reservoir inflow using the installed rainfall gauges and decide the operation of the gates and issue dam discharge warning, when gates are opened. PAGASA disseminates flood warning to the downstream areas using the discharge data released from the dam with the storage function runoff model.

(3) Community-based Flood Early Warning System (CBFEWS)

In the READY Project, PAGASA will install CBFEWS at 27 Provinces. Based on the experience of the PABC FFWS and FFWSDO, PAGASA designs and install observation and communication network while the LGUs operate the network and disseminate flood warning with assistance of PAGASA. The procedure of establishing CBFEWS is explained as follows:

(a) Consultation with LGUs

The consultation meeting aims to bring together the stakeholders to discuss the feasibility of implementing a CBFEWS and to assess the existing facilities for the CBFEWS. The consultation meeting shall be conducted in coordination with the Governor or City/Municipal Mayor and invite the key persons in the target area.

(b) Design of Rain Gauges, WL Gauges and Communication

Type of gauge is selected in consideration of:

- Technical capability of the community to operate and maintain the installed equipment;
- Economic capability of the community to purchase or acquire the equipment and spare parts to ensure the continuous operation of the system; and
- Availability of volunteer or LGUs from the community to operate the instrument.

The communication system to transmit observed data to the operation center is selected among ;

- Existing communication system (SMS),

- Radio; or
- Walkie-talkie.

For warning purposes, bells can be used in addition to the warning equipment being utilized by the community.

(c) Ocular Survey of Proposed Sites

After establishing the network density, the proposed sites are verified through actual survey in coordination with LGUs. The criteria to be considered in choosing the sites of the proposed monitoring stations are the presence or availability of an observer, access to the site and the availability of communication facilities.

(d) Installation and Hydrologic Survey

(i) Installation of Observation Instruments

The rain gauges and WL (staff) gauges are installed by PAGASA personnel and the LGUs based on the Installation guidelines made by the PAGASA.

(ii) Hydrologic Survey

The hydrologic survey consists of discharge measurement and cross sectioning of the river channel by PAGASA to determine the carrying capacity of rivers and to derive the assessment levels at the particular cross-section.

The assessment levels are divided into Level 1, Level 2 and Level 3. These levels are the basis in issuing flood advisories/warnings as shown in **Table R 8.4**.

Table R 8.4 Meaning of Flood Advisory

Assessment Level	Discharge at WL Observation Point	Flood Advisory/ Warning	Meaning of Message
Level 1	40 % of flow capacity	READY	**"Awareness** " that flooding is possible within the next 24 hours
Level 2	60 % of flow capacity	GET SET	**"Preparedness**" that flooding is threatening with 12 hours
Level 3	100 % full	GO	**"Response"** that flooding is expected to occur/or will persist within the next 12 hours

For rainfall gauges, initial threshold values for "Ready", "Get Set" and "Go" are set.

(e) Training of Observers

The LGUs are requested to identify two observers for each installed station to be trained in the observation, recording and transmission of data to the DOC. Formal

lectures and on-the-job training are conducted by PAGASA and the necessary forms and operation manuals will be provided to the observers.

The Deputy Civil Defense Coordinator (DCDC) in the municipality and his staff will also be trained on the protocols on data interpretation and issuance of flood warning/advisory

(f) Pilot Testing/Dry Run on the Operation of the CBFEWS

A dry run is conducted to test the observation and transmission of data by observers, analysis of data and formulation of flood warning/advisories and the dissemination of warnings to the threatened communities. A sample flow chart of the communication flow for the CBFEWS is shown in **Figure R 8.6**.

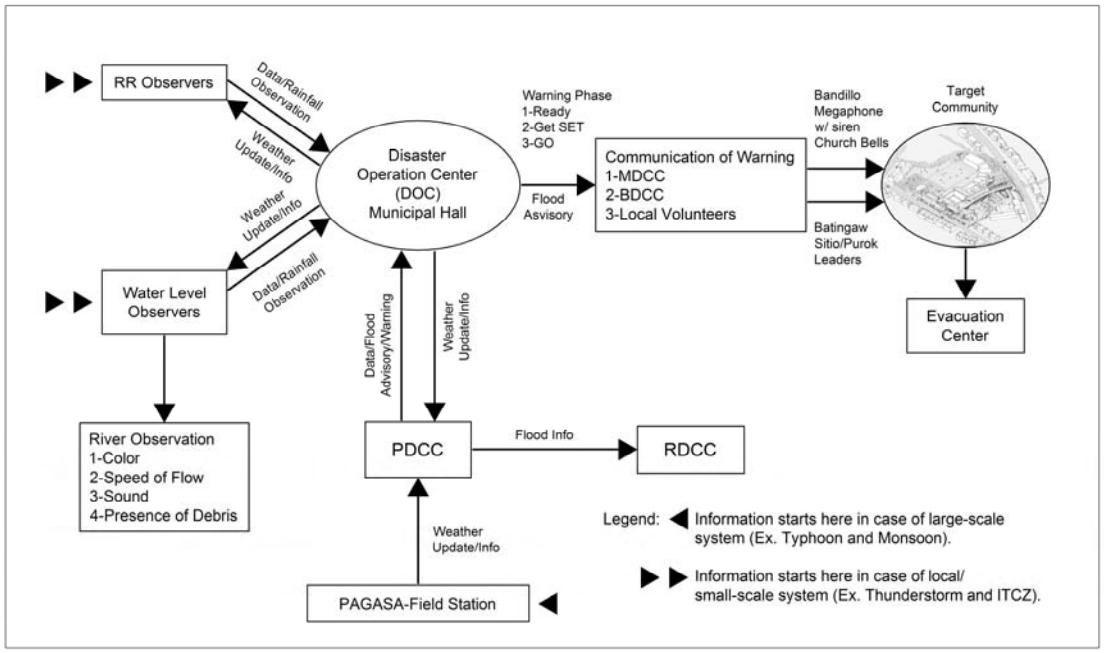


Figure R 8.6 Communication Scheme of a CBFEWS

(g) Other Activities

(i) Signing of a Memorandum of Agreement

Activities to be undertaken, the cost sharing scheme and roles of the community and institutions shall be stipulated in a Memorandum of Agreement (MOA).

(ii) Enactment of a Local Ordinance for the Operation and Maintenance of the CBFEWS

Local ordinance shall be enacted by the Provincial Council and City/Municipal Council to allocate continuously a reasonable amount of money for the operation and maintenance of the CBFEWS.

8.3 Present Activities related to Non-structural Measures in the Cagayan River Basin

8.3.1 Disaster Coordinating Council

(1) Tuguegarao CDCC

(a) Organization and Functions

Figure R 8.7 indicates the organization of CDCC for Tuguegarao City. The tasks of Tuguegarao CDCC are as follows.

- Provision of evacuation center;
- Provision and dissemination of warning;
- Direction and coordination of counter-disaster measures;
- Liaison with the media;
- Application of emergency regulation;
- Information and advice to the public;
- Evacuation of individuals, groups and communities and livestock;
- Search and Rescue;
- Treatment and care of victims;
- Provision of emergency food and water supplies;
- Control and distribution of emergency supplies;
- Provision of health and sanitary measures;
- Restoration of essential services such as communications, water supply and power supply;
- Clearance of debris and rehabilitation of roads, airfields, posts and other key areas;
- Survey, assessment and reporting of disaster effects;
- Emergency building program;
- Rehabilitation of crops, production and other aspects of subsistence and livelihood;
- Counseling of victims and relatives; and
- Measure of long-term recovery

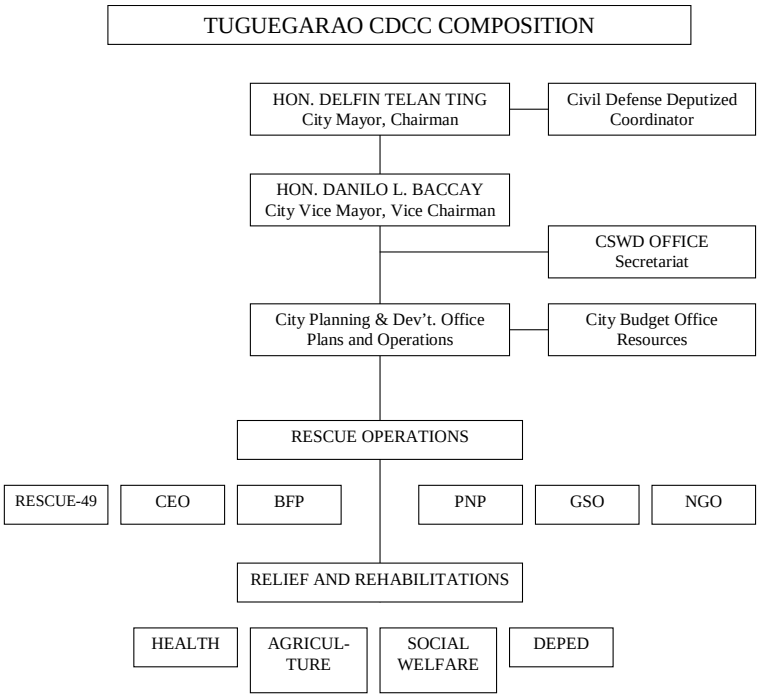


Figure R 8.7 Organization Chart of Tuguegarao CDCC

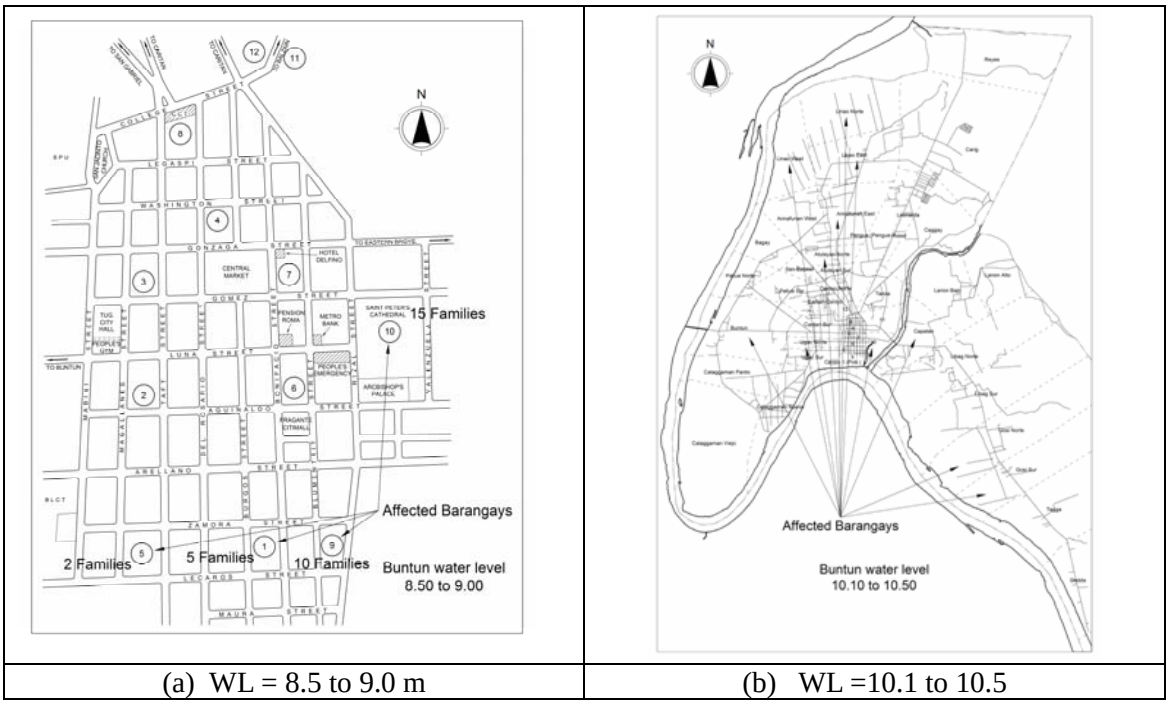
(b) Hazard Mapping and Evacuation Centers

Tuguegarao CDCC prepares hazard maps and list of affected families in relation with the PAGASA's Buntun WL Gauge as shown in **Figures R 8.8**. **Table R 8.5** tabulates evacuation centers with number of personnel, which should be accommodated in the evacuation centers.

Table R 8.5 Affected Barangays, No. of Families and Evacuation Centers

Buntun Water Level	Levels of Risk Barangays			Estimate No. of Families Affected	Evacuation/Alternative Center	
	High	Medium	Low		Location	Accomodation
8.50 to 9.00			Centro 10	15	BH/DCC	25 persons
			Centro 01	5	DCC	25 persons
			Centro 05	2	C1 DCC	25 persons
			Centro 09	10	BH/DCC	60 persons
9.10 to 10.00			Centro 10	50	BH/DCC/TECS	1000+ persons
			Centro 01	5	DCC	25 persons
			Centro 05	2	C1 DCC	25 persons
			Centro 09	10	BH/DCC	60 persons
			Centro 04	10	Lavadia Bldg.	25 persons
			Centro 11	10	BH/DCC	30 persons
10.10 to 10.50		Centro 10		175	TECS	1000+ persons
			Centro 01	10	DCC	25 persons
			Centro 05	5	C1 DCC	25 persons
			Centro 04	20	Lavadia Bldg.	25 persons
			Centro 09	30	BH/DCC/TECS	1000+ persons
			Centro 11	50	PG	1000+ persons
			Centro 12	50	PG	1000+ persons
			Linao East	125	BH/DCC/BG	1000+ persons
			Linao North	50	Linao ES/HS	1000+ persons
			Linao West	25	DCC/Chapel	150 persons
			Annafunan E.	75	BH/DCC/BG	1000+ persons
			Atulayan Sur	50	BH/DCC/AES	1000+ persons
			Gosi Norte	50	BH/GHS	1000+ persons
			Gosi Sur	10	BH/GHS	1000+ persons
			Buntun	15	BH/DCC/BG	1000+ persons
			Capatan	15	BH/DCC/BG	1000+ persons
			Ugac Sur	8	BH/DCC	30 persons
			Pengue	50	BH/DCC	30 persons
10.60 to 11.50	Centro 10			500	PG/TECS	1000+ persons
	Centro 11			500	PG/TECS	1000+ persons
	Centro 12			500	PG	1000+ persons
	Anna. East			400	AES/BH	1000+ persons
	Linao North			1000	LHS/LES	1000+ persons
	Linao East			250	LHS/LES	1000+ persons
	Gosi Norte			850	GHS	1000+ persons
		Centro 09		150	TECS	1000+ persons
		Centro 04		150	PG	1000+ persons
		Linao West		100	LHS/LES	1000+ persons
		Pengue		250	PES	1000+ persons
		Atulayan Sur		250	AES/BH	1000+ persons
		Gosi Sur		75	GHS	1000+ persons
		Centro o1		30	TECS	1000+ persons
			Caritan Centro	100	BH/DCC	1000+ persons
			Capatan	50	BH/DCC/BG	1000+ persons
			Caritan Norte	75	CES	1000+ persons
			Atulayan Norte	25	BH/DCC/BG	1000+ persons
			Tagga	35	BH/DCC/Chapel	50 persons
			Dadda	20	BH/DCC	30 persons
			Catag. Nuevo	15	BH/DCC	150 persons
			Catag. Viejo	15	BH/DCC	150 persons
			Catag. Pardo	15	BH/DCC	150 persons

BH = Barangay Hall
BG = Barangay Gymnasium
DCC = Day Care Center
TECS = Tug. East Central School
AES = Atulayan/Annafuna Elem. School
LES/LHS = Linao Elementary/High School
PG = People's Gymnasium
PES = Pengue Elem. School
GHS = Gosi High School
CES = Caritan Elem. School



(a) WL = 8.5 to 9.0 m | (b) WL =10.1 to 10.5

Figure R 8.8 Flood Hazard Map of Tuguegarao

(c) Activities for Weather and Flood Warming

Flood Bulletin issued by the PAGASA for the Cagayan FFWS is disseminated to the Tuguegarao CDCC then transmitted to the barangays as shown in **Figure R.8.9**.

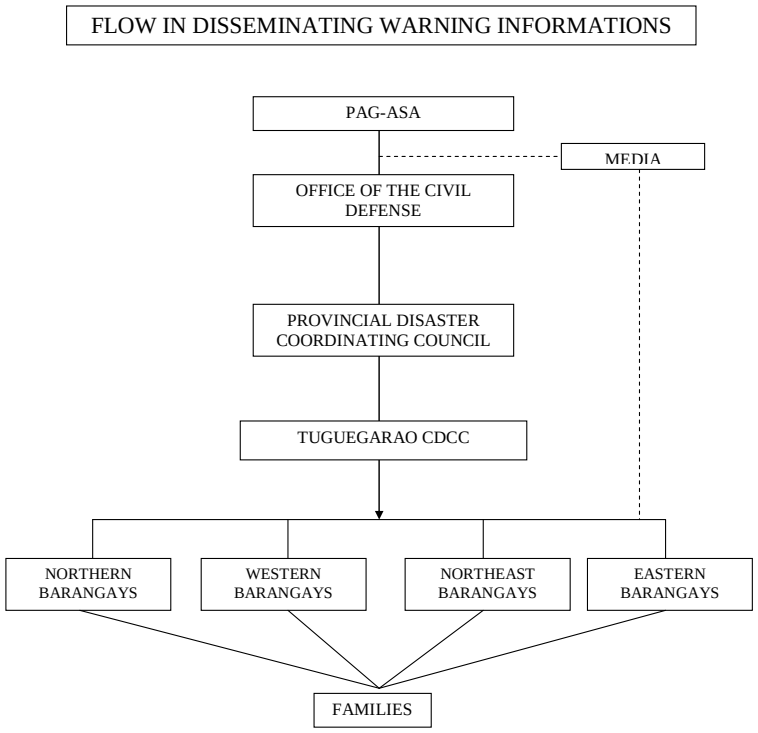


Figure R 8.9 Information Route to Barangays in Tuguegarao

(2) Enrile MDCC

(a) Organization

Enrile MDCC is composed of: 1) Intelligence and Disaster Analysis Unit; 2) Plans and Operation Unit; 3) Resources Unit; 4) Communication and Warning Unit; 5) Emergency Transportation Service; 6) Evacuation Service; 7) Rescue and Engineering; 8) Health; 9) Fire; 10) Police; 11) Relief Service; 12) Rehabilitation; and 13) Public Information.

(b) Activities

Enrile MDCC informs the captains of affected barangays about the contents of the Flood Bulletin which is transmitted from the PDCC.

8.3.2 Flood Warning System

(1) Cagayan Flood Forecasting and Warning System

PAGASA operates Cagayan FFWS and WL gauge, which is installed at the Bridge (Buntun Bridge) of Tuguegarao City. **Figure R 8.10** indicates the observation network of Cagayan FFWS. In the rivers upstream of Tuguegarao, four (4) rainfall and WL gauging stations are installed. PAGASA forecasts WL level at these points and issues Flood Bulletin twice a day as indicated in **Figure 8.5**. However, it is necessary to secure lead time for flood forecasting and to increase accuracy in upper river basins and those in tributaries, particularly in the Ilagan River Basin, according to the PAGASA.

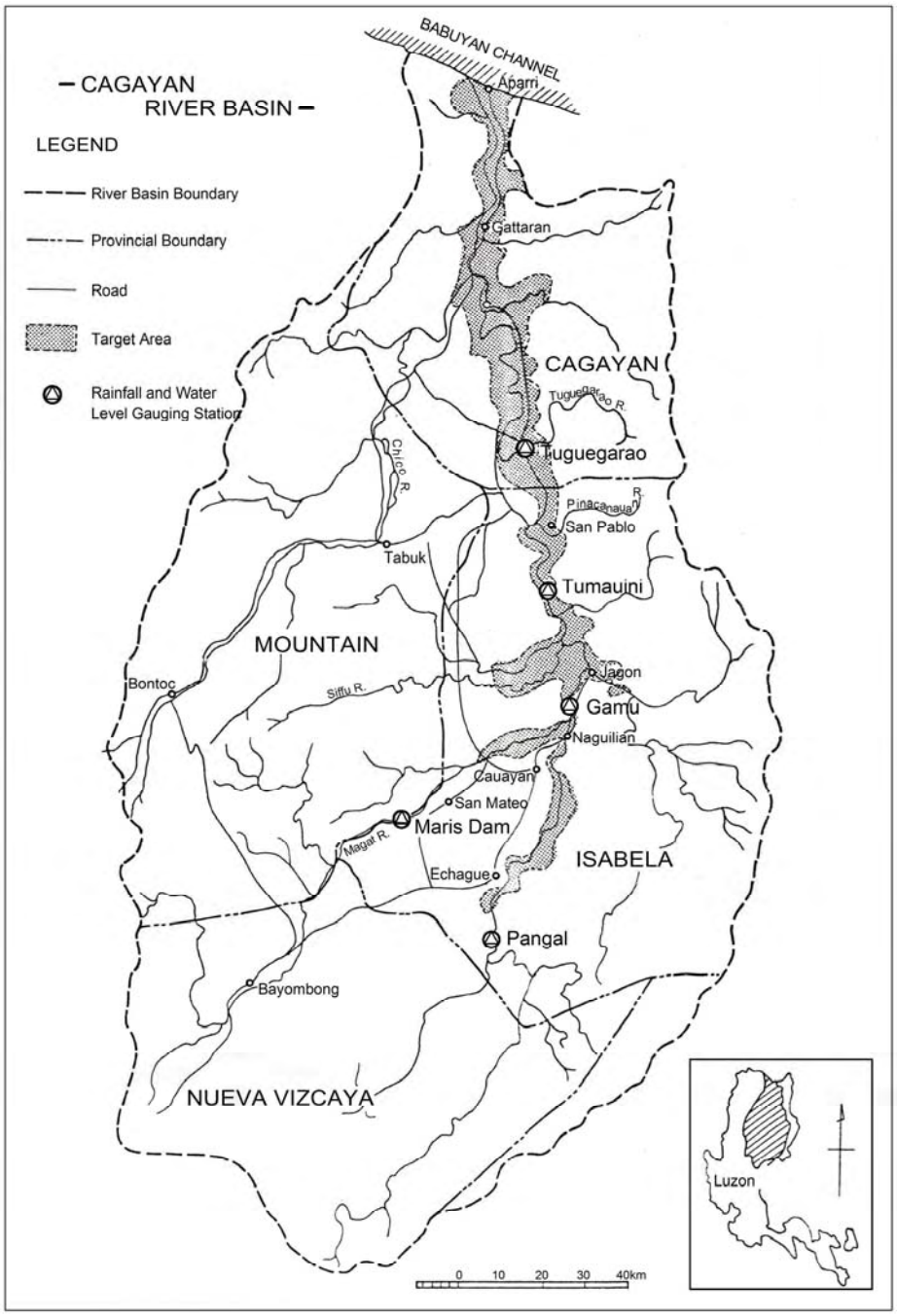


Figure R 8.10 Cagayan FFWS

(2) Magat Dam FFWSDO

Magat Dam is located upstream of the Maris irrigation diversion dam. Magat Dam FFWSDO is operated by the NIA to effectively utilize the Magat dam reservoir and to conduct Dam Discharge Warning when the NIA releases the stored water. PAGASA is informed about the condition of the dam WL and the released discharge and uses this for flood warning activities of the Cagayan FFWS.

(3) Improvement of the Flood Forecasting and Warning System for Magat Dam and Downstream Communities Project

The following projects will be undertaken in 2010 under the assistance of the Norwegian Agency for Development Cooperation. The contents of the project are as follows:

(a) To restore and enhance the communication system of the FFWS for Magat FFWSDO and Cagayan FFWS;

(b) To rehabilitate the existing automatic ground observation facilities of the FFWS by utilizing locally available spare parts and accessories;

(c) To upgrade the existing network of rainfall and water level stations for flood forecasting and warning;

(d) To improve the operation of Magat Dam through the provision of inflow and flood forecasts with enough lead times using ground observations and remotely sensed data from Aparri and Baguio radars;

(e) To conduct Research on an Integrated Weather and Flood Forecasting System for the Cagayan River Basin;

(f) To establish a decision support system for the operation of Magat Dam;

(g) To conduct training and capacity building; and

(h) To enhance public information drive in flood prone areas.

Figure R 8.11 indicates location of the existing and proposed monitoring stations.

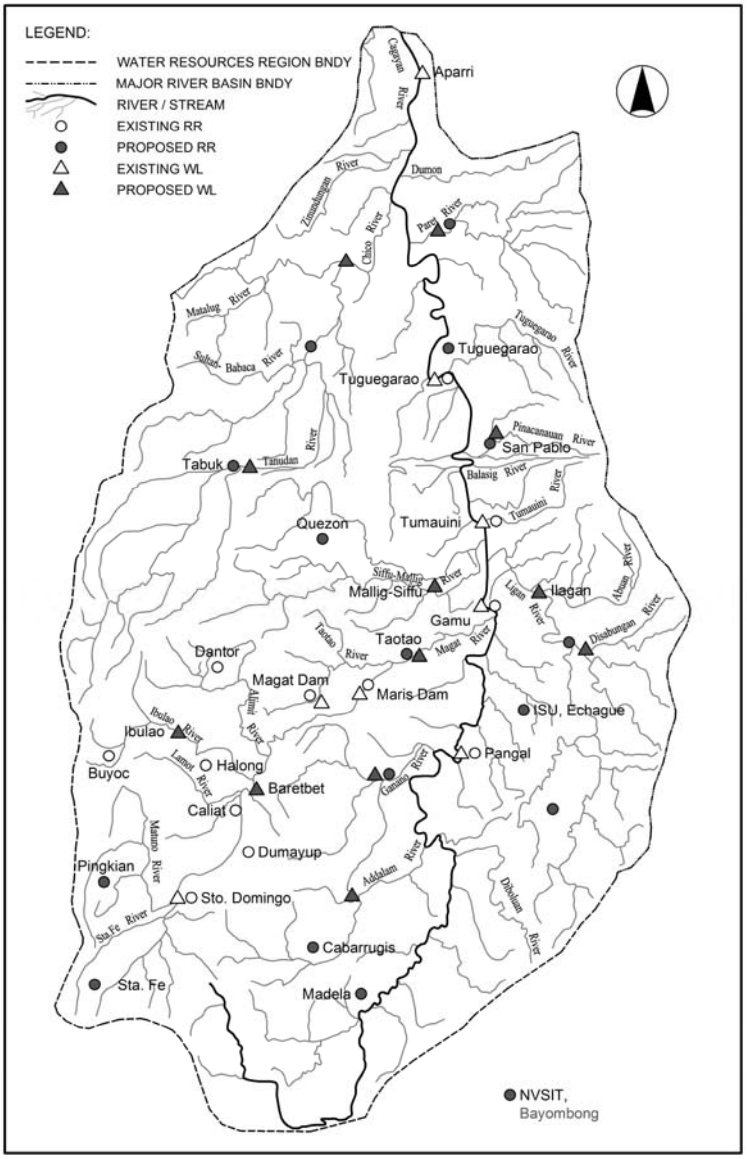


Figure R 8.11 Proposed Ground Monitoring Stations for Cagayan FFWS and Magat FFWSDO

8.4 Non-Structural Measures and Implementation Plans

8.4.1 Hydrological Hazard Mapping and Flood Preparedness Plan

(1) Objectives

The CDCC or MDCC in the core area conducts evacuation operation based on experience of past floods. The magnitudes of these past floods are normally not so large and thus there is a high possibility that unexpected floods exceeding the magnitude outlined in the 'preparedness plan' might occur even in the areas, which are normally not flooded.

In the Feasibility Study for the Core Area, the results of runoff and inundation analysis can be used for establishment of more effective flood preparedness plan and early flood warning system covering floods exceeding the normal flood, though it is necessary to review the model to be use for this objective. Under these circumstances, this project aims to assist that; 1) inundation maps for the probable floods containing description of hazard

impacts are prepared by the related agencies, 2) flood preparedness plan including hazard maps is prepared by the LGUs in the Core Area, 3) early warning system necessary for the flood preparedness plan, and 4) a suitable type of land development in the flood-prone areas is prepared.

(2) Related Agencies

(a) OCD: Executive Agency

(b) NAMRIA: Provision of base maps

(c) FCSEC: Runoff model/analysis and Inundation modeling/analysis

(d) PAGASA: Runoff model/analysis, Inundation modeling/analysis and establishment of community based early warning system

(e) LGUs (CDCCs, MDCCs, BDCCs): Preparation of flood preparedness plan

(f) LGUs (CPDOs, MPDOs): Land use and development planning

(3) Activities

Activities will be done with the JICA experts to be dispatched for the Project.

(a) Identification of Necessary Preparedness Plan and FEWS

Consultative meeting will be held in coordination with Regional Director, Governor(s), Mayors of City/municipalities located in the river basin. Key staffs of the related RDCC, PDCC and CDCC/MDCC will be invited.

(i) Disaster profile in target core area;

(ii) Necessity of preparedness plan and FEWS; and

(iii) Identification of preparedness plan and FEWS

For the Cagayan River Basin, existing Cagayan FFWS will be used, with some adjustment, considering the progress and contents of "Improvement of the Flood Forecasting and Warning System for Magat Dam and Downstream Communities Project".

The most crucial for CBFEW is that the Project should install robust information network from hydrologic warning transmission stations up to the end communities against an impending flood disaster, in terms of institutional capacity for data transmission and reception as well as technical aspects.

(b) Establishment of Hazard Map and Preparedness Plan

(i) Detailed Inundation Maps

Probable runoff discharge and inundation conditions used during the Feasibility Study are reviewed and revised. Using the NAMRIA data (land use, land elevation, etc), runoff model and inundation model will be established.

- Data collection

- Establishment of runoff and inundation model
- Detailed flood inundation analysis for the core area corresponding to the probable discharge

(ii) Establishment of Warning WLs and Threshold Rainfalls

- Grouping of barangays in core areas in consideration of inundation characteristics
- Establishment of warning WLs and threshold rainfalls (if appropriate) corresponding to the grouped barangays

(iii) Establishment of Flood Preparedness Plan

- Flood Preparedness Plan is formulated in respective barangays to be affected by flood including evacuation centers, route and method
- Flood Preparedness Plan is formulated for the City or Municipality

(iv) Implementation of Dry Run

- Field Reconnaissance
- Preparation of seminar and dry run
- Implementation of dry run
- Modification of Flood Preparedness Plan

(v) Revision of Flood Preparedness Plan

- Review of flood preparedness plan after major flood events using the runoff model and the inundation model
- Revision of flood preparedness plan and flood warning WL and thresh-old rainfall

(c) Revision/Modification of Land Use/Development Plan

Urban/industrial developments in the flood-prone areas always increase flood damages. Thus future land development should endeavor to establish a suitable land use in the flood prone areas. Evaluation on the land use and development plan should be made overlaying the City/Municipality development plan onto the flood hazard map. If such land use modification/control could be successfully pursued, it might be advantageous for future river improvement to acquire the necessary land for floodway purposes, upgrading the design level or adopting the measures against effects of global warming.

CHAPTER 9 ENVIRONMENTAL SOCIAL CONSIDERATIONS

9.1 Introduction

9.1.1 Necessity of environmental and social considerations

In accordance with DENR (Department of Environment and Natural Resources) Administrative Order NO.37 in 1996 (DAO 37-1996), any projects in Philippines are required to obtain Environmental Compliance Certificate (ECC). If a project has no significant impact and has no necessity of ECC, the project proponent shall obtain the Certificate of Non-Coverage (CNC).

The Environmental Management Bureau (EMB) of the DENR published the Revised Procedural Manual (August 2008) (hereinafter referred to as RPM). The relation between the project cycle and Environmental Impact Assessment (EIA) process is described in Chapter 1.0 of the RPM. In accordance with the RPM, the EIA study for preparation of ECC application would be carried out during the F/S study. Meanwhile, this study can be termed as a preparatory study for the detail EIA/Resettlement Action Plan (RAP) study in the next stage as shown as Figure R 9.1

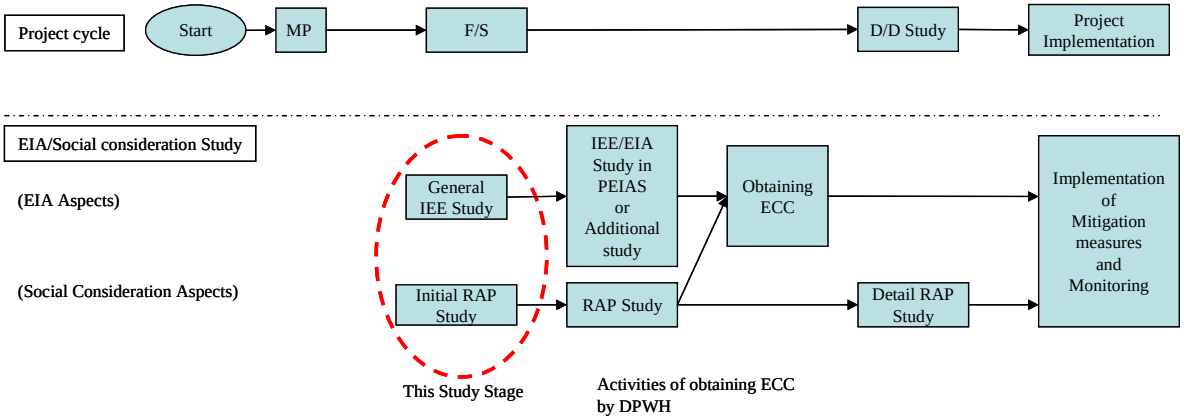


Figure R 9.1 Project cycle and EIA/Social Consideration Study of the Project

9.1.2 Scope of IEE study

The scope of this Initial Environmental Examination (IEE) study is described as below:

Study Area: The areas directly and indirectly affected by the Project. The Project Area is shown in Chapter 1 and 2.

Baseline data collection: The baseline data of natural and social environments on the project threshold.

IEE study: The study follows the requirements of the RPM. The outline of IEE report is described in the RPM.

Recommendation of the necessary mitigation measures: The mitigation measures for the results of scoping on the project threshold will be considered.

Recommendation of the monitoring plan: The monitoring plan will be recommended.

9.1.3 Baseline data of natural condition

(1) Data of natural condition

The RPM describes three specific modules of natural conditions as below:

(a) The land (Land Use/classification, associated Terrestrial Biology (flora and fauna), Relevant aspects of Geology (i.e. land forms/topography/slope/ terrain), and Pedology (main soil type and quality). In this report, the land use/classification was described in Sub-section 9.1.4. (2) as a part of social environment conditions.

(b) The water (Hydrology and Hydrogeology, Water quality, and Freshwater Biology.

(c) The air (Meteorology and Air Quality)

(2) Biological Environment

The existing vegetation and wildlife survey in the Project site was not conducted. Assessment of the vegetation and wildlife in the Project site were conducted from July to August 2009. Three survey routes were selected along the river banks with 500m width of both sides of the river. The survey routes were established and all plants and animals encountered were noted and recorded (Annex PIIA_9-1). Some animal species not observed were yielded by interviews to local farmers and residents in the area.

The site was noted to consist predominantly of residential, and commercial built up areas. Areas along the river banks were found to have secondary growth of plant cover composed of grasses, shrubs, trees, with some areas being planted out with backyard vegetables. In accordance with the results of field surveys, rare species listed on the Philippines Red Data Book were not found in the Project area.

(3) Topography/Geology

(Geographical features): The river basin is bounded by mountain ranges - the Sierra Madre to the East, the Cordillera Central to the West and the Caraballo-Maparang to the South. It faces the Babuyan Channel to the North.

(Topography): The Cagayan River Basin has many sloped areas, with 6,600 km^2 having the slope of less than 8%, 3,400 km^2 between 8% to 18%, and 17,300 km^2 over 18%. The Main Cagayan River runs from south to north in the flat alluvial plain and finally empties into the Babuyan Channel.

(Geological condition): Rocks of the Cagayan River Basin consist of the metamorphic and plutonic rocks of Pre-Tertiary age, which have been uplifted by igneous intrusions during the Late Tertiary and Quaternary. The Oligocene section consists of basic lava flows, metamorphosed conglomerate, tuff breccia, and tuffaceous sandstone and siltstone.

(Properties of Foundation): The geology in and around Tuguegarao consists of the clayey soil in the hilly area and the sand and sand/gravel in the alluvial plain. The sand/gravel is distributed along the Tuguegarao River and the right bank of the Cagayan River at the vicinity of the confluence with the Tuguegarao River.

The details of topographical/geological condition were described in Chapter 2.1 in this report.

(4) Soil/Sediments

Sediments were collected from the sampling sites to test for heavy metals in case these areas were dredged and the dredged materials sent elsewhere. The results were as follows:

Table R 9.1 Results of Sedimentation Quality Measurement

(Unit: ppm)

Analysis	Sample 1	Sample 2	Standard Value in Dutch
Total mercury	Not Detected	Not Detected	0.3
Arsenic	2.6	2.7	29.0
Cadmium	Not detected	Not Detected	0.8
Chromium	11	7.5	100.0
Lead	Not detected	Not detected	85.0
Cyanide	Not detected	Not detected	5.0

Source: JICA Study Team

The Philippines does not have any standards for soil or sediment quality. The Dutch standard for sediments is generally used. The standard values are shown in the Table R 9.1. The survey results show that the sediments in the project site are not contaminated by heavy metals.

(5) Hydrology (River System)

The Main Cagayan originates in the Caraballo mountain range. Passing through the mountainous areas towards North-Northeast, it joins the largest tributary, the Magat on the left bank and the right tributary, Ilagan, in succession. Just downstream of the confluence with the Ilagan River, the Cagayan River changes its direction towards North-Northwest, flows down through the alluvial plain confined by natural levees, terraces, etc., and reaches Alcala. The Cagayan river channel in this reach especially from Tuguegarao to Alcala meanders violently. The major tributaries in this reach are the Siffu-Mallig in the left bank and Tumauini, Tuguegarao and Pared in the right bank. The total basin area at Alcala is around 21,400 km^2. According to longitudinal profile, the general tendency of the longitudinal riverbed elevations is as follows:

(i) River mouth to Magapit Bridge: No significant change
(ii) Magapit Bridge to Alcala: Slightly raised
(iii) Alcala to Confluence with the Tuguegarao River: Slightly raised
(iv) Confluence with the Tuguegarao River to Cabagan: No significant change

From the above, it can be said that the longitudinal riverbed variation is, as a whole, in equilibrium condition.

The details of river system were described in Chapter 2.2 in this report.

(6) Surface Water

(a) General

According to DENR Administrative Order (DAO) No. 34 (Revised Water Usage and Classification 1990), water bodies are classified into five (5) classes (i.e AA, A, B, C and D) for fresh surface waters, and four (4) for marine and estuarine waters (i.e SA, SB, SC and SD). The criteria of classification of the water quality are shown below:

Class	Definition
Class AA	Public Water Sully Class I. This class is tended primarily for waters having watershed which are inhabited and otherwise protected and which require only approved disinfection order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
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: DAO NO.34, 1990)

DAO 34-1990 establishes the water quality standard (water quality criteria for conventional and other pollutants contributing to aesthetics and oxygen demand for fresh waters). The table below shows some parameters of the standard.

Table R 9.2 Water Quality Criteria for Conventional and Other Pollutants Contributing to Aesthetics and Oxygen Demand for Fresh Waters (abridgment)

Parameter	Unit	Class AA	Class A	Class B	Class C	Class D
BOD (Max)	mg/L	1.0	5.0	5.0	7.0 (10.0)	10.0 (15.0)
DO (Min)	mg/L	5.0	5.0	5.0	5.0	3.0
TDS (Max)	mg/L	500.0	1,000.0	--	--	1,000.0
TSS (Max)	mg/L	25.0	50.0	(b)	(c)	(d)

Notes: BOD: Biochemical Oxygen Demand, DO: Dissolved Oxygen, TDS: Total Dissolved Solids, TSS: Total Suspended Solid
(a) -The numerical limits are yearly average values. Values enclosed in parentheses are maximum values., (b) -Not more than 30% increase, (c) -Not more than 30 mg/L increase, (d) -Not more than 60 mg/L increase

Source: DENR Administrative Order 34-1990

The DAO establishes water quality standards for toxic and other deleterious substances for fresh waters as Table R 9.3.

Table R 9.3 Water Quality Criteria for Toxic and Other Deleterious Substances for Fresh Waters (For the Protection of Public Health)

Parameters	Class AA	Class A	Class B	Class C	Class D
Arsenic	0.05	0.05	0.05	0.05	0.01
Cadmium	0.01	0.01	0.01	0.01	0.05
Chromium (hexavalent)	0.05	0.05	0.05	0.05	-----
Cyanide	0.05	0.05	0.05	0.05	-----
Lead	0.05	0.05	0.05	0.05	-----
Total Mercury	0.002	0.002	0.002	0.002	0.002
Organophosphate	nil				
Aldrin	0.001	0.001	-----	-----	-----
DDT	0.05	0.05	-----	-----	-----
Dieldrin	0.001	0.001	-----	-----	-----
Heptachlor	nil		-----	-----	-----
Lindane	0.004	0.004	-----	-----	-----
Toxaphane	0.005	0.005	-----	-----	-----
Methoxychlor	0.10	0.10	-----	-----	-----
Chlordane	0.003	0.003	-----	-----	-----
Endrin	nil		-----	-----	-----
PCB	0.001	0.01	-----	-----	-----

nil: Extremely low concentration and not detectable by existing equipments
(Source: DENR Administrative Order 34-1990)

(b) Water quality of river in the Project site

The classification of river water quality by EMB-DENR shows the class of upper stream of lower reach of Cagayan River (the Project site is included in it) is C.

The water quality measurements in accordance with a document in the Feasibility Study (F/S) report[1] are shown in Table R 9.4. The station, Buntun Bridge connects Tugegarao City and Municipality Enrile.

Table R 9.4 Average Figure of Water Quality Measurements During 1997-1999

Station No.	DO (mg/l)	pH	Temperature (ºC)	EC (mS/cm) (× 1/1000)	Turbidity (NTU)	Salinity (ppt)
1. Two(2) km from the mouth of Cagayan River	6.74	8.01	28.36	11,229	36.9	13.9
2. Buntun Bridge	7.00	8.13	28.02	211	46.1	0.1
3. Lullutan Bridge	7.17	8.17	28.06	242	57.9	0.1
4. Gamu Bridge	7.04	8.13	28.40	222	36.3	0.1
5. Boat Terminal	7.33	8.03	26.58	226	15.9	0.0
Average	7.06	8.09	27.88	2,426	38.6	2.8

(Source: The result of on-site survey in the F/S report[1])

In the F/S report[1] the river water quality measurements were carried out as showing Table R 9.5. (extracting the chemical parameters at Tugegarao only)

Table R 9.5 Results of Water Sampling

Sampling Place	Salinity	DO	TSS	BOD_5	Total N	Total P
	%	mg/L	mg/L	mg/L	mg/L	mg/L
3.Cagayan River at Bunton, Tuguegarao at low level	0.00	6.85	226	2.59	3.01	0.28
3. Cagayan River at Bunton, Tuguegarao at high level	0.00	8.62	54	0.59	3.89	0.06
DAO 34 Standards (Class C)	-	5.0	-	7.0	10.0	0.4

Physico-chemical test performed at the Analytical Service Laboratory, Institute of Chemistry, UPLB
Bacteriological test conducted by Pbil. National Collection of Microorganisms, BIOTECH-UPLB
On site analysis using Horiba Quality Checker U10
(Source: F/S Report[1])

The results in Table R 9.5, only the value of DO exceeded the standard value. But, other parameters were lower than the standard.

Water quality sampling (heavy metals) was conducted on July 26, 2009. Table R 9.6 shows the results of the laboratory analyses for each station. Based on the water samples collected, the waters of Cagayan still passes for Class C waters for the above heavy metals and poisons. Annex PIIA_9-2 shows the details of sampling survey.

[1] The Feasibility Study of the Flood Control Project for the Lower Cagayan River in The Republic of Philippines, 2002, NIPPON KOEI CO., LTD, and NIKKEN Consultants, Inc.

Table R 9.6 Water Quality Sampling Results

(Unit: mg/L)

Analysis	Sample 1 (ST.1)	Sample 2 (ST.2)	Standard for Class C waters
Total mercury	<0.0001	<0.0001	0.002
Arsenic	0.03	<0.02	0.05
Cadmium	<0.002	<0.002	0.01
Chromium	<0.005	<0.005	0.05 (hexavalent)
Lead	<0.01	<0.01	0.05
Cyanide	<0.01	<0.01	0.05

Source: JICA Study Team

(7) Climatologic Features

The climate in the Cagayan River Basin consists of two tropical monsoons, i.e., the Southwest Monsoon and the Northeast Monsoon. According to the climate classification by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), climate in the Cagayan River Basin falls under Type III. This climate type is characterized as not having very pronounced seasons with relatively dry weather condition from November to April, while the remaining part of the year is noted as wet weather. Major storms that have struck the Cagayan River Basin have resulted from typhoons and monsoon in the area. The typhoons normally strike during July to December, with about 8 times a year on the average.

The annual average rainfall in the basin is estimated to be 2,600 mm. The monthly mean air temperature ranges from 23.1°C in January to 29.0°C in May, and the annual mean air temperature is 26.4°C at Tuguegarao. At Tuguegarao, the monthly mean relative humidity varies from 69% in April/May to 82% in November/December, and the annual mean relative humidity is 76%,

The details of climatologic features were described in Chapter 2.2.1 in this report.

(8) Air quality

(a) Air quality standard

The air quality standard in Philippines is shown in Table R 9.1. Note that there is no emission standard covering construction sites.

Table R 9.7 National Ambient Air Quality Guideline Values

Pollutions	Short Term[a]			Long Term[b]		
	µg/NCM[d]	ppm	Averaging Time	µg/NCM	ppm	Averaging Time
Suspended Particulate Matter[c] TSP	230[d]		24 hours	90		1 year [e]
PM-10	150[f]		24 hours	60		1 year [e]
Sulfur Dioxide [c]	180	0.07	24 hours	80	0.03	1 year
Nitrogen Dioxide	150	0.08	24 hours			
Photochemical Oxidants as Ozone	140 60	0.07 0.03	1 hour 8 hours			
Carbon Monoxide	35mg/NCM 10mg/NCM	30 9	1 hour 8 hours			
Lead [g]	1.5		3 months [g]	1.0		1 year

[a] Maximum limits represented by ninety-eight percentile (98%) values not to exceed more than once a year.
[b] Arithmetic mean.
[c] SO2 and Suspended Particulate matter are sampled once every six days when using the manual methods. A minimum of twelve sampling days per quarter or forty-eight sampling days each year is required for these methods. Daily sampling may be done in the future once continuous analyzers are procured and become available.
[d] Limits for Total Suspended Particulate Matter with mass median diameter less than 25-50 µm.
[e] Annual Geometric Mean.
[f] Provisional limits for Suspended Particulate Matter with mass median diameter less than 10 µm and below until sufficient monitoring data are gathered to base a proper guideline.
[g] Evaluation of this guideline is carried out for 24-hour averaging time and averaged over three moving calendar months. The monitored average value for any three months shall not exceed the guideline value.

(Source: DENR DAO NO.2000-81 (2000))

(b) Air condition in the Project site

DENR took monitoring of TSP in the whole Philippines. The results enable to be seen on the web site[2] and Table R 9.8 shows extracted Regional data.

Table R 9.8 The Regional Monitoring Data of TSP

(Unit: µg/NCM)

Place	2001	2002	2003
NCR	151	147	156
CAR	238	145	-
Region I	64	93	130
Region II	213	339	198
Region III	-	113	120
Region IV-A	-	110	103
Region IV-B	-	246	-
Region V	76	109	109

[2] http://www.emb.gov.ph/air/AQMN2.html

Place	2001	2002	2003
Region VI	201	168	134
Region VII	66	89	94
Region VIII	98	98	100
Region IX	438	360	154
Region X	142	128	156
Region XI	74	92	96
Region XII	175	99	96
Region XIII	184	100	-

(Source: Extracting from web site of EMB-DENR
: The results of monitoring of Regional sampling of TSP)

Table R 9.8 shows the average value of a year. The value of Region II is 213 in 2001, 339 in 2002, and 198 in 2003; it is slightly inclinable to decrease.

The air quality site survey in Cagayan River basin was taken in 2002 as a part of F/S[1]. Table R 9.9 shows the site survey result by the F/S[1] report. The highlighted data shows air condition in Tugegarao City. The latest environmental standard is added in the Table. The data in 2002 shows the all air condition parameter in Tugegarao were lower than the environmental standard.

Table R 9.9 Results of Air Quality Sampling

Sampling Site	NO_2	SO_2	CO	TSP	Lead
Ambient Air Sampling Stations	µg/NCM (30 min ave. time)	µg/NCM (30 min ave. time)	mg/NCM (1 hr ave. time)	µg/NCM (1 hr ave. time)	µg/NCM (1 hr ave. time)
Alcala Town Hall	37	27	8.5	143	0.24
Alcala Town Market	48	35	15.1	151	0.28
Punta, Aparri	36	22	7.6	134	0.20
Aparri Town Market	62	38	12.4	154	0.31
Marigba St., Ugac, Tuguegarao	41	31	8.5	146	0.25
Tuguegarao Public Market	83	44	18.1	155	0.39
Centro, Cabagan	42	34	7.2	138	0.25
Cabagan Public Market	76	39	16.0	151	0.28
Maramag St., Ilagan	47	30	9.2	146	0.22
Ilagan Town Market	68	39	14.0	151	0.27
National Ambient Air Quality Guideline Values (DENR DAO NO.2000-81 (2000))	150µg/NCM (24 hrs ave. time)	230µg/NCM (24 hrs ave. time)	35mg/NCM (1 hr ave. time)	230µg/NCM (24 hrs ave. time)	1.5µg/NCM (3 months ave. time)

(Source: The result of on-site survey in The F/S[1])

The Project site is urbanizing in the local area but, the situation of existing numbers of mobiles or industries activities are still little compared to the condition in Manila. There is no air pollution problem in the surrounding area in accordance with hearing from the officials and residents. It was confirmed that there is not significant issues regards to air pollution in the Project site under the present circumstances.

(9) Noise

The environmental standards for noise in the Philippines are stipulated based on Presidential Decree (P.D.) No. 984 (1978) as Table R 9.10.

Table R 9.10 Environmental Quality Standards for Noise in General Areas

Category of Area	Daytime	Morning & Evening	Nighttime
AA	50 dB	45 dB	40 dB
A	55 dB	50 dB	45 dB
B	65 dB	60 dB	55 dB
C	70 dB	65 dB	60 dB
D	75 dB	70 dB	65 dB

Source: Official Gazette, 1978 Implementing Rules and Regulations of P.D. 984.

(Legend)

Category of Area is as follows:

AA: a section or contiguous area which require quietness such as area within 100 meters from school sites, nursery schools, hospitals, and special home for the aged

A: a section or contiguous area primarily used for residential purposes

B: a section or contiguous area primarily used as commercial area

C: a section primarily reserved as a light industrial area.

D: a section primarily reserved as a heavy industrial area

Division of 24-hour period is as follows:

Morning	5:00 AM to 9:00 AM	Evening	6:00 PM to 10:00 PM
Daytime	9:00 AM to 6:00 PM	Nighttime	10:00 PM to 5:00 AM

Noise level measurement was conducted at the two noise sampling locations on July 16, 2009. The noise sampling stations were positioned at the nearest residential community to determine the possible impact of noise during the construction period. The measurement was conducted using a precision type, digital sound level meter using the method prescribed in the implementing rules and regulations of PD 984. The instrument is also provided with an integral calibrator which is allows the instrument to be calibrated to 94dB. The minimum and maximum of continuous readings were recorded in each station. The median values were then taken and compared with the DENR noise standards based on the 1978 Rules and Regulations of PD 984. The noise standards may be considered as Class A since the area is primarily used for residential purposes. Thus, the results of the sound level measurement are compared to the daytime standard for Class A area.

Table R 9.11 shows the summary of the noise measurement around the planed revetments areas at Alibago, Enrile, and Catagaman. There were some instances where the noise exceeded the governing parameters because of the passing through of tricycles and jeepneys in the area which are often noisy and not fitted with noise reduction accessories. In Enrile, however, tricyles were far and few between and the predominant noises or sound would be the sound of horse hooves. The details are shown in Annex PIIA_9-3.

Table R 9.11 Summary of Noise Measurement

(1) At Catagaman area		
Distance from planned revetment	Time	Difference from the noise standard (dBA)
10 m	Morning	+ 5.8
	Noon	+ 17.5
	Evening	+ 12.8
15 m	Morning	+ 0.0
	Afternoon	+ 9.0
	Evening	+ 2.8
(2) At Alibago Enrile		
10 m	Morning	- 6.0
	Afternoon	- 2.5
	Evening	- 5.0
20 m	Morning	- 4.0
	Afternoon	- 0.5
	Evening	- 5.5
(3) At Palua Norte		
10 m	Morning	- 5.5
	Afternoon	- 5.5
	Evening	- 5.0
15 m	Morning	＋2.1
	Afternoon	+ 5.1
	Evening	0.0

Source: JICA Study Team

(10) Sensitive areas

(a) Areas declared by law as protected areas: The Peñablanca Protected Landscape (formerly known as Callao Caves National Park) is located about 15 km northwest of Tuguegarao along Pinacanauan River and the Magapit Protected Landscape is located at downstream of Tuguegarao. But, there are no nearest protected areas to the Project site, all declared areas by law are too far for it to be affected.

(b) Areas set aside as aesthetic potential tourist spots: There are no potential tourist spots in the Project site as provided in the comprehensive land use plans.

(c) Areas which constitute habitat for any endangered or threatened species of Philippine wildlife: The habitats for endangered or threatened species are located in the protected areas. Since Tuguegarao is a city, there are no endangered or threatened specie habitats in the area since whatever habitats were available have been taken over by urban and agricultural activities.

(d) Areas of unique historic, archeological, geological, or scientific interests: There have been scientific efforts to catch and domesticate the very rare and expensive (not to mention delicious) lobed river mullet (Cestraeus plicatilis) which is locally known as banak or ludong along the Cagayan River but this have been confined to the upper portions of the river in Isabela and not along the Cagayan. The main historical sites are the old Spanish houses in Tuguegarao but these are mostly for tourist purposes only and are not really protected.

(e) Mangrove Areas: The Project site is located far from the river mouth. There are no mangrove areas in the site.

(f) Coral Reefs: There are no coral reefs in/around the project site, because it is located far from the sea.

9.1.4 Baseline data of social condition

(1) Data collection methodology

The RPM describes necessary social baseline data as a) demography data, b) displacement of settlers and c) presence of Indigenous people. The land use condition is also required. In this study, demography data was described in Chapter 3 and 4, b) data of displacement of settlers were collected by the interview survey in the field. And there are no indigenous people in the Project site in accordance with the sourced data from the National Commission on Indigenous Peoples.

(2) Land-use

The Existing and Proposed Land Use in Tugegarao City is outlined in Annex PIIA_9-4. The agricultural land covers 4,520 ha (about 40% of the total area), followed by the residential area which covers 1,313 ha (about 12% of the total area). The commercial area covers about 1%, the industrial area covers about 1.5%. The land used for crop planting is shown as Annex PIIA_9-4

(3) Indigenous People

There are no Indigenous groups in/around the Project site. All Indigenous people's groups were reported in the Accomplishment Report (National Commission on Indigenous Peoples). According to the web site and interviews with municipal officials, there are no tribes resident within the project sites. The relevant section of Region II of the annual report from the web site is shown in Table R 9.12. It shows that the 5 claimants listed are outside of the Project site.

Table R 9.12 Relevant section of Status Report of Accomplishment Report (CY 2004)

REGION	PROVINCE	AD Location	Claimants Tribe	Area (Has)	Remarks
REG. II	Batanes	Itbayat	Ivatan	9,053.00	Survey to resume by 2nd quarter of 2005
	Cagayan	Gattaran	Agtas	20,662.83	For survey
	Isabela	Palanan and San Mariano Maconacon San Mariano	Agta	45,276.00	Social preparation stage
	Nueva Vizcaya	Sta. Fe and Aritao	Kalanguya	23,000.00	survey completed; finalization of proofs
	Quirino	Madella & Nagtipunan	Agta	10,971.00	Social preparation stage
	Subtotal			108,962.83	

Source: ACCOMPLISHMENT REPORT, CY 2004, NATIONAL COMMISSION ON INDIGENOUS PEOPLES (http://www.ncip.gov.ph/downloads/Annual%20Report%202004.pdf)

(4) Profile of people in/around the Project site

Census data covering demography on the Municipality level is available in the Philippines. However, data on education, employment, income, etc are compiled on a Region level only and therefore Municipality level data is not available. The JICA Study Team therefore carried out an interview survey of about 10 households who were going to be Project-Affected Persons (PAPs) at each planed facility. In total 53 households were interviewed. The interview survey was conducted in order to collect

and collate - in brief – the residents' socio-economic conditions and opinions on the Project. The results of the survey were described in (a) to (d). The distribution of the interviewees and the details of the survey results are shown in Annex PIIA_9-5.

Table R 9.13 Number of Respondents in Study Area

(Class-wise)			
Residents	Farmers	Fish Cultivators	Total
45	8	0	53

Source : JICA Study Team

(a) Household (HH) heads and family

Gender and age of HH heads

11 of the interviewed respondents' household heads are female, with most of HH heads being male. The ratio of males is 79% of 53 HH heads. The age of the household heads varies between 30 and 60 years old.

Education of HH heads

A clear majority of the respondents did not reach a college level education. 43% of HH heads are below elementary school level and 73% of them are below high-school level.

27% of 53 respondents are educated to a college level.

Family composition

47 HHs (89% of total respondents) were composed of single families and 6 HHs (11% of total respondents) have extended families in their households. Family sizes also tend to be smaller, with major family sizes of between 3 to 6 persons (78% of 53 HHs). The average of the total family members is 4.5 (persons/house) which is calculated by weighted average method.

(b) Economic condition

Income source of HH heads

22 % of 53 respondents are farmers, followed by employees at 20 %. Other income sources vary, ranging from fishermen (15 %), no source of income (15%), business (8%), and construction workers (8%).

Family income

The combined family income in the Project areas is generally low with about 62% of the respondents having family incomes of 8,000 Pesos and below. The average of family income (calculated by the weighted average method) is about 9,000 Pesos per month.

(c) Life condition of HHs

House size and material, Electricity, Water supply and Toilet location

(House materials): The major responses as to housing materials were concrete at 42 % (out of 45 respondents), cement and natural materials combined at 33 %, and other materials follow at 18%. The usage of natural material was smallest at

7%. There are no informal resettlers in the revetment planned areas. Most of the residents are permanent.

(Electricity): 93 % of 45 respondents in Tugegarao City are connected to an electrical service. Only 3 respondents (7% of 45 respondents) have no electricity connection.

(Drinking water): About 76 % of 45 respondents use piped water. The river water is used for agricultural field irrigation.

(Toilet): Sanitation coverage amongst the respondents is almost complete with no respondents using the river as a toilet facility.

(d) Property

House ownership and size

39 HH heads own the house (87% of 45 respondents) and 11% (or 5 HHs) are renting their houses from relatives w/o payments. Their house size is small: the majority range from 20 to 50 m^2 (35 HHs or 78% of 45 respondents).

Land ownership and size

The ratio of lot ownership is the same as house ownership. 39 HH heads of 45 respondents own the land. Regarding the size of the homestead land (hereinafter referred to as "lot"), 23 HH heads quotes sizes ranging from 50m^2 to 200m^2. The others vary in size.

(e) Opinion on the Project

Opinion on relocation

There is general agreement that flood control measures need to be placed in the area. According to the interview result, there is only one respondent who disagrees on the issue of relocation if the Project requires this. 68% of 53 respondents agreed unconditionally and 14% of them agreed conditionally to be relocated or transferred, with 12% agreeing to follow the LGU's decision. Others needed more information before deciding. Meanwhile, most would agree to the project, they did, however, need more concrete information about the extent to which they will be affected, including the relocation site and the lawful compensation payments for their land and crops.

Relocation site

The residents who agreed to be relocated were asked their preferred relocation site and about 78% of them answered that - if possible - they wanted to be relocated within their neighborhood.

9.1.5 The Project

(1) Project Site

The Sector-Loan Project aims to protect the core areas which are Tugegarao City and the Municipality of Enrile. The locations of the core areas are shown in Figure R 6.1 in Chapter 6.

(2) Project Components

The main component of the Project is revetment construction at the river band where much erosion can be seen. The distribution of the physical construction locations is shown in the attached Figure 7.8 in Chapter 7. The summary of project components is shown below:

Table R 9.14 Summary of the Project Components

Component		Length (m)	Elevation of Revetment (EL+ m)	Type of Structure	
				Lower Portion	Upper Portion
Alibago Revetment		900	EL+21.0	SSP Revetment with Foot Protection	Wet Stone Masonry
Cataggaman Revetment		1,400	EL+20.0		
Enrile Revetment		800	EL+15.0		
Total	(Revetment)	3,100	-	-	-
	(Excavation)	860 thousand m^3			
	(Backfill/embankment)	860 thousand m^3			

Source : JICA Study Team

(3) Alternatives and Evaluation from Environmental & Social Aspects

The alternatives were considered on several aspects, such as risk management, economic, construction, natural environment, and social environment. With regard to environmental and social consideration aspects, the scale of impact on people's lives can be shown as the scale of land acquisition and resettlement.

(a) Consideration of without project

The damage done to the natural and social environment through flooding would not be mitigated in the case of the project not proceeding. Other impacts which would be caused by the project such as land acquisition, resettlement, salt water intrusion, etc., will not eventuate if the Project does not proceed. However, the risk of a flooding disaster would never be mitigated without the Project, and it would certainly have a negative impact on both natural and social environments. The negative impact without the project proceeding is considered much greater than the potential impacts by the project itself. Taking into consideration the entire evaluation of alternatives in Chapter 7- including the option of the project not proceeding- it is concluded that the Project is required and necessary for the Project site.

(b) Comparison of alternatives

There are 4 alternatives (C-1 to C-4). C-1 and C-2 show the dikes and cut-off-channel. The dikes are necessary to protect the core areas. However, the implementation of dike construction leads to major land acquisition and resettlements, which requires a large budget as well. Finally, the full and entire package of the plan will be required to protect the core areas.

C-3 shows huge dredging of the river and excavation of the agricultural lands. It includes a large degree of land acquisition and resettlement. However, the cut-off-channel has been evaluated and considered as effective for the mitigation of slope erosion. Flood mitigation through the cut-off-channel can be evaluated as a side benefit with a high impact on social aspects. Therefore, according to a

comparison of C-3 and C-4, C-4 is better than C-3 on both environmental and social aspects.

Table R 9.15 Comparison of Impact on Environmental and Social Condition

Item	Alternative C-1	Alternative C-2	Alternative C-3	Alternative C-4
Project Objective	Flood protection for 25-year Erosion Control	Flood protection for 25-year Erosion Control	Flood mitigation Erosion mitigation	Erosion Control
Const. Cost	8 billion	7 billion	5 billion	2.3 billion
L.A	(-A)	(-A)	(-B)	(-C)
R.	(-A)	(-A)	(x)	(-C)
F.A.E	(+A)	(+A)	(+C)	(+C)
D.S	(-A)	(-A)	(-A)	(-B)
C.E.	(-A)	(-A)	(-B)	(-C)
Comparative evauation	-A	-A	-B	-C

L.A.: Land acquisition, R: Relocation, S.W.I.: Salted water intrusion, F.A.E.: Flood area expanding
D.S.: Disposal Soil amount, C.E.: Comparative Evaluation
(-A): much significant, (-B): significant, (-C): small impact, (x): no impact

Source: JICA Study Team

9.2 EIA system in Philippines and ECC for the Project

9.2.1 Outline of Philippine EIA System (PEIAS)

(1) Regal Framework of Environmental and Social Considerations in Philippines

The powers and functions of executive agencies other than the Local Government Units (LGUs) are provided in the Administrative Code. Under this law, the Department of Environment and Natural Resources (DENR) is the primary agency responsible for environmental management as well as the use and management of all natural resources.6 The EMB is the unit within DENR that is primarily responsible for pollution issues and environmental impact assessment. A quasi-judicial body, the Pollution Adjudication Board (PAB), is composed of top DENR officials and representatives from the private sector. The PAB is authorized to decide pollution cases and impose fines.

Presidential Decree 1586 required certain projects to submit an environmental impact statement (EIS: detailing the environmental consequences of construction and operation) prior to the development activity. The DAO 37-1996 lists the types of "Environmentally-Critical Projects (ECP)" covered by the requirement (usually heavy industries). All ECPs are required to conduct an environmental study even if the scale of the project impacts would be small. The DAO 30-2003 has added a list of "Environmentally-Critical Areas (ECA)" where even minor projects are required to conduct some impact assessment. It requires detailed EIA for ECPs and relatively simpler studies (called Initial Environmental Examinations (IEEs) or checklists for minor projects or activities in ECAs) based on the level or degree of potential environmental impacts. For projects without any significant impacts, the project proponent shall obtain a Certificate of Non-Coverage (CNC). The EMB-DENR is the primary implementer of the law. The ECC of major projects needs to be approved by the Secretary of the DENR. For minor projects, the Regional Director of the DENR in the region where the project is situated approves the ECC.

PEIAS is a set of laws, regulations, administrative orders and guidelines concerned Environmental Impact Assessment (EIA). Among them some of the most important laws and guidelines are bellows:

(Environment)

- Environmental Impact Statement System, Presidential Decree No. 1586 (1978)

  An act establishing and centralizing the Environmental Impact Statement (EIS) System under the National Environmental Protection Council (NEPC), which merged with the National Pollution Control Commission (NPCC) in June 1987 to become the Environmental Management Bureau(EMB).

- Presidential Proclamation No. 2146 (1981) and No. 803(1996)

  It proclaims Environmentally Critical Projects (ECPs) to have significant impacts on the quality of the environment and Environmentally Critical Areas (ECAs) as environmentally fragile areas within the scope of the EIS System.

- DENR Administrative Order No. 30 Series of 2003 (DAO 03-30), Revised Procedural Manual (2007)

It provides implementing rules and regulations of Presidential Decree No. 1586, establishing the Philippine Environmental Impact Statement System (PEISS). Also, detailed information in definitions of technical terms, procedures, related laws and regulations are described.

(Social Consideration)

- Guidelines for the Acquisition of Certain Parcels of Private Land Intended for Public Use Including the Right-of-Way Easement of Several Public Infrastructure Projects, Administrative Order No. 50 (1999)

  The order is an amendment of the procedures for acquisition of property, declared by Presidential Decree No. 1533 mentioned in the latter section.

  With respect to the conditions to be complied with during the negotiated sale, the order states that all the government agencies which are engaged in public infrastructure projects shall first negotiate with the owner for the acquisition of parcels of private land intended for public use including the right-of-way easement of such projects, by offering in writing a purchase price of an amount equivalent to 10% higher than the zonal value of the said property. During the negotiation, the landowner shall be given 15 days within which to accept the amount offered by the concerned government agency as payment for the land.

  After the abovementioned period and no acceptance is made by the landowner, the concerned agency, in coordination with the Solicitor General, shall initiate expropriation proceedings in the proper court, depositing 10% of the offered amount.

  Besides, the order prescribes the standards for the assessment of the value of the land subject of expropriation proceeding.

- An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and for other Purposes, Republic Act 8974 (2000)

  It declares that private property shall not be taken for public use without just compensation. Towards this end, the State shall ensure that owners of real property acquired for national government infrastructure projects are promptly paid just compensation. The Act also provides Guidelines for Expropriation Proceedings including compensation of the property which shall be appraised by determining the market values of lands and improvements. The Sec. 8 states that the implementing agency shall take into account the ecological and environmental impact of the project.

- The Agricultural Land Reform Code, Republic Act 6389 (1971)

  The Act amended the agricultural land reform code. The agricultural lessee shall be entitled to disturbance compensation equivalent to five times the average of the gross harvests on his landholding during the last five preceding calendar years.

- Executive Order 1035 (1985)

  The order provides the procedures and guidelines for the acquisition of private properties or rights for development projects by the government, including

government-owned or controlled corporations and state colleges and universities.

Acquisition shall be done either through negotiated sale or expropriation. The order gives authority to the government implementing agency/instrumentality concerned to immediately institute expropriation proceedings if the parties fail to agree in negotiation of the sale. The just compensation to be paid for the property acquired through expropriation shall be in accordance with the provisions of P.D. No. 1533 under-mentioned.

- Presidential Decree No. 1533 (1978)

  It establishes a uniform basis for determining just compensation and the amount of deposit for immediate possession of the property involved in eminent domain proceedings.

- Urban Development and Housing Act, Republic Act 7279 (1992)

  This Act provides policy to undertake, in cooperation with the private sector, a comprehensive and continuing Urban Development and Housing Program. The program is aimed to uplift the conditions of the underprivileged and homeless citizens in urban areas and in resettlement areas by making available to them decent housing at affordable cost, basic services, and employment opportunities. The Program covers lands in urban and urbanizable areas, including existing areas for priority development, zonal improvement sites, slum improvement and resettlement sites. Under this Act, eviction and demolition are allowed in danger areas such as railroad tracks, garbage dumps, riverbanks, shorelines, waterways, and other public places such as sidewalks, roads, parks, and playgrounds.

- Instituting the National Drive to Suppress and eradicate Professional Squatters and Squatting Syndicates, Executive Order No.153 (1999)

  The Act states that the Housing and Urban Development Coordinating Council (HUDCC) and the Department of Justice (DOJ) shall have authority to call on the relevant government agencies to give their assistance and cooperation to intensify the national drive against the professional squatters and squatting syndicates.

  Also, the Act prescribes that the National Police Task Force shall be strengthened as the operational arm of the HUDCC in the implementation of the provisions of the order.

- Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP) (2007)

  This is the guideline of DPWH for land acquisition and resettlement. This policy was established based on Philippines national laws, regulations and it includes the guidelines of WB, ADB, and JBIC. This policy is applicable for the projects under DPWH.

- Relevant Guidelines

  Some of the guidelines prepared to put the above-mentioned laws into effect are listed below.

- Implementing Rules and Regulations Governing the Registration of Socialized housing Beneficiaries (1993)
- Implementing Guidelines for the Acquisition, Validation, Disposition and Utilization of Lands for Social Housing (1993)
- Implementing Rules and Regulations to Ensure the Observance of Proper and Hmane Relocation and Resettlement Procedures Mandated by the Urban Development and Housing Act (1992)
- Guidelines for Land Validation for Socialized Housing, Local Financial Circular 3-92 (1992)
- Guidelines of Executive Order No.153

(Laws and Regulations Concerning the Environmental Standards)

- Environment Code, Presidential Decree No. 1152

  Known as the Philippine Environment Code, it launches a comprehensive program on environmental protection and management. It also provides for air, water quality, land use, natural resources and waste management for fisheries and aquatic resources; wildlife; forestry and soil conservation; flood control and natural calamities; energy development; conservation and utilization of surface and ground water and mineral resources.

- Water Code, Presidential Decree No. 1067

  A decree instituting a water code which revises and consolidates the laws governing the ownership, appropriation, utilization, exploitation, development, conservation and protection of water resources.

- Clean Water Act, Republic Act 9275

  An Act which aims to protect the country's water bodies from pollution of all possible sources (industrial, commercial, agriculture and household activities). It provides for a comprehensive and integrated strategy to prevent and minimize pollution through a multi-sectoral and participatory approach involving all the stakeholders.

- Clean Air Act of 1999, Republic Act No. 8749

  An Act which lays down policies to prevent and control air pollution. The act sets standards of exhaust gas from vehicles, manufacturing plants and so on to follow. All potential sources of air pollution must comply with the provisions of the Act. As such, all emissions must be with in the air quality standards set under the law. It also imposes the appropriate punishments for violators of the law.

- Ecological Solid Waste Management Act, Republic Act No. 9003 (2000)

  An Act providing for an ecological solid waste management program, creating the necessary institutional mechanisms and incentives, declaring certain acts prohibited and providing penalties, appropriating funds therefore, and for other purposes.

- Pollution Control Law, Presidential Decree No. 984

  An Act that serves as the foundation for managing industrial activities impacting air and water quality. It empowers the DENR to impose ex-parte cease and desist orders (CDO) on the grounds of immediate threat to life, public health, safety or welfare, or to animal or plant life when wastes or discharges exceed the normal.

- Forestry Reform Code, Presidential Decree No. 705

  The Forestry Reform Code of the Philippines recognizes that there is an urgent need for proper classification; management and utilization of the lands of the public domain to maximize their productivity to meet the demands of the increasing population of the Philippines. It surmises that to achieve the above purpose, it is necessary to reassess the multiple uses of forest lands and resources before allowing any utilization to optimize the benefits that can be derived. It also emphasizes not only the utilization but more so on the protection, rehabilitation and development of forest lands to ensure the continuity of their productive condition.

- National Integrated Protected Areas System (NIPAS), Republic Act No. 7586

  An Act that aims to protect and maintain the natural biological and physical diversities of the environment notably on areas with biologically unique features to sustain human life and development as well as plant and animal life. It establishes a comprehensive system of integrated protected areas within the classification of national park as provided for in the Constitution to secure for the Filipino people of present and future generations the perpetual existence of all native plants and animals. It encompasses outstandingly remarkable areas and biologically important public lands that are habitants of rare and endangered species of plants and animals, bio-geographic zones and related ecosystems, whether terrestrial, wetland or marine.

(2) Category of project

In accordance with DENR Administrative Order No.37, series of 1996 (DAO 37), any projects in Philippines are required to obtain ECC or CNC. The projects which are required CNC are defined in Section 2.0 of DAO 37. The other projects are categorized as EIA-covered projects which are classified into Group I to V as below.

Table R 9.16 Project type in PEIAS

Group	Description
I	Single ECP (Environmentally Critical Project) in ECA (Environmentally Critical Area) or NECA (non-ECA)
II	Single NECP (non-ECP) in ECA
III	Single NECP in NECA
IV	Co-located Projects in either ECA or NECA
V	Unclassified Projects

Source: Table 1-3 of RPM

There are 4 EPCs and 12 ECAs, they are described as Table R 9.14.

Table R 9.17 ECPs and ECAs in PEIAS

A. List of ECPs	
1	Heavy Industries – Non-ferrous Metal Industries, Iron and Steel Mills, Petroleum and Petro-chemical Industries including Oil and Gas, Smelting Plants
2	Resource Extractive Industries – Major Mining and Quarrying Projects, Forestry Projects (logging, major wood processing projects, introduction of fauna (exotic animals) in public and private forests, forest occupancy, extraction of mangrove products, grazing), Fishery Projects (dikes for/ and fishpond development projects)
3	Infrastructure Projects – Major Dams, Major Power Plants (fossil-fueled, nuclear fueled, hydroelectric or geothermal), Major Reclamation Projects, Major Roads and Bridges
4	All golf course projects
B. List of ECA Categories	
1	All areas declared by law as national parks, watershed reserves, wildlife preserves, sanctuaries
2	Areas set aside as aesthetic potential tourist spots
3	Areas which constitute the habitat of any endangered or threatened species of Philippine wildlife (flora and fauna)
4	Areas of unique historic, archaeological, or scientific interests
5	Areas which are traditionally occupied by cultural communities or tribes
6	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)
7	Areas with critical slopes
8	Areas classified as prime agricultural lands
9	Recharged areas of aquifers
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth of major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines

The groups mentioned in Table R 9.16 are classified into several project types, and project types are classified into sub-types. Table R 9.18 shows number of project type and sub-type. The details are described in the Annex 2-1b of the RPM.

Table R 9.18 Number of project types in PEIAS

Group	Number. of types	Number. of sub-types
Group I	4 types	37 sub-types
Group II	20 types	121 sub-types
Group III:	no type	no sub-type
Group IV	1 type	1 sub-type
Group V: ,	1 type	2 sub-types
Total	26 types	161 sub-types

Source: Annex 1-2b of RPM

(3) Required report

There are seven (7) major EIA Report types as: (1)Environmental Impact Statement (EIS), (2) Programmatic EIS (PEIS), (3) Initial Environmental Examination Report (IEER), (4) IEE Checklist (IEEC), (5) Project Description Report (PDR) (6) Environmental Performance Report and Management Plan (EPRMP), (7) Programmatic EPRMP (PEPRMP) for co-located project applications. (1) to (4) are prepared for Group I and II, (5) is for non-covered project (to obtain CNC), (6) and (7) are for the revised projects or co-related projects. The necessary type of EIA report is decided by EMB-DENR.

Table R 9.19 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	Max Processing Duration
I: Environmentally Critical Projects (ECPs) in either Environmentally Critical Area (ECA) or Non- Environmentally Critical Area (NECA)	Environmental Impact Statement (EIS)	ECC	EMB Director / DENR Secretary	120 days (Working Days)
II: Non-Environmentally Critical Projects NECPs) in Environmentally Critical Area (ECA)	Environmental Impact Statement (EIS) / Initial Environmental Examination Report (IEER) / Initial Environmental Examination Checklist (IEEC) /Project Description Report (PDR)	ECC/CNC	EMB RO Director	15-60 days (Working Days)
III: Non-Environmentally Critical Projects (NECPs) in Non-Environmentally Critical Area (NECA)	Project Description Report (PDR)	CNC	EMB Director / EMB RO Director	15 days (Working Days)
IV: Co-located Projects	Programmatic Environmental Impact Statement (PEIS)	ECC	DENR Secretary	180 days (Working Days)
V: Unclassified Projects	Project Description Report (PDR)	CNC or Recommendation on Final Grouping and EIA Report Type	EMB Director / DENR Secretary / EMB RO Director	15 days (Working Days)

Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30) (2007)

After decision of type of required report, the EIA system in Philippines is going on as follows.

(4) Procedure of ECC obtaining

The following comprise the major steps of the environmental compliance certificate application process for projects requiring an environmental impact study:

1. Project Screening - The first step in the EIS process is determining which projects are covered or not by which requirements. The law pre-categorizes projects based on the level or degree of potential environmental impacts and each category has a prescribed environmental assessment instrument of commensurate scale or level of complexity. Projects that fall under environmentally critical projects in both

environmentally critical areas and non-environmentally critical areas are classified as Group I projects. Those that are non-environmentally critical but located within environmentally critical areas are classified as Group II projects. Projects that are neither environmentally critical nor located in environmentally critical areas fall under Group III projects. Co-located projects fall under Type IV while unclassified projects are under Group V. Environmental enhancement projects are included under Group II projects and are required only a simple Project Description except for those with environmentally critical components which will be required IEEs or EIAs. The initial screening is usually done by the proponent with the help and concurrence of DENR staff.

(While the projects in the three rivers are meant to help alleviate the flooding impacts in the core development areas, the projects have been screened as environmental enhancement projects under Group II but since they do have some critical components such as dredging and land excavation they have been required to have an IEE report. This was done with the help of EMB staff and the DPWH-ESSO)

2. Scoping – Scoping is where the key issues and concerns are identified and the scope of the study is agreed upon by the proponent, the EIA consultants, DENR-EMB, EIA Review Committee (EIARC), local residents and other project stakeholders. Here the proponent is required to submit a Project Description for Scoping (PD-S) which will be the basis for the determination by the EIARC of the pertinent technical issues. It is during scoping that the EIARC for the project is formed and project stakeholders are identified. The review committee is a body of independent technical experts and professionals of various fields organized by the DENR-EMB to evaluate the EIS Report and to make appropriate recommendations regarding the issuance or non-issuance of an environmental compliance certificate. It is also during scoping when requirements for specific studies such as environmental risk assessment and environmental health impact assessment are determined. The major activities include presentation of project to the EIA Review Committee, on-site scoping with project stakeholders, and a technical scoping session with the review committee. These activities result in the production of the scoping report and the scoping checklist.

A new memorandum issued only last October 1, 2009 has made such a scoping session optional although the necessary scoping guidelines have not yet been issued. This means that scoping may be done wholly by the project proponent without intervention by the EMB or the EIARC. The hiring of outside consultants for the EIARC has also been discouraged. This means that the EMB has to review the submitted report with its in-house personnel.

3. Environmental Impact Assessment Study - The conduct of the EIA study commences after the scoping checklist is finalized. The assessment for Category B projects typically includes characterization and analysis of the biophysical, chemical, social, economic and cultural environment although on a much smaller and specific scale than that of a full-blown EIA. However, the new memorandum issued on October 1, 2009 has focused the EIA study to include only the environmental impacts of the proposed project. The socio-economic impacts and impact mitigation have been transferred to other agencies such as the LGUs. Public participation has also been removed from the EIA process with public scoping, socio-economic and perception surveys, and public hearings and consultations not required anymore . Since the memorandum is rather new, the impact of this on the EIA guidelines is rather obscure and a new set of guidelines will be expected from the DENR. Other important parts of the EIA study include the following

a. baseline data gathering, where the environmental conditions within the main impact areas before the project commences are gathered. This includes air quality, water quality, soil quality, flora and fauna studies, and other environmental data that is identified during scoping. Primary data may be collected but for IEE reports, data may be sourced from secondary sources

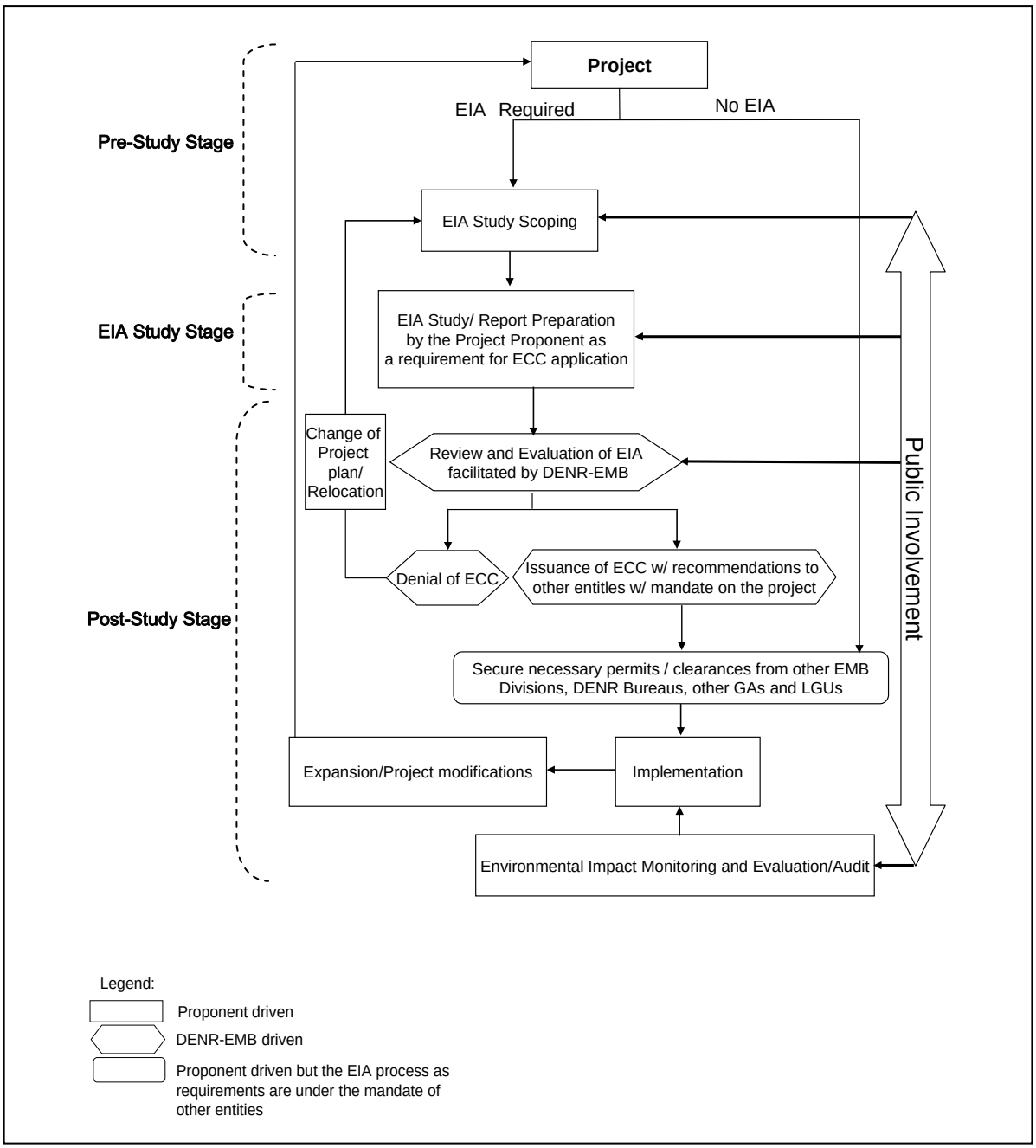
b. impact identification, prediction and evaluation, which involves a description of the project to be developed and its activities and the characterization of the possible impacts of project activities

c. environmental planning, which involves the creation of an environmental management plan and an environmental monitoring plan. The environmental management plan focuses on the key impacts and the manner by which these impacts are mitigated. This will also include a maintenance plan and an abandonment plan if the project is abandoned.

4. Environmental Impact Assessment Review - The results of the EIA study together with other required documents are packaged into an EIS or an IEE Report, which is submitted to DENR-EMB office for review. If a full-blown EIA is required, the document is submitted to the EMB central office. If an IEE or a CNC document is provided, the document is submitted to the EMB regional office where the project is located The review process consists of two stages. The first stage is a "procedural review" to be conducted by a DENR-EMB staff whose primary job is to check for completeness and ensure that submitted documents are clear and legible. Once the document is complete, the IEE or EIA shall be deemed accepted by the EMB. The second stage is the "substantive review" by the EIA Review Committee, which is now supposed to be chiefly composed of EMB and DENR personnel. At this stage, the review committee may conduct field visits or site inspections. The EIARC may not require any additional information anymore according to the new memorandum. ECC process application is now 20 working days.

5. Post-ECC requirements – After the environmental compliance certificate is issued, the proponent is expected to implement the environmental management plan and meet the conditions stipulated in the environmental compliance certificate. Post-environmental compliance certificate requirements may include the conduct of additional specialized studies such as biodiversity. With the shorter processing times and the optional attendance of the EMB and the EIARC during scoping, it is expected that the ECC conditions may become longer and more stringent. Since there is no limit on the number and types of conditions that can be included in the environmental compliance certificate, the DENR has used the environmental compliance certificate to include conditions or requirements that were not yet mandated by law but which the DENR felt necessary.

The summarize EIA process in Philippines is shown in Figure R 9.2.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)(2007)

Figure R 9.2 Summary Flowchart of EIA Process

9.2.2 ECC obtaining process for the Sector-Loan Project

(1) Category of the Project in PEIAS

The JICA Study Team prepared the checklist as self-screening and discussed the category of the Project, the procedure for ECC with EMB-DENR on 28th of September. Also, The JICA Study Team discussed this matter with R.O. of EMB in each region.

EMB-DENR evaluated the Project through project description and concerning the condition surrounding the Project site as below:

a. The Project is not EPC stipulated by DAO 37-1996.

b. The Project targets a river. However, the Project does not include a reservoir, and there is not much possibility that the river flow will be changed in any way.

c. The Project aims to mitigate the impact of potential natural disasters and would enhance the social environment.

Based on these considerations, EMB-DENR explained that the Project was categorized as the Environmental Enhancement Project of Type II. The required reports for ECC application for the Project are IEE report. The prepared self-screening checklist was attached as Annex PIIB_9-7.

(2) Necessary items of application for ECC in PEIAS

In accordance with explanations by EMB-DENR, for projects required to submit an Initial Environmental Examination, the requirements would almost be the same as an Environmental Impact Statement, although scaled down. There would be the same modules required, i.e. land, water, air, people but the EMB is usually not stringent in requiring actual water sampling or primary data collection in this case. Presumably, the IEE report can be accomplished in a faster span of time.

(3) Outputs of IEE report of this study

The outline of this study is listed below: 1) Project description, 2) Baseline data of natural/social conditions, 3) Scoping and necessary mitigation measures, 4) Recommendations of the monitoring plan

(4) Comparison of former JBIC guideline and requirements for ECC in Philippines

The comparisons between JBIC Guidelines for Confirmation of Environmental and Social Considerations[3] (hereinafter referred to as JBIC guidelines) and requirements for IEE report in PEIAS are described in Annex PIIB_9-8. There is no major difference between them.

(5) Necessary studies for the next step by DPWH

After this preparatory study, DPWH would need to carry out the IEE study and simple RAP study to obtain ECC.

9.3 General IEE study result (not specified IEE in Philippine)

The Project description and the baseline data collection have been described in previous chapters. In this chapter, the results of scoping, mitigation measures and recommendation of the monitoring plan are described.

[3] It was established in 2002 April.

9.3.1 Scoping results

(1) Resettlement, land acquisition

The estimated number of houses which would be relocated is approx. 10 or less. The average number of family members per house in Tuegegarao is 4.5; about 45 people are expected to be resettled at the most. The numbers show that this is not a large scale resettlement.

The land acquisition area for revetments is 0.93 ha and for the quarry it is 53 ha, 53.98 in total. The expected land acquisition areas are almost all private lands.

(2) Affection for traffic, living facilities, and the living of residents

(Impact on traffic): It is expected that the revetment construction will not cause much disturbance to traffic, because the construction sites are located along the river there does not seem to be much traffic. The residents use Bunton Bridge between Tugegarao and Enrile and there is no water traffic in the Project site. Therefore not much impact is expected on the traffic.

(Impact on living conditions of residents): The impact on the life of residents is expected to include i) temporary noise/vibration, air pollution, water pollution during construction, ii) life style changes due to resettlement. The impacts during construction are described (6) in this chapter.

(Benefit impact on living conditions of residents)

i) Mitigation of flood disaster: The residential areas in Tugegarao City and Municipality Enrile are located along the river. These areas have been previously damaged by flood disasters for a long time. Based on this assessment, the Project aims to mitigate the flood disasters. The project would therefore have a large beneficial impact on the living conditions of residents. ii) Opportunities for employment: Construction would need many laborers during construction thus it would introduce opportunities for employment to the residents.

(3) Solid waste/sanitation

Short-term deterioration of sanitary conditions could occur in and around the construction site during construction activities, including worker's camps. Disposal of the construction residue of the project would be expected to occur during construction. Waste from worker's camps is also expected to increase during construction in the short-term.

The amount of soil for revetment construction will be taken from the quarry at the opposite side with the same amount in accordance with project plan in this report. The soil from sediments was sampled and analyzed for this study to check for heavy metals. There are no indications of risky heavy metals being present. Therefore it is not expected for the project to cause significant impact of surplus soil.

(4) Safety during construction

Due to the revetment constructions involving the use of heavy equipment, there is a possibility for the Project to cause a construction-related accident.

The revetment constructions are located near the residential areas. There is a possibility of traffic accidents involving the residents due to the increase in the volume of construction equipment and transportation vehicles.

(5) Biological Environment

The major direct impacts on the natural vegetation cover and wildlife would not be expected to be significant. The Project will build revetments near the residential areas where the natural conditions have already been changed to the extent that the area no longer contains much original natural vegetation which could be potentially negatively and directly affected. There exists the possibility for the Project to cause an impact on sediment-based living creatures due to the excavation works to correct the soils for revetments. However, the scale of work to be carried out is small compared to the scale of the Cagayan River (the whole Cagayan River is 520 km in length, and only 2 km in the excavation areas). The change of conditions of the sediments in the river through excavation could be expected to return to normal levels again in a comparatively short period of time. Therefore a significant impact on the sediments in the river would not be expected.

(6) Impact during the construction phase

Impacts during the construction period include i) air quality, ii) noise/vibration, iii) traffic, and iv) water pollution These impacts of construction are expected only during the construction stage but their magnitude would be large.

(Air quality): Locally significant impacts of dust emission are expected in the short term during the construction period caused by the movement of haulers and construction vehicles, the operation of construction equipment, earthworks, and other related activities. A degradation of air quality due to gas emissions from those vehicles would be expected in the short term.

(Noise/vibration): Short-term noise created by the operation of the construction equipment and transport vehicles could be expected.

(Traffic); The number of vehicles would increase in the short term during construction. There is not a lot of traffic at present and a significant impact - such as heavy traffic - is not expected.

(Water pollution); There is a possibility in the short term for the Project to cause water pollution due to the revetment construction and the excavation of the river.

In the case of water pollution occurring, fisheries downstream and residents who use river water for drinking purposes, are expected to be affected. There are no fisheries in the river, and most residents do not use the river water for domestic consumption.

The total length of Cagayan River is approximately 520km. The scale of excavation is about 2km. The excavation is designed to excavate the locations which are extremely curved, making the river flow more smoothly. Therefore, water pollution resulting from excavating the river could be expected to return to normal levels again in a comparatively short time.

SS (suspended solids) in the river are not measured and the river water looks murky with a charcoal color. It could be estimated that the water includes a lot of silt which would have been carried down from upstream.

There is, therefore, the possibility for the Project to cause water pollution in the short term but there would be no significant impacts in accordance with the overall scale of construction, size and condition of the river, as well as current usage of the river water.

(7) Scoping table

The scoping results are shown in Table R 9.20.

Table R 9.20 Scoping Table

Item	Rating	Rating ground
Social consideration		
Resettlement	-B	- Only a few houses would be relocated along the designed revetments in the Project area. - The necessary land acquisition area is about 53.93 ha in total. Most of the landowners are private, but the details are unclear.
Effect on traffic, living facilities, and the living conditions of residents	-B/+A	- (negative point) Temporary air pollution, noise/vibration and water pollution from the construction and the lifestyle changes due to the resettlements, are expected. - The people use Bunton Bridge between Togegarao and Enrile and there is no water traffic. - (positive point) The residential areas have received flood damage before. The protection of these areas as the fundamental base of people's lives, would be very beneficial. - (positive point) During construction, employment opportunities for local residents would be created.
Decoupling the areas	D	- The revetments would be constructed as close to the river banks as possible. Therefore, no houses would be set in the areas at the river banks from the revetments.
The local archeological, historical, cultural, and religious heritage sites	D	- There are no local archeological, historical, cultural, and religious heritage sites in and surrounding the Project area.
Right of water, right of common	D	- There are no fisheries in Cagayan River
Ethnic Minorities and Indigenous Peoples	D	- There are no Ethnic Minorities and Indigenous Peoples in and the near areas of the Project area.
Waste/sanitation	-D	- Deterioration of sanitary conditions could occur in and around the construction sites & worker's camps in the short-term. - Disposal of the construction residue and waste from worker's camps of the project would be expected during construction in the short-term. - About 860 thousand m^3 soil will be excavated, but all will be used for backfill of the revetments. There will not be any disposal soil. - The sedimentations were sampled and analyzed. There are no indications of the presence of hazardous heavy metals.
Safety during construction	-A	- Heavy equipment would be used for the construction. Therefore, there is some chance of accidents occurring. - The construction sites are located near residential areas. There is the potential for traffic accidents.
Natural condition		
Protected areas	D	- There are no national parks, protected areas,

Item	Rating	Rating ground
		endangered or threatened species, protected mangrove areas, protected coral reefs in or near the Project site.
Topography and Geology	D	- The Project components are revetment construction, excavation of the river. These constructions are not expected to introduce significant changes of topography and geology.
Lake, river flow condition	D	- The revetment constructions would not cause a significant change of river flow.
Sea shore, marine area	D	- The Project does not include any change in the drift sand
Flora and fauna	D	- The Project area is a developed area. - There are no endangered species. - The revetments will be constructed near the residential areas which do not include a lot of natural vegetation which could be directly affected. - Total length of Cagayan River is 520km, the scale of excavation is not big. A change in sediment condition could be expected to recover comparatively quickly.
Landscape	D	- The height of revetment is 1 to 3 m. It will not cause topographic change, change or landscape.
Pollution		
Air quality	A	- Significant impacts of dust emission are expected in the short term during the construction period - A degradation of air quality due to gas emissions from those vehicles would be expected in the short term
Noise/vibration	-A	- The revetments will be constructed near the residential areas. Therefore, the impact of noise/vibration would be expected to be significant in the short term.
Traffic	D	- The number of vehicles would increase in the short term during construction. - There is not a lot of traffic at present and a significant impact - such as heavy traffic - is not expected.
Water pollution	-B	- There is a possibility for the Project to cause water pollution caused by revetment constructions and excavation of the river in the short term. - The river water is not used domestically by the majority of residents. - There are no fisheries in the river. - The entire Cagayan River is 520km long and the excavation is 2km in length and would make the river flow more smoothly. - The river water looks murky with a charcoal color, it could be estimated that the water includes a lot of silt which would have been carried from upstream.

A: Significant impact will be expected
B: Some impact will be expected
C: The impact is not clear this time.
D: No impacts will be expected. No consideration is required for the EIA study
(Source: JICA Study Team)

9.3.2 Recommendations of the mitigation measures

The outlines of the mitigation measures are suggested below, with these representing the minimum requirement. These are expected to be verified and finalized by the results of IEE and simple RAP study which would be carried out by DPWH

(1) Mitigation measures for Resettlement, land acquisition

About less than 10 households would be relocated and the land acquisition area is estimated as 53.93 ha. The impact of resettlement and land acquisition is not expected to be significant. It is a requirement to carry out a simple RAP study which would be carried out by DPWH. The simple RAP would be prepared through the study referring to the international donors' guidelines such as the World Bank and JICA guidelines.

(2) Mitigation measures for waste/sanitation

(Sanitation): To provide appropriate waste water treatment facility, toilet and waste collection at the workers' camps and project site.

(Waste): Rubbish, waste surplus and debris be cleared from the site and regularly disposed of in n approved landfill sites in line with and following governing rules and regulations.

(3) Mitigation measures for safety during construction

The recommendations for safety during the construction are: i) keep safety in mind at all times, ii) provide safety helmets to each laborer. It is highly recommended to pay attention to accident prevention especially during heavy equipment operation, iii) emphasis on accident prevention involving residents when transport vehicles access through residential areas, iv) disclosure of information relating to construction to the residents from the construction planning stage onwards and asking them for their understanding and cooperation regarding the impacts of construction.

(4) Mitigation measures for biological conditions

The dredging work will excavate a part of the sediment, which would have an impact on the sediment biology. However, it could be expected to be insignificant and to recover comparatively quickly. In the case of a long span of dredging being carried out in the short term, it is expected to become significant. Therefore, it is recommended to set a sufficient and adequate construction time period. Also, it is recommended to conduct interviews with the residents regarding the river conditions and confirm that significant changes – such as the degradation of fish stocks - would not occur.

(5) Mitigation measures for impacts by construction

The impacts during construction would be expected to be i) air pollution (dust, exhaust emissions), ii) noise/vibration, and iii) water pollution. The recommendations of mitigation measures for them are as follows:

(Air pollution): It is recommended to mitigate the impact of air pollution as follows: i) launder mud and dust from vehicles, ii) keep the excavated soil or other soil materials wet by watering. The mitigation measures of exhaust emissions are; i) prohibit needless idling of engines, ii) prevent the concentrated operation of heavy equipment in one place, iii) adhere to the construction time schedule.

(Noise/vibration): It is recommended to mitigate impacts of noise/vibration as follows; i) use low noise equipment, ii) prohibit construction work during night time hours, iii) employ low noise construction methods. It is also recommended to disclose the information regarding construction procedures to the residents from the construction planning stage onwards and ask them to understand the resulting impacts of the construction activity.

(Water pollution): The impact from water pollution caused by the revetment construction and excavation. However, it can be expected to be insignificant on the basis of considering the entire scale of construction as well as the river and the current usage of river water. It is recommended to conduct interviews with the residents and local governments' officials during construction and operation to confirm the impacts on river conditions.

9.3.3 Recommendation of monitoring plan

The environmental monitoring plan is recommended as below. The necessary items are i) air quality, ii) water quality, iii) noise/ vibration, v) resettlement/compensation and land acquisition.

The monitoring of air quality and noise/vibration is required during construction. Water quality needs to be monitored during both the construction and operation stage.

The outlines of the monitoring plan are suggested below. They constitute the minimum requirements. These are expected to be verified and finalized on the basis of the results of IEE and simple RAP study which would be carried out by DPWH

Table R 9.21 Recommended Monitoring Plan

Item	Location	Parameter	Frequency	Supervision
Preconstruction stage				
Payment of compensation according to the compensation policy described in the simple RAP				RIC
Public information (campaign) procedures				RIC
Grievance procedures				RIC
Resettlement site location/ design/ construction and plot allocation				RIC
Houses and its construction technical assistance, payment of subsistence and shifting allowances as described in the simple RAP				RIC
Provision of livelihood restoration programs (job training, etc.)				RIC
Construction stage				
Air quality	Each construction site (see the Figure R 9.3)	PM10, TSP, CO, NOx, and SOx	Once per 4 months	Contractor
Water quality (General)	Downstream of the construction sites (see Figure R 9.3)	BOD, (5-Day 20ºC), DO, TDS, TSS ,Temperature, Oil/Grease, pH	Once per 4 months	Contractor
Water pollution	Each construction site (see the Figure R 9.3)	Interview of relevant persons (City and Municipality), residents (head of Barangay): confirmation of impacts on river conditions	Once per 4 months	Contractor
Noise/vibration	Each construction site (see Figure R 9.3)	Leq, sound speed and acceleration	Once per 4 months	Contractor
Operation Stage				
Water quality (General)	Downstream of the construction sites (see Figure R 9.3)	BOD, (5-Day 20ºC), DO, TDS, TSS ,Temperature, Oil/Grease, pH,	Once a year	DPWH
Water pollution	Downstream of the construction sites (see Figure R 9.3)	Interview of relevant persons (City and Municipality), residents (head of Barangay): confirmation of impacts on river conditions	Once per year	DPWH
Livelihood conditions of PAPs (Whether the income of PAPs would not decrease caused by the resettlement)				RIC/ LUGs
Live conditions of PAPs (Whether the life conditions of PAPs would not be changed by the resettlement)				RIC/ LUGs

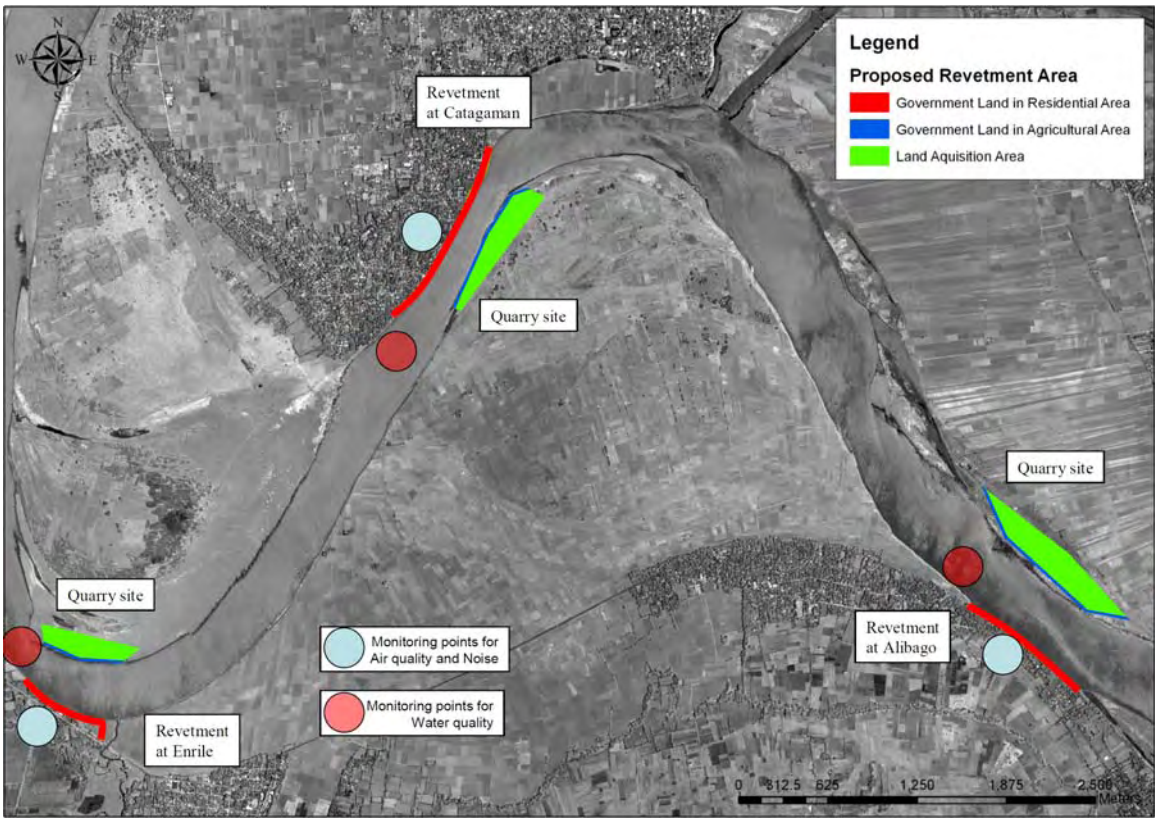


Figure R 9.3 Recommended Monitoring Locations

9.4 TOR for additional study in next stage for ECC obtaining

Initial Environment Evaluation Study: This study provides an IEE study report. DPWH will prepare the application to obtain ECC using this report and the IEE report.

9.5 Social consideration

9.5.1 Institution of resettlement and land acquisition in Philippines

(1) Policy of DPWH for resettlement and land acquisition

In the case of DPWH implementing a project, a revised policy was established in March 2007 (the contents show as guidelines). It is named as Land Acquisition, Resettlement, Rehabilitation and Indigenous People's Policy, 3rd edition (2007) (hereinafter refer as LARRIPP). It was revised and is now in its third edition. It was established in 1999 as Land Acquisition, Resettlement and Rehabilitation (LARR). The World Bank (WB) assisted in developing it with other financing institutions such as the Asian Development Bank (ADB), JBIC. A second edition of the LARR was formulated in 2004, assisted by ADB with JBIC guidelines. It was revised in 2006 when the DPWH policy of indigenous people was added, based on the Indigenous Peoples' Right Act (IPRA) and NCIP Administrative Order No. 1, series of 2006 or the Free and Prior Informed Consent Guidelines of 2006. Some minor points were revised in 2007 and it is now used as 3rd edition.

This policy includes the principles and objectives of the involuntary resettlement policy, the legal framework, eligibility, compensation and entitlements, the indigenous peoples' policy framework, implementation procedures that ensure complaints are processed, public support and participation, and the provision of internal and external monitoring of the implementation of the RAP with other financing institutions' policies such as WB, ADB and JBIC. It is composed of 8 chapters which are described below:

Chapter 1: INTRODUCTION (the general meaning of this policy, the sequence of revises)

Chapter 2: LEGAL FRAMEWORK

Chapter 3: POLICY ON ELIGIBILITY, COMPENSATION AND OTHER ENTITLEMENTS (1. landowners, 2. PAPs, 3. indicators of severity of impacts, 4. compensation per category of assets affected, 5. entitlement matrix)

Chapter 4: ON INDIGENOUS PEOPLE WHO WILL BE AFFECTED BY THE PROJECT

Chapter 5: PUBLIC PARTICIPATION AND CONSULTATION

Chapter 6: GRIEVANCE PROCEDURES

Chapter 7: INSTITUTIONAL ARRANGEMENTS

Chapter 8: MONITORING AND EVALUATION

The Process of land acquisition was described in 2 cases; i) including the indigenous people in the project site, and ii) not including the indigenous people in the project area. In accordance with LARRIPP, the process of land acquisition in the case of no indigenous people in the project site is summarized below:

DPWH, the project proponent, informs all PAPs of the following 3 points: i) the project would introduce involuntary resettlement, ii) Each PAP is entitled to receive just compensation for his/her affected plot at a rate to be negotiated between the Bureau of Internal Revenue (BIR) zonal valuation and the fair market value as provided by RA 8974, iii) 3. The BIR zonal valuation and the fair market value may differ substantially. The negotiation process is described as follows:

a. The DPWH will explainthe necessity of land acquisition as well as the compensation to PAPs,

b. In the case of PAPs not agreeing with the above, the DPWH will offer compensation at the BIR zonal valuation rates,

c. In case PAPs not agreeing with the above, the DPWH will promptly seek an independent valuation agent / estimator to appraise and determine the fair market value based on the following parameters: i. land use classification, ii. development costs for land improvement, iii. value declared by PAPs, iv. current selling price of similar properties in the vicinity, based on deeds of sale, v. disturbance / inconvenience, vi. tax declaration and BIR zonal valuation, vii. replacement cost,

d. The DPWH will communicate to the PAPs the current market value as determined by an independent land valuation agent,

e. The DPWH then begins negotiations with the PAPs to determine the final compensation,

f. If the PAPs do not accept the terms of this negotiation and the land valuation possible under RA 8974, their affected properties will be expropriated,

g. The DPWH will pay those PAPs whose property is under expropriation the amount equivalent to the sum of one hundred percent (100%) of the BIR zonal valuation and the court shall determine the just compensation to be paid to the PAP within sixty (60) days from the date of filing of the expropriation case. When the decision of the court becomes final and executable, DPWH shall pay the PAP the difference between the amounts already paid and the just compensation as determined by the court. In the interim, DPWH will deposit 100% of the BIR valuation into an escrow account.

The PAPs will be advised and notified of the available channels for complaints and grievances and related procedures. The PAPs will be informed that grievances related to the LARRIPP implementation or any aspect of the project will be handled through negotiations and are aimed at achieving consensus according to the following procedures:

1. The PAPs will lodge their grievances in writing with the Resettlement Implementation Committee (RIC) for immediate resolution.

2. If the complaint is not satisfactorily resolved within 15 days or the PAP does not receive any response from the RIC, the PAP can forward the complaint to or file an appeal with the DPWH Regional Office (RO).

3. If the complaint is not satisfactorily resolved within 15 days or the PAP does not receive any response from the DPWH RO, the PAP can file a legal complaint in any appropriate Court of Law.

The process of information disseminationwill be carried out by the Project Management Office (PMO) with the support of the Environmental and Social Services Office (ESSO, internal organization of DENR), the Regional Offices and District Engineering Offices and will be implemented through community meetings and leaflets. In accordance with Chapter V in the LARRIPP, it is noted that women and the elderly among the PAPs shall be consulted and mobilized to participate in the consultation meeting, and the Resettlement Action Plan discussed with them.

(2) Comparison of JBIC guideline and LARRIPP

The comparisons between JBIC Guidelines and LARRIPP are described in Annex PIIB_9-8. There are some differences between them, as outlined below. However, there is no major difference as to other items.

- Promotion of appropriate participation by the PAPs and their communities in the planning, implementation and monitoring of involuntary resettlement plans: The LARRIPP mentions the promotion of participation in the consultation meeting, but not any implementation and monitoring stages.

- Assistance for the informal settlers: The LARRIPP does not mention informal resettlers.

9.5.2 Stake holders meeting (SHM) and public consultation meeting (PCM)

(1) Plan of SHMs and PCMs

(a) Purpose of the meetings

Purpose of SHMs and PCMs are listed as below:

- To explain the project concept/design to LGUs and the general public.
- To answer their questions.
- To collect their opinions and revise the design taking into consideration their opinions.
- To confirm basic agreement of the proposed Project and the design.

(b) Participants

The target participants for SHM are the members of LGUs such as, City/municipality/Barangay government officials, the Mayor and the politicians. The target participants for PCMs are the general public and NGOs. Basically, it is not easy for the public at large to express their opinions/questions in front of high positioned and senior persons such as the mayor. Therefore, the JICA Study team decided to divide the meetings into 2 types.

(c) Achievements

The SHMs in Tugegarao were held on three occasions. The dates and venues of SHMs are shown in Table R 9.22.

Table R 9.22 SHMs in Tugegarao

SHM	Date/time	Host organization	Venue	Major participants	Major Agenda
1st	June 27	R.O. of DPWH in region 2	Tugegarao Crown Hotel Conference Hall	From City/Municipality: CPDC/MPDC, Engineer, Sanggunian members, etc. From central Agencies: NEDA, DPWH, OCD, etc.	Project concept
2nd	Aug. 11	-ditto-	-ditto-	-ditto-	Design alternative
3rd	Oct. 7	-ditto-	-ditto-	-ditto-	Revised design
C.H.: City Hall, M.H.: Municipality Hall CPDC: City Planning and Development Coordinator, MPDC: Municipality Planning and Development Coordinator,OCD: Office of Civil Diffence, Sanggunian: Council of City/Municipality					
Source: JICA Study Team					

DPWH held SHMs as a host organization. The R.O. of DPWH arranged the SHMs with cooperation of government of City/Municipality. The officer of City/Municipality facilitated the meetings at the request of DPWH. The JICA Study Team took presentations of the design and answered the questions from participants.

The JICA Study Team held PCMs with the cooperation of the LGUs (City/Municipality) as shown in Table R 9.23.

Table R 9.23 PCMs in Cagayan River Project Site

SHM	Date/time	Host organization	Venue	Major participants	Major Agenda
1st	July 28	JICA Study Team	Alibago B.H. of Enrile	Stakeholders (basically general people including PAPs)	Project concept
2nd	Aug. 22	-ditto-	-ditto-	-ditto-	Design alternative
3rd	Sep. 25	-ditto-	-ditto-	-ditto-	Revised design
C.H.: City Hall, M.H.: Municipality Hall, B.H.: Barangay Hall, F.C.: Formation Center					
Source: JICA Study Team					

9.5.3 Necessity of land acquisition and resettlement

(1) Land acquisition

(a) Principle of land acquisition at the planned revetments

(Necessary Areas): The land considered for the planned revetments is all private land. The design of the revetments is done so as to prevent any land acquisition as possible, as shown in Figure R 9.4.

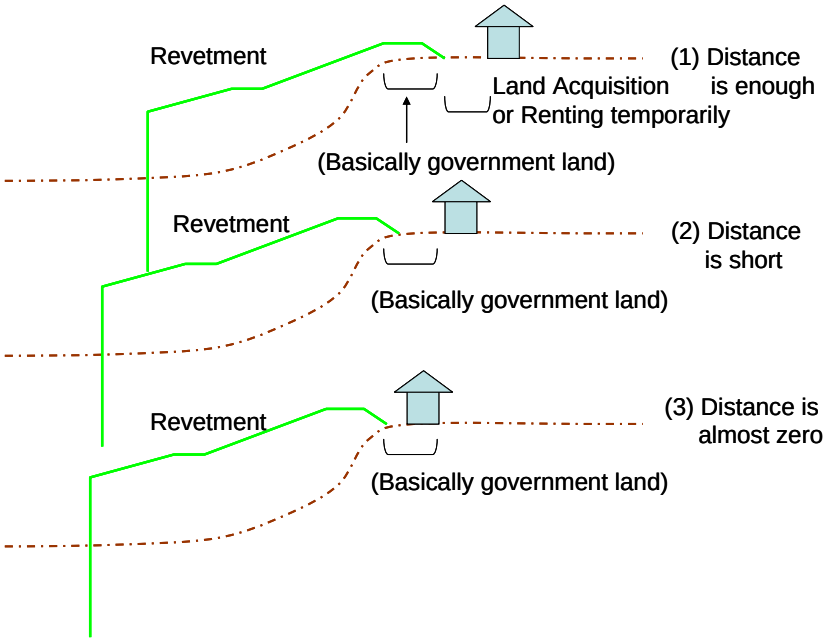


Figure R 9.4 Principle of design of revetment design

The construction will be implemented using the construction road between the revetment and existing houses along the principle detailed in the figure above. Within the Project site are some structures which are not occupied residential houses, for example castles, storage dwellings, etc. in most of the designated places. Therefore only 10 or fewer houses are affected according to Case 3 in the figure shown above. The prevention possibility was confirmed in this F/S Study, and the detailed design will be prepared based on this principle. Thus, the necessary land acquisition areas are shown in Case 1 in the figure above.

(Government land permitted to be used): The PAPs along the revetments plan are permanent residents. Some of them have inherited the land/house from their

ancestors, but sometimes they do not hold the land titles. The land is still owned by the Government and when the land is designated and used for public purposes, it shall revert back to the Government, with compensation payable on structures only but not on the land itself.

(b) Land acquisition areas covering agricultural land where excavation will take place

The remaining land acquisition areas are agricultural lands which will be excavated.

(Government land next to the river): In accordance with regulations the area with a distance of 3m from the edge of the river in the residential area shall be deemed as Philippines Government-owned land, meaning the land belongs to DPWH. The width or distance applicable to agricultural land is 20m and 40m in forest areas. The determination of the area for residential, agricultural and forest is governed by the land-use plan in each City/Municipality. (Figure R 9.5).

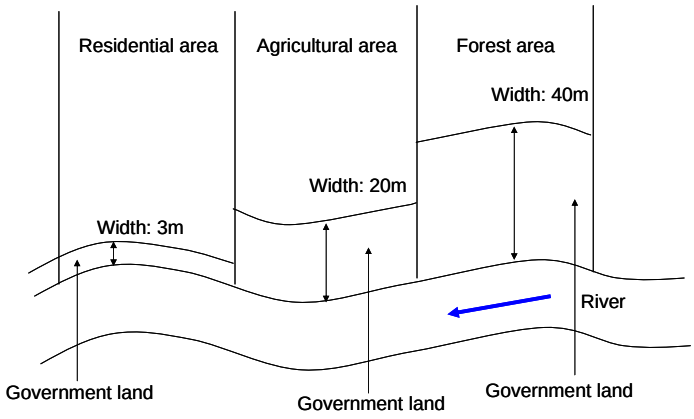


Figure R 9.5 Land ownership next to the river

(c) Necessary areas for land acquisition

The total land acquisition area in the Project site is Approx 53.93 ha. The details of the land acquisition area are shown in Table R 9.24.

Table R 9.24 Land Acquisition Area

Construction	Place	L.A. area (ha)	Initial land use
Revetment_Alibago	Alibago	0.27	Residential Area (Rural)
Revetment_Cataggaman	Cataggaman	0.42	Residential Area (Urban)
Revetment_Enrile	Enrile	0.24	Factory, Farm (Rural)
Quarry _Alibago	Alibago	28	River bank (flood plain)
Quarry _Cataggaman	Cataggaman	15	River bank (flood plain)
Quarry _Enrile	Enrile	10	River bank (flood plain)
Total		53.93	River bank (flood plain)
L.A.: Land acquisition Source: JICA Study Team,			

The location of the land acquisition area is shown in Figure R 9.6.

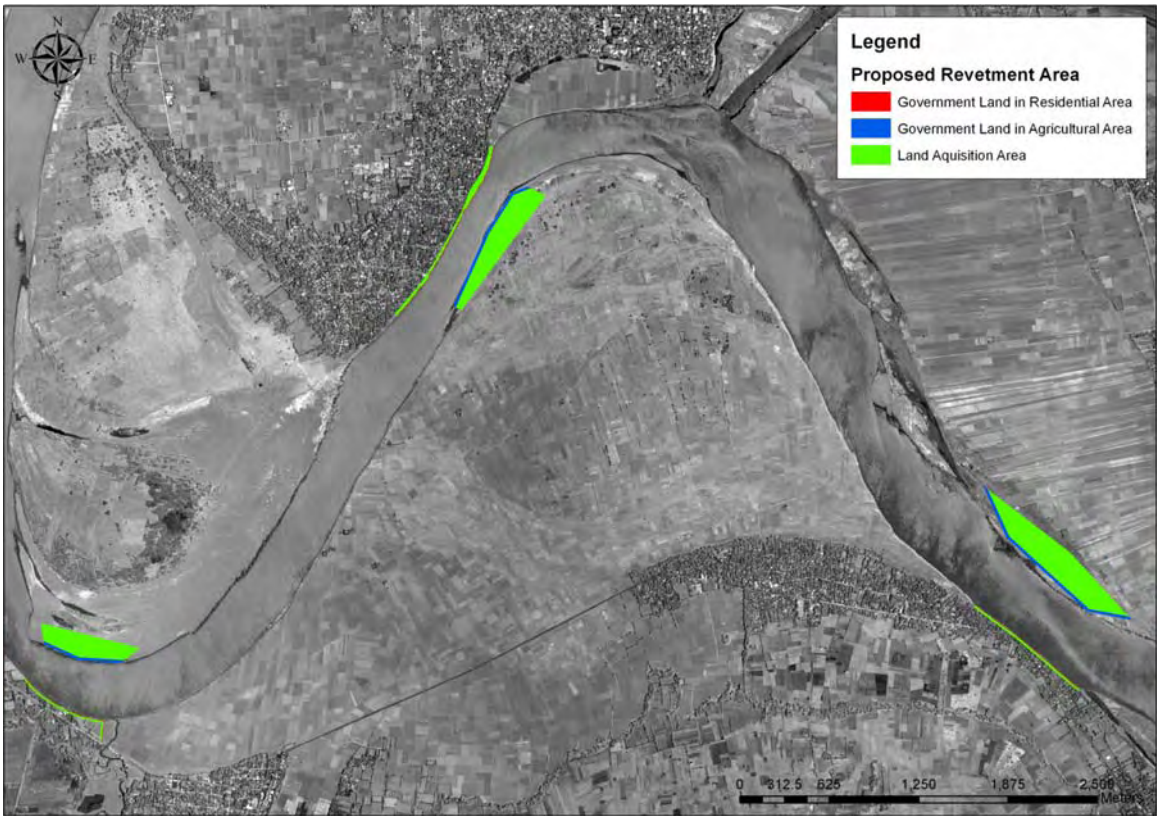


Figure R 9.6 Location of Land Acquisition

(2) Resettlement

Determination of housing which will be relocated

Those houses located near the river side would be affected by the construction of the revetments. As shown in Figure R 9.3, the revetments design will be prepared with the goal of avoiding any resettlement. Therefore the total number of resettlement houses is estimated to be 10 or less.

9.5.4 Preparation of RAP study in the next study stage

The following study items are recommended for the simple RAP.

- Number and distribution of relocated houses, socio-economic conditions of PAPs, resettlement site candidates
- Determination of PAPs, eligible, entitles, -> entitle matrix, necessary study items for simple RAP (especially JICA requirements shall be considered)
- Recommendation of a restoration program
- Recommendation of a monitoring plan