5. NON-STRUCTURAL MEASURES

5. NON-STRUCTURAL MEASURES

5.1 Basic Concept of the Plan

The flood forecasting and warning system (FFWS) is defined as one of the non-structural components of the Flood Control Plan. The FFWS Framework Plan presented in Part 1 volume aims to up-grade the existing system and achieves an integrated basin wide flood forecasting and warning system which fulfills the following objectives:

i) FFWS for Resident's Protection from Flood Incident

It aims to secure the life of people and minimize flood damages in the flood prone area by enhancing prompt flood protection activities which necessitate sufficient and accurate information, through agencies and organizations concerned. This can be achieved through advanced forecast of extreme floods which exceed the capacity of existing river facilities.

ii) FFWS for Flood Operation

It aims to promptly execute effective operation of the flood control facilities such as dams, floodways and retarding basins by forecasting the magnitude of flood inflow into these facilities in advance. It also aims to avoid artificial flood disasters by disseminating in advance to the people to be affected, information concerning flood releases from the facilities.

iii) FFWS for Basinwide Flood Management

It aims to execute effective basinwide flood management and administration by integrated real time operation of all the flood control facilities in the basin through proper coordination with agencies concerned with river and basin conditions.

FFWS for the Priority Project Plan considers the function for Flood Operation; flood control operation and maintenance of the prospective flood control facilities selected in the Priority Project Plan.

Objective flood control facilities are:

. A diversion channel at the bifurcation point of the Poponto floodway leading to the Bayambang stretch
. New Poponto floodway
. Ring dikes in the Poponto retarding basin
. Diking and gate systems in Dagupan City
. Other major facilities planned as Priority Project

The flood control operation and maintenance system is planned as an extension of the existing FFWS in order to minimize facility cost.

This system requires the following institutional arrangement:

a) PAGASA allows AFCS-DPWH to install new data communication and monitoring equipment in the AFCS office which is to be connected with the existing telemetry equipment in Rosales FFWS sub-center.

b) AFCS-DPWH takes the responsibility of operation and maintenance of the prospective new communication and operation system and safety of the river control facilities.

The conceptual procedure and information flow of the proposed flood control operation and maintenance system are illustrated in Figure 5.1.1 in relation with the existing Agno River FFWS.

5.2 Flood Control Operation and Maintenance System

The network plan and the corresponding unit component of the proposed flood control and maintenance system for the prospective flood control facilities are conceived. Figure 5.2.1 illustrates the network plan which provides a proposed operation system as an extension to the existing flood forecasting and warning system.

The unit components of the extension to the existing system are described below.

a) AFCS Control Office

The AFCS control office will be located at Rosales and all the activities for flood operation and maintenance of facilities will be managed by this office. The equipment to be installed is:

. Data communication and monitoring equipment connected with the existing telemetering equipment in Rosales FFWS sub-center
. Multiplex telecommunication equipment
. Telecommunication equipment for O & M
. Power supply equipment

b) Dagupan Branch Office

This new office will be established to operate and maintain the systems in Dagupan city area. The equipment to be installed is:

. Data communication and monitoring equipment
. Multiplex communication equipment
. Telecommunication equipment for O & M
. Power supply equipment

c) Flood Control Facilities

An operation room is provided to the major flood control facilities. The equipment to be installed is:

. Radio telephone equipment
. Antenna equipment
. Water level gauge station and monitoring equipment

Major equipment for these system is listed in Table 5.2.1.

The telecommunication network between the AFCS and flood control facilities aims to exchange information such as flood conditions, rainfall, water levels, and operating conditions of flood control facilities.

The total equipment facility cost of the proposed system is roughly estimated at 38 million pesos as shown in Table 5.2.2.

5.3 Monitoring of Sedimentation

5.3.1 Poponto Retarding Basin

The design sediment volume of the Poponto retarding basin is estimated based on some assumptions because no sediment records are available in this area. Monitoring of sedimentation in the Poponto swamp area is recommended in order to get reliable quantitative sediment data required for implementing future flood control plans. The proposed monitoring procedure is:

a) Concrete posts with a reading scale will be provided at selected sites as shown in Figure 5.3.1.
b) The ground levels will be measured with the posts at the end of the rainy season every year.
c) In addition to the periodical measurement, the ground levels shall be measured immediately after a big flood.
d) A phased installation schedule of the concrete posts is recommended to ease financial difficulties. A total of 35 posts will be installed in two phases; 9 of them will be installed under the first phase at the selected sites where heavy sedimentation is expected. The installation and measurement shall be carried out as soon as possible even prior to the commencement of the improvement works of the floodway.
e) The remaining 26 posts shall be installed under the second phase, which may be during the improvement works. The measurements at the sites, which were selected as a site per 4 km^2, will make it possible to estimate the sedimentation volume in the Poponto swamp.

5.3.2 River Mouth Clogging of Pantal-Sinocalan River

In order to monitor the transition of the river mouth of the Pantal River, a cross section survey is recommended to be executed once a year, at least by the end of the dry season.

Table 5.2.1 MAJOR EQUIPMENTS FOR THE PROPOSED SYSTEM

Office / Facilities	Equiptment
1. Agno River Flood Control System / Rosales FFWS Sub-center	Data Communication and Monitoring Equipment - Personal Computer with Keyborad and Printer Multiplex Commnunication Equipment * - Multiplex Radio Equipment - Carrier Terminal Equipment - Antenna Equipment - Telephone and Facsimile Equipment Telecommunication Equipment for O&M - Radio Telephone Equipment - Antenna Equipment - Patrol Car - Portable Radio Tel. Equipment Power Supply Equipment
2. Dagupan Flood Control Office	Data Communication and Monitoring Equipment - Personal Computer with Keyborad and Printer Multiplex Commnunication Equipment - Multiplex Radio Equipment - Carrier Terminal Equipment - Antenna Tower and Equipment - Telephone and Facsimile Equipment Telecommunication Equipment for O&M - Radio Telephone Equipment - Antenna Equipment - Patrol Car - Portable Radio Tel. Equipment Power Supply Equipment
3. Flood Control Facilities	Radio Telephone Equipment Antenna Equipment Power Supply Equipment

Note : * In addition to the existing multiplex communication equipment in Rosales FFWS Sub-center

Table 5.2.2 COST ESTIMATE FOR THE PROPOSED SYSTEM

	ITEM	COST (1,000 Peso)
I	DIRECT COST	
1.	TELECOMMUNICATION WORKS	
1.1	Agno River Flood Control System / Rosales FFWS Sub-center	7,160
1.2	Dagupan Flood Control Office	13,884
1.3	Flood Control Facilities	1,627
1.4	Measuring Equipments	2,260
1.5	Spare Parts	1,820
	SUB-TOTAL OF TELECOM. WORKS	26,751
2.	CIVIL AND BUILDING WORKS	
2.1	Agno River Flood Control System / Rosales FFWS Sub-center	990
2.2	Dagupan Flood Control Office	2,180
2.3	Flood Control Facilities	600
2.4	Measuring Equipments	400
2.5	Spare Parts	400
	SUB-TOTAL OF CIVIL AND BUILDING WORKS	4,570
	TOTAL OF DIRECT COST	31,321
II	INDIRECT COST (20% of Direct Cost)	6,260
	TOTAL COST	37,581

Notes : Peso 1.0 = Yen 5.0

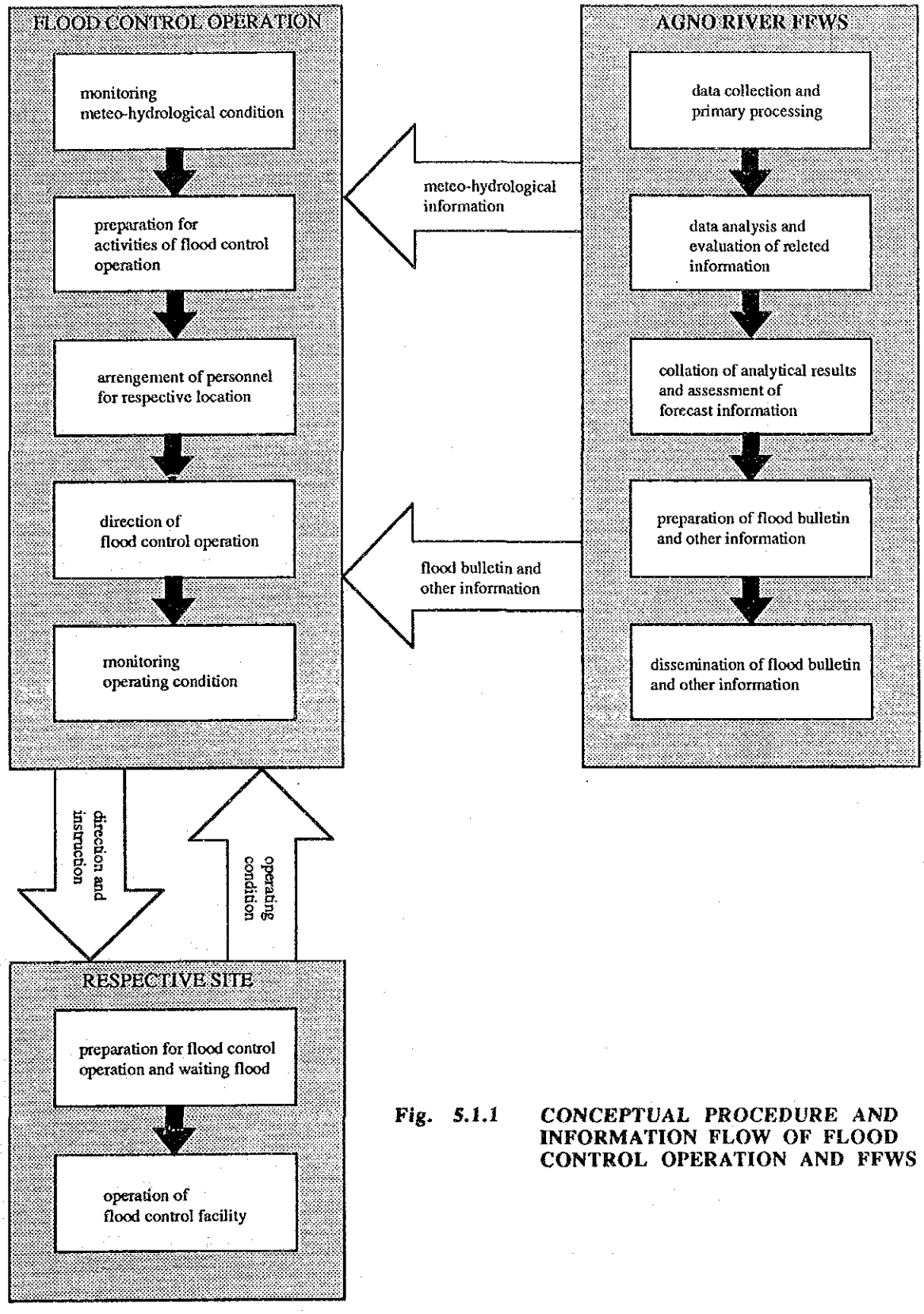


Fig. 5.1.1 **CONCEPTUAL PROCEDURE AND INFORMATION FLOW OF FLOOD CONTROL OPERATION AND FFWS**

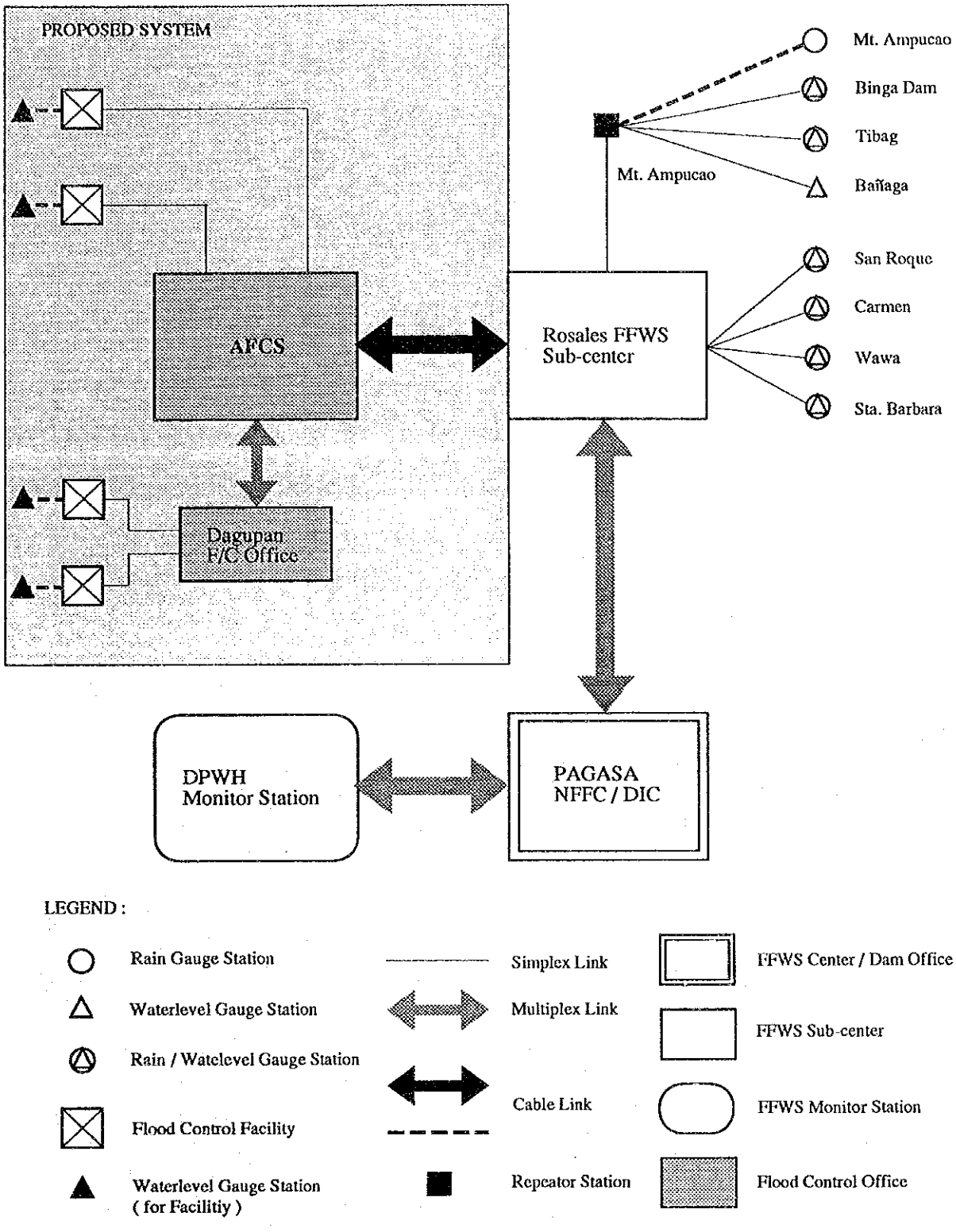


Fig. 5.2.1 NETWORK PLAN OF THE PROPOSED OPERATION AND MAINTENANCE AS EXTENSION TO EXISTING FFWS

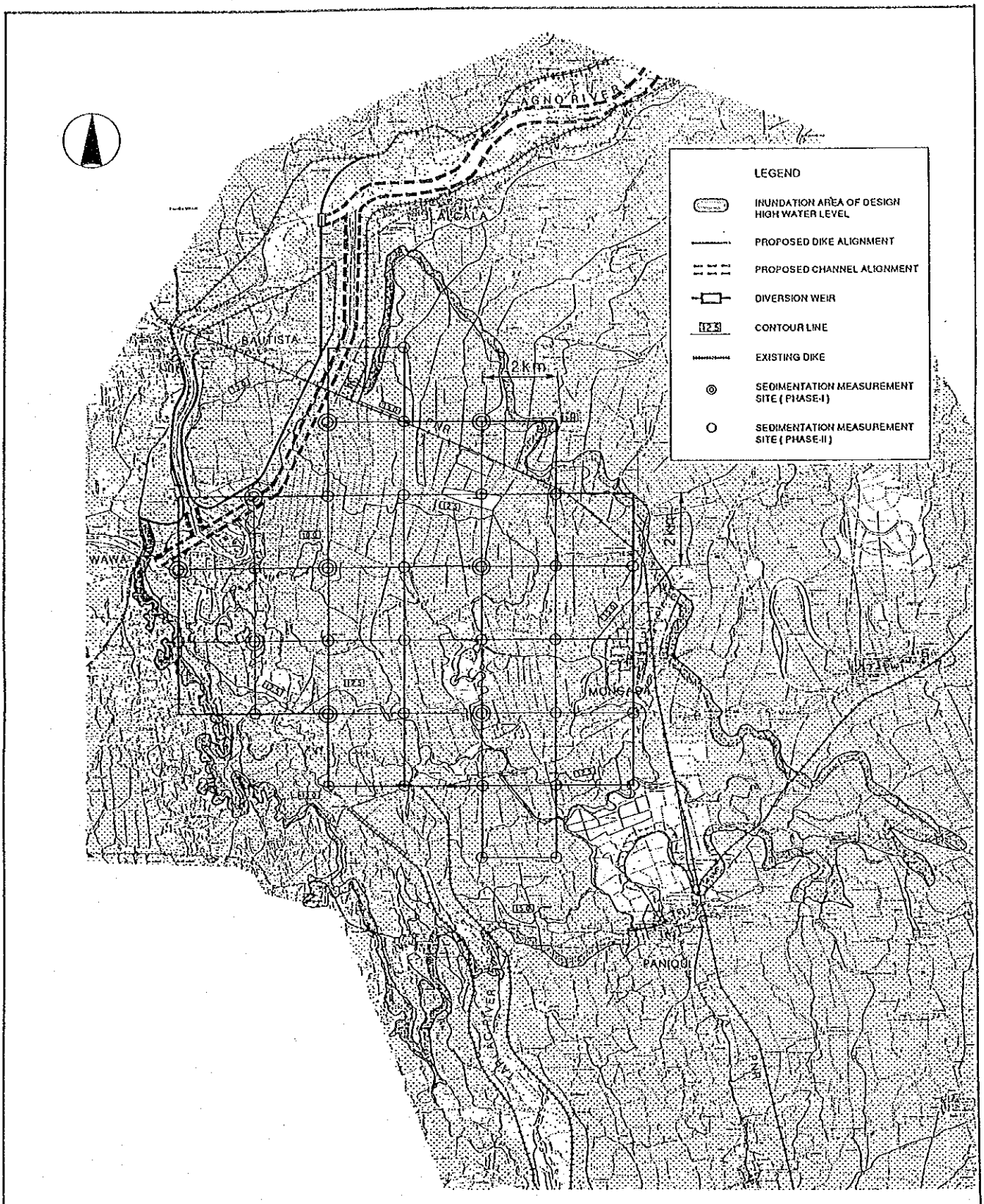


Fig. 5.3.1 PROPOSED MEASUREMENT SITE FOR SEDIMENTATION IN POPONTO SWAMP AREA

6. ENVIRONMENTAL IMPACT ASSESSMENT

6. ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Objectives and Methodology of the Environmental Study

6.1.1 Objectives

The objectives of the Environmental Study in this Feasibility Study are as follows;

(1) To identify impacts on the environment concerned by the proposed Priority Projects,

(2) To evaluate the magnitude and significance of the impacts,

(3) To judge whether the proposed projects need further environmental study, and if so, to point out the effects to be studied in the next stage.

6.1.2 Methodology of EIA for the Projects

To attain the objectives of this environmental study in the Feasibility Study stage, an Initial Environmental Examination (IEE) was conducted at first. The preliminary Environmental Impact Assessment (EIA) is conducted only for the parameter items which were scooped by the IEE. IEE is essentially an initial examination of the environmental effect potentials of the proposed projects based mostly on readily available preliminary information. The IEE is thus a first approach of EIA by screening and scooping, needing to be carried out at a depth only to determine whether an EIA will be required in the next stage through the IEE.

A checklist method is applied for IEE and preliminary EIA in this environmental study, because it is one of the useful initial tools for identification of impacts and evaluation of their significance. The checklist is prepared by using major items of environmental effect as rows and major project components as columns. The expected effects are evaluated by significance, ranging from A to C, and classified as positive or negative for each project component. The checklist items are selected by the Study Team taking into consideration the features of the Projects and the

guidelines prepared by the Government of the Philippines (GOP) and the Asian Development Bank (ADB).

6.2 Existing Environment

6.2.1 Initial Environmental Examination

Parameter items of the existing environment which could be potentially affected by the proposed project components were screened and scooped by the Initial Environmental Examination (IEE). Those items identified through IEE are:

1) Water Resource
   - . Water quality
   - . Seawater intrusion
   - . Water use
   - . Groundwater

2) Ecological Environment
   - . Aquatic life

3) Economic Activities
   - . Fisheries
   - . Navigation

4) Public Health
   - . Water-borne parasitic Diseases
   - . Water-related Disease

Particular description of the identified parameter items of the existing environment is presented hereunder.

6.2.2 Water Resource

The water resources in the Study Area consist of surface and marine water and groundwater. Surface water is mainly used for irrigation, fish culture, and navigation, while marine water is used for navigation and fish culture (as blackish water). Groundwater is mainly used for domestic water and partly for fish culture.

(1) Water Quality

Classification of Water Quality

The National Pollution Control Commission (NPCC) classified fresh surface water in terms of the criteria for maintaining water quality and preservation of present and future water use in 1978.

Table 6.2.1 shows the NPCC guidelines on water usage and classification while Table 6.2.2 lists the water quality criteria specified by NPCC for surface water and groundwater.

At present, the following designation are set for rivers in the Priority Projects area.

Upper Agno River	:	Class A
Pantal-Sinocalan River		
- Dagupan River	:	Class C
- Sinocalan River	:	Class D
- Ingalera River	:	not specified

Water Quality Tests in June 1991

Water sampling and simplified water quality tests were conducted by the Study Team on June 24-29, 1991 to assess the present water quality condition in the upper Agno River and the Pantal-Sinocalan River. The water sampling locations are shown in Figure 6.2.1. The test results are summarized in Table 6.2.3. Data related to water quality analysis was collected and referred.

Although test quantities and reliability is not sufficient, the present river water quality in the Study Area was roughly assessed based on the test results together with collected data as summarized below:

a) Upper Agno River
   - Potential of hydrogen (pH) of river water tends to be alkalinity except in the junction of the Tarlac River which might be affected by the volcanic ash form Mt. Pinatubo.

- Dissolved oxygen (DO) and Biochemical oxygen demand (BOD) fulfull the Class A standard.
- The turbidity and suspended solids (SS) and heavy metals (Fe, Cu, Mn, Pb) exceed the standard of Class A.
- Electric conductivity (E.C.) shows low value (average 0.58 ms/cm), which implies that the organic content in this level is not so significant.

b) Pantal-Sinocalan River
- The pH tends to be higher alkalinity in the upper reaches.
- The DO fulfills the Class D standard while the E.C. is high (average 14.7 ms/cm) due to seawater intrusion in the lower reaches.
- In the urban stretch (the Marusay River), effluent load of domestic solid waste and sewerage deems to be not remarkable and no water quality deterioration issue is observed at present.

c) Dagupan River
- The pH tends to be higher alkalinity in the upper reaches.
- The DO fulfills the Class C standard except downstream of San Carlos in the Campangbogan River.
- The E.C. is high due to seawater intrusion in the lower reaches.

d) Ingalera River
- The pH tends to be neutrality in the whole stretches.
- The DO fulfills the Class D standard although no standard has been established yet.

(2) Seawater Intrusion

The extent of seawater intrusion of the Pantal-Sinocalan River is assessed from the E.C. values measured. Figure 6.2.2 illustrates the presumed front of the saline wedge in the Pantal-Sinocalan River, the upstream stretch of the Dagupan River, and the Agno River. Although these are all rough estimates it can be said that the seawater of the Sinocalan reaches at least up to downstream of Calasiao town during the dry season.

(3) Water Use

The existing water use in the Bayambang stretch in the upper Agno River and in the urban stretch of the Pantal-Sinocalan River is identified as potential conflict areas on water rights.

Private water use for irrigation exists in the Bayambang stretch between the inlet of floodway to the Wawa bridge along the Agno River, where river water is withdrawn by 100 units of movable pumps with capacities of 0.01 - 0.02 m^3/s from the both banks downstream of the Calvo bridge. The total water use is estimated around 2 m^3/sec at the upper limit. Furthermore, there will be no future increase of irrigation water use.

There is no water use for irrigation and domestic water supply downstream of the Pantal-Sinocalan River because of seawater intrusion in this stretch. The piped domestic water supply sources of Dagupan city and Calasiao town are deep wells (deeper than 100 m).

(4) Groundwater

The alluvial plain in the Agno River has moderate to extensive, highly productive groundwater. Thus, groundwater in the Priority Project areas is widely used for public and private water supply, industrial use, and irrigation. However, there is no available data on the amount of groundwater withdrawal for these water uses.

In a separate study conducted by the Bureau of Soils and the National Hydraulic Research Center, the results of the analysis of well waters were generally satisfactory for domestic and agricultural uses, except for the following: Urdaneta wells where the pH was 3.7; Binmaley wells where color, turbidity, and chloride were high; and the San Carlos wells where calcium and chloride levels failed drinking water standards. Coastal waters in Dagupan city, Bolinao, Agno, and Alaminos showed high salinity as well as in Malasiqui which varies in response to tidal fluctuations. Overpumping and close proximity to the sea could be the reasons for the high salinity in these areas' groundwater. Generally, however, groundwater in the Priority Project areas have good physics-chemical and bacteriological quality, and are suitable for domestic and other purposes.

Figure 6.2.3 shows the distribution of groundwater wells in Pangasinan. Deep wells more than 100 m in depth exists in the coastal area in the plain due to high salinity. Figure 6.2.4 shows the domestic water supply system in Dagupan city and Calasiao town.

6.2.3 Ecological Environment

There are no endangered and/or protected forests or wildlife species in the Study Area, while mangroves are partly observed in the Pantal-Sinocalan River and the Dagupan River.

Figure 6.2.5 shows the map of fish spawning/breeding grounds and fishponds area in Pangasinan. Fish species caught in Pangasinan are listed in Table 6.2.4.

In the upper Agno River, freshwater fish live such as mudfish, freshwater shrimp, catfish, milkfish (bangus), carp, tilapia, freshwater terapon, eel, and climbing perch. Of these, freshwater terapon, eel, climbing perch, and freshwater goby are decreasing in number. Freshwater fishponds exist near Bayambang and Rosales towns. Moreover, the Poponto swamp area is a traditionally productive one for freshwater fish and crustaceans, mollusks, and water fowl. The Culisaw creek located at the northwest of swamp is well known as a spawning and breeding ground for migratory fish species. However, the creek was heavily damaged by volcanic debris and mudflows due to the eruption of Mt. Pinatubo.

The species of freshwater fish in the Pantal-Sinocalan River are the same as ones in the upper Agno River. Decreasing species of fish caught has not yet been recorded at present. Milkfish fishponds are intensively developed in the downstream reaches of the Pantal-Sinocalan River by use of marine water intrusion.

6.2.4 Economic Activities

Major economic activities in Pangasinan is primarily agriculture, forestry and fishery industries as listed in Table 6.2.5. Agriculture is predominant among them and the cultivated area is covered by economical crops and cultivated-type vegetation.

(1) Fisheries

Table 6.2.6 lists the area and production of fisheries in Pangasinan where coastline and rich fishery resources exist. Aside from its natural marine, brackish and freshwater fisheries, it engages in extensive brackish water aquaculture (milkfish and prawn), oyster culture, seaweed culture, and freshwater inland fishponds (tilapia) and rice-fish culture.

Fisheries in the upper Agno River are natural fisheries, freshwater inland fishponds (tilapia) and rice-fish culture where flood inundation areas are mainly utilized for fisheries. Natural fisheries and rice-fish culture are usually supplied for private consumption, while tilapia fishculture is on commercial basis. Marine fisheries, together with brackish fishpond culture, are significant in the downstream reaches of the Pantal-Sinocalan River.

(2) Navigation

Navigation is one of major water uses in the downstream reaches of the Pantal-Sinocalan River. The purpose of navigation is classified into community traffic by small boats, fishing boats, naval guard ships, and dredgers for river maintenance.

Community traffic and fishing by small boats form the majority of navigation, about 5,000 person trips a day in the urban stretch in Dagupan city as shown in Table 6.2.7. The main route of daily navigation in Dagupan city is illustrated in Figure 6.2.6. The size of ships is summarized in Table 6.2.8.

6.2.5 Public Health

There are observed water-related diseases, insect vectors, and other public health hazards in the Priority Projects area. The historical morbidity and mortality rates per 100,000 population for the period of 1975 to 1988 in Pangasinan are tabulated in Tables 6.2.9 and 6.2.10. The leading causes of morbidity and mortality are mainly upper respiratory tract and other infections that are curable with appropriate medical attention or even preventable.

During and after the year that large floods occurred, the morbidity rate was observed to increase. Especially, the cases of respiratory organs, water-related and water-borne parasitic diseases tend to increase. Although more people are getting sick, the mortality rate from the diseases (diarrheas, gastro-enteritis, and dysentery), however, did not rise significantly, about the same number as the previous year's.

(1) Water-borne Parasitic Diseases

The major water-borne parasitic disease is malaria, although it has a small rate in terms of leading causes of morbidity and mortality. Figure 6.2.7 shows the areas in Pangasinan that are endemic for malaria, and the malaria incidence distribution map in terms of Annual Parasite Incidence (API) in Pangasinan. Malaria incidence is 2 or more times during the dry season; anopheles mosquitoes (medium of transmission) are adversely affected by rains/floods and they can't breed in contaminated or dirty water.

According to the interview survey of medical doctors, the malaria incidence during/after floods has not yet been reported in the Priority Projects area. However, it is noted that flies, mosquitoes, and cockroaches are enumerated as a media of transmission in contagions in view of causality of diseases and epidemics.

(2) Water-related Disease

Diarrhea, food poisoning, dysentery, anforms, gastro-enteritis, a typhoid fever are water-related diseases. Among them the incidence of diarrhea is significant. Figure 6.2.8 shows the distribution of diarrhea cases by health district in Pangasinan in 1988.

The number of diarrhea cases are almost uniformly distributed in the Priority Projects area, while higher cases are reported in and around coastal area. According to the interview survey, diarrhea is present in most of cases of diseases and epidemics which occurred during and after large floods.

6.3 Results of Preliminary EIA

6.3.1 Overall Assessment

(1) Environmental Parameters Identified

The results of preliminary Environmental Impact Assessment (EIA) are presented in Table 6.3.1. The parameter items of which impact is significant are:

Parameter Item	Upper Agno River	Pantal-Sinocalan River
A) Problems due to the location		
. Resettlement	-/A	-/A to -/C
. Land value changes	= to +/A	+/A
. Encroachment of agricultural and aquacultural lands	-/A to -/B	-/A to -/C
. Effects on groundwater hydrology	0	-/C to 0
. Impairment of Navigation	0	-/C to 0
. Loss of community and recreation areas	-/B to -/C	-/C
B) Problems in Construction Stage		
. Hazards to workers and nearby residents	-/C	-/C
. Deterioration of water quality	-/C to 0	-/C to 0
C) Problems in Operation Stage		
. Deterioration of water quality	0	-/C to 0
. Intrusion of saline water	0	-/C to 0
. Vector disease hazards	-/C to +/C	0 to +/C
. Public health hazards	-/C to +/C	0 to +/C

Note: (1) + : Positive effect, - : Negative effect, 0 : No effect,
= : Neutral effect
(2) A : High level of significance, B : Medium level of significance,
C : Low level of significance

Among the environmental parameter items identified as significant, social environments are loaded higher negative impact than natural environment in both the upper Agno River and Pantal-Sinocalan River projects.

	Upper Agno River	Pantal-Sinocalan River
Natural Environment		
. Effects on groundwater	no effect	low
. Deterioration of water quality	low	low
. Intrusion of saline water	no effect	low
Social Environment		
. Resettlement	high	high
. Encroachment of lands	high to medium	high to low
. Impair of navigation	no effect	low
. Loss of community	medium to low	low
. Hazards to workers and nearby residents	low	low
. Vector disease hazards	low	no effect
. Public health hazards	low	no effect

Expected positive impacts are:

	Upper Agno River	Pantal-Sinocalan River
Social Environment		
. Land value change	high	high
. Vector disease hazards	low	low
. Public health hazards	low	low

(2) Principal Conclusions

Upper Agno River Project

The project components of flood control in the upper Agno River are: river improvement works along the main stream, mainly construction of diking systems; excavation of low water channels; construction of Poponto floodway; and expansion of Poponto retarding basin. Among them, construction of new dikes and Poponto floodway, and expansion of Poponto retarding basin are expected to impose significant impact on the social environment in terms of resettlement and encroachment of agricultural and residential lands. Loss of the community is also an adverse effect due to the resettlement.

The identified municipalities to be affected are:

a) Poponto floodway and retarding basin; Bayambang, Bautista, Alcala, San Manuel, Moncada, Paniqui and Ramos
b) Carmen stretch; Vilasis and Rosales
c) Asingan-San Manuel stretch; Santa Maria, Asingan, San Manuel and Tayug.

The impacts due to problems during construction and the impacts on vector disease and public health are all of a low level of significance and are expected to be mitigated to satisfactory level.

Pantal-Sinocalan River

The project components of flood control in the Pantal-Sinocalan River are construction of the Dagupan bypass and river improvement works along the main stream and its tributaries, the Dagupan and the Ingalra; mainly, construction of diking systems, and excavation of low water channels. Among them, construction of new dikes in the areas of Dagupan city and towns of Calasiao and Santa Barbara are expected to impose significant impact on the social environment in terms of resettlement and encroachment of agricultural and residential lands. Loss of the community is also an adverse effect due to the resettlement.

The identified cities and municipalities to be affected are:

a) Pantal-Sinocalan River stretches; Dagupan, Binmaley, Calasiao, Santa Barbara, Urdaneta, San Carlos, and Malasiqui
b) Dagupan bypass; Dagupan and Calasiao

The impact due to problems during construction and intrusion of saline water, and the impact on navigation, vector disease and public health are all of a low level of significance. Although the expected impact on water quality in the urban stretch of the Sinocalan River and fishponds along the Dagupan River is assessed to be low level, further detailed study will be required in order to clarify some unknowns involved due to insufficient records.

Particular description of the identified parameter items and their level of significance is presented hereunder.

6.3.2 Problems Due to the Location

(1) Resettlement

The planned new setback levees of the upper Agno River and Poponto floodway, new diking systems of the Pantal-Sinocalan River, and the Dagupan bypass confine land, buildings and houses inside the new river areas. The Poponto retarding basin extends inundation area around the existing Poponto swamp.

The number of affected buildings and houses, and riparians and residents who are to be evacuated and resettled is estimated as follows:

River	Evacuation/Resettlement	
	No. of Building /Houses	Population
(1) Upper Agno River		
- Upper Agno River	920	5,520
- Poponto retarding basin	3,960	23,760
Total	4,880	29,280
(2) Pantal-Sinocalan River		
- Main Pantal-Sinocalan River	1,790	10,740
- Ingarela River	504	3,024
- Dagupan River	481	2,886
- Bypass channel	103	618
Total	2,878	17,268

Negative impact on these assets and people is at a high level of significance (+A) in the upper Agno River and the Pantal-Sinocalan River, while it is at a low level (+C) in the Dagupan bypass. These impact differs from other right-of-way issues because the subject land, assets and people are located mostly in flood prone areas. Namely, the riparians and residents to be resettled are also beneficiaries on account of flood protection.

(2) Land Value Change

With the provision of safeguards against flooding, market land values of the subject flood control areas, which are lower than those of flood-free areas, will increase significantly reflecting enhancement of land use and increase in the quality of life with the projects.

Positive impact on land value change is assessed at a high level (+A) in both the upper Agno River and the Pantal-Sinocalan River except in the area around the Poponto retarding basin. Impact on the Poponto area is assessed to be neutral because negative impact due to the increase in inundation area might be involved.

(3) Encroachment of Agriculture and Aquacultural Lands

In the upper Agno River project, realignment of dikes, and construction of new levees and a floodway will encroach on some agricultural and residential areas in the municipalities of San Manuel, Asingan, Villasis, and Alcala. In the Pantal-Sinocalan project, the proposed bypass channel in Dagupan city will occupy cropland as well as residential areas. Likewise, construction of new dikes along the river course will encroach on agriculture, fishpond, and residential land in and around Dagupan city and towns of San Carlos, Calasiao, and Santa Barbara. A total of 2,006 ha is required to be acquired for the right-of-way as estimated below:

River	Area (ha)
(1) Upper Agno River	
- Upper Agno River	1,041
- Poponto retarding basin	166
Total	1,207
(2) Pantal-Sinocalan River	
- Main Pantal-Sinocalan River	467
- Ingarela River	121
- Dagupan River	146
- Bypass channel	65
Total	799

Negative impact on these land encroachment is assessed at a high (-A) to medium (-B) level in the upper Agno River, while it is assessed at a high (-A) to low (-C) level in the Pantal-Sinocalan River.

(4) Effects on Groundwater Hydrology

The proposed bypass channel in Dagupan city will allow seawater to intrude in its low water channel. Existing shallow wells along the channel will be affected by permeation of the seawater to some extent. However, water from shallow wells is used mainly for cleaning, washing, and fishpond water supply. The domestic water in the area depends mainly on deep wells. It's negative impact on the groundwater use is assessed at a low level (-C).

(5) Impairment of Navigation

Navigation in the downstream reaches of the Pantal-Sinocalan River involves:

a) community traffic by small boats
b) fishing boats
c) naval guard ships
d) dredgers for river maintenance

Community traffic and fishing by small boats constitute the majority of the navigation and amounts to about 5,000 person trips a day around the Marsay stretch. Traffic of 15 large fishing boats, a naval guard ship and a dredger are identified as a minority.

The Dagupan bypass plan necessitates installation of a water gate at the inlet of the existing urban stretch of the Pantal-Sinocalan River. The community and fishing boat traffic can be maintained through this 10 m wide water gate, however, the vertical clearance of the gate is not sufficient for the naval ship and dredger. An anchorage and loading pier is to be provided for large ships downstream of the gate in the Sinocalan River.

The negative impact on this traffic is assessed at a low level (-C).

(6) Water Right Conflicts

The existing water uses in the Bayambang stretch in the upper Agno River and in the urban stretch of the Pantal-Sinocalan River are identified as potential conflict areas on water rights in Section 6.2.2 (3).

The present total water use in the Bayambang stretch is estimated around 2 m^3/sec at the upper limit. About 5 m^3/s of the average dry season flow which fulfills the requirement of 2.0 m^3/s is planned to be discharged in this stretch after construction of the Poponto floodway.

There is no water use for irrigation and domestic water supply in the downstream of the Pantal-Sinocalan River because of seawater intrusion in this stretch. No water use conflict is expected after construction of the Dagupan bypass.

In short no water right conflicts are expected in these two areas.

(7) Loss of Community and Recreation Area

Resettlement programs for the upper Agno River and the Pantal-Sinocalan River involve isolation of the residents in the existing communities.

Negative impact on the existing communities is assessed at a medium (-B) to low level (-C) in the upper Agno River taking into consideration of the size and isolation distance of resettlement, while it is assessed at a low level (-C) in the Pantal-Sinocalan River.

6.3.3 Problems in the Construction Stage

(1) Hazards to Workers and Nearby Residents

Environmental deterioration which might take place in the construction stage is air pollution, traffic accidents, noise and vibration to the works and the residents around the project sites.

Air might be contaminated by soil dust from the earthworks of the river channels, dike embankment and structures. Traffic accidents might increase

due to increase of heavy construction equipment and vehicles. Vibration might be generated by heavy construction works.

The negative impact on the workers and nearby residents is assessed at a low level (-C) in all the project areas.

(2) Deterioration of Water Quality

Turbidity of water due to suspended soil particles from the earth works will be the only adverse impact on the quality of surface water. Adequate settling and filtering facilities will be required in the dredging works in order to avoid pollution of suspended solid to fish cultures.

The negative impact due to the suspended load on fish cultures is assessed at a low level (-C) for both project areas assuming provision of adequate facilities during construction.

6.3.4 Problems in the Operation Stage

(1) Deteriation of Water Quality

Potential deteriation of water quality is identified in the Bayambang stretch of the Agno River and in the urban stretch of the Sinocalan River in Dagupan city.

Bayambang Stretch

At present, water quality in this stretch fulfills the Class A standard of NPCC regarding the DO and BOD due to decomposition of organic matter. This is explained by the fact that there are no significant amount of effluents from commercial and industrial establishments, the major sources of organic matter. In this regard, no deterioration of water quality is expected in this stretch although the majority (85%) of the existing low flow discharge is diverted to the newly made Poponto floodway channel.

Urban Stretch in Dagupan City

After construction of the proposed bypass in Dagupan city, the majority

(80%) of the low flow of the Sinocalan River is planned to be diverted into the bypass, while the remaining 20% is discharged into the existing urban stretch. This reduction of low flow discharge might induce deterioration of water quality in the urban stretch. Major sources of pollution load in this area are considered to be gray water, feces and urine.

The nutrient level of the river water in the Dagupan city area is very low at present according to the concentration records of nitrite (NO_2-N), nitriate (NO_3-N) and phosphate (PO_{4-3}) monitored in 1987-1988 (refer to Table 6.3.2).

Phosphate is chosen as a key parameter to assess deterioration level of water quality instead of nitrogen because the reducing function in nitrogen is deemed to be very high in this tropical region. The future concentration of phosphate in the year 2000 was projected, and the minimum low flow discharge which fulfills the water quality standard of phosphate, 0.2 mg/lit, is estimated to be around 0.6 m^3/s.

With provision of the Dagupan bypass the minimum low flow discharge in the existing urban stretch of the Sinocalan River is expected to be reduced to around 0.7 m^3/s which is slightly higher than the minimum required.

The negative impact on the water quality is assessed at a low level (-C).

(2) Intrusion of Saline Water

Seawater intrusion analysis was performed to determine the impact of the salt wedge which could intrude to the upstream of the Sinocalan River through the proposed bypass channel in Dagupan city. Under the design condition, the seawater is estimated to intrude only 1 km more upstream from the existing condition. The existing irrigation intake weir is located about 4 km upstream of the estimated front of the saline wedge in the Sinocalan River.

The negative impact on the existing water use is assessed at a low level (-C).

(3) Vector Diseases and Public Health Hazards

The flood-prone areas of the upper Agno River and the Pantal-Sinocalan River will be free from flood inundation if the Priority Projects are realized. Incidence of diseases such as diarrhea, gastro-enteritis, and influenza will be readily reduced except in the area around the Poponto swamp. Here the occurrence of vectors (flies, mosquitoes, and cockroaches) will be reduced during and after heavy rainfall. In the Poponto swamp area the amount of vectors might be increased due to an increase in inundation area after a flood.

A low level (+C) of positive impact on vector diseases and public health is identified in the flood-prone areas along the upper Agno River and the Pantal-Sinocalan River, while a low level (-C) of negative impact is identified in the Poponto retarding basin area.

Table 6.2.1 NPCC GUIDE ON WATER USAGE & CLASSIFICATION

(a) Fresh Surface Water

Classification	Best Usage
Class AA	For source of public water supply. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
Class A	For source of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.
Class B	For primary contact recreation.
Class C	For the propagation and growth of fish and other aquatic resources.
Class D	For agriculture, irrigation, livestock watering, and industrial coolong and processing.
Class E	For navigational use.

(b) Ground Water

Classification	Best Usage
Class GA	For source of domestic water supply.
Class GB	For source of irrigation and industrial water supply.

(c) Marine and Estuarine Water

Classification	Best Usage
Class SB	For primary contact recreation.
Class SC	For propagation and growth of fish and other aquatic resources.
Class SD	For industrial cooling and processing.
Class SE	For navigation.

Source: Rules & Regulations of the National Pollution Control Commission (1978)
Section 69, NPCC Water Quality Criteria (1978)

Table 6.2.2 AMBIENT WATER QUALITY CRITERIA BY NPCC

Quality Parameter	Surface Water										Ground Water	
	Fresh						Marine and Estuarine					
Class	AA	A	B	C	D	E	SB	SC	SD	SE	GA	GB
Color, Units		75	50	50			50					50
Temperature, ℃		30	30	3(e)	3(e)			3(e)	3(e)			
Transparency			(c)	(c)	(c)		(c)	(c)				
Dissolved Oxygen		5	5	5	3	2	5	5	3	2		
5-day BOD at 20 ℃		10	15	20			15	20				
Total Dissolved Solids				1,000	1,000		1,000	1,000				1,000
Total Solids	(a)	(a)		2,000	2,000		2,000	2,000			(a)	
pH	(a)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	5.0-9.0	6.5-8.5	6.5-8.5	6.5-8.5	5.0-9.0	(a)	6.0-8.5
Coliform, MPN/100ml	50	5,000	1,000	5,000			1,000	5,000			50	
Phenolic Substances	(a)	(a)	0.002	0.02			0.002	0.02			(a)	
Radioactive substances												
Ra - 226, uuCi/L	(a)	(a)									(a)	
Sr - 90, uuCi/L	(a)	(a)									(a)	
Beta Emitter, uuCi/L	(a)	(a)									(a)	
Trace Elements												
Aluminum					5							5
Arsenic	0.05	0.05	0.05	0.05	0.1		0.05	0.05			0.05	0.1
Barium	(a)	(a)		0.05				0.05			(a)	
Berryllium					0.1							0.1
Boron					0.75							0.75
Cadmium	(a)	(a)	0.01	0.01	0.01		0.01	0.01			(a)	0.01
Cobalt					0.05							0.05
Chromium	(a)	(a)	0.05	0.05	0.10		0.05	0.05			(a)	0.10
Copper	(a)	(a)		0.02	0.20			0.02			(a)	0.20
Cyanide	0.05	0.05	0.05	0.05			0.05	0.05			0.05	
Flouride	(a)	(a)			1						(a)	
Iron	(a)	(a)			5						(a)	5
Lead	0.05	0.05	0.05	0.05	5		0.05	0.05			0.05	5
Lithium					2.5(d)							2.5(d)
Manganese	(a)	(a)			0.2						(a)	0.2
Mercury	0.002	0.002	0.002	0.002			0.002	0.002			0.002	
Molybdenum					0.01							0.01
Nickel					0.2							0.2
Selenium	0.05	0.05	0.05	0.05	0.02		0.05	0.05			0.05	
Silver	0.05	0.05	0.05	0.05			0.05	0.05			0.05	
Vanadium					0.1							0.1
Zinc	(a)	(a)		2	2						(a)	2
Sodium Absorption Ratio (SAR)					8-18							8-18
Organic Chemicals												
Synthetic Detergents (MBAS)	nil	0.05	0.05	0.05			0.5	0.5			nil	
Oil and Grease	nil	2	2	5	5	10	2	5	5	10	nil	
Persistent Pesticides												
Aldrin	0.001	0.001	0.001	0.01	ug/L		0.001	0.01	ug/L		0.001	
DDT	0.05	0.05	0.05	0.02	ug/L		0.05	0.02	ug/L		0.05	
Dieldrin	0.001	0.001	0.001	0.005	ug/L		0.001	0.005	ug/L		0.001	
Chlordane	0.003	0.003	0.003	0.04	ug/L		0.003	0.04	ug/L		0.003	
Endrin	0.0002	0.0002	0.002	0.002	ug/L		0.0002	0.002	ug/L		0.0002	
Heptachlor	0.0001	0.0001	0.0001	0.01	ug/L		0.0001	0.01	ug/L		0.0001	
Lindane	0.004	0.004	0.004	0.02	ug/L		0.004	0.02	ug/L		0.004	
Toxaphene	0.005	0.005	0.005	0.01	ug/L		0.005	0.01	ug/L		0.005	
Methoxychlor	0.1	0.1	0.1	0.005	ug/L		0.1	0.005	ug/L		0.1	
2, 4-D	0.1	0.1	0.1	4.0	ug/L		0.01	2.0	ug/L		0.01	
2, 4,5-TP	0.01	0.01	0.01				0.01				0.01	
P C B s	nil	0.001	0.001				0.001				nil	
Other Chemicals												
Ammonia		0.01										
Calcium	(a)	(a)									(a)	
Chloride	(a)	(a)									(a)	
Magnesium	(a)	(a)									(a)	
Nitrate	(a)	(a)									(a)	
Sulfate	(a)	(a)									(a)	
Nutrients		(b)	(b)	(b)	(b)		(b)	(b)	(b)			

Remarks: 1.(a) National Standards for Drinking Water in the Philippines
(b) Shall not be present in conc. to cause deleterious or abnormal biotic growth
(c) Secchi Disk shall be visible at a minimum depth of one (1) meter
(e) Rise in temperature
2. All values are max, permissible except for Dissolved Oxygen which is min, permissible.
3. All units in mg/L (milligrams/liter) except those indicated
4. uuCi/L - micro micro Curie per liter
5. uug/L - micro micro gram per liter
6. MPN - most probable number

Source: Rules & Regulations of the National Pollution Control Commission (1978)
Section 69. Table 1 - NPCC Water Quality Criteria (1978)

Table 6.2.3 RESULT OF WATER QUALITY TESTS

Point No.	Date	Time	Air Temp (C)	Water Temp (C)	pH	DO (mg/l)	Tub (mg/l)	E.C. (ms/cm)	Remarks
1	6/28	11:30	36.0	31.7	7.1	5.2	1,320	0.658	Agno River Wawa Bridge
2	6/28	11:55	38.0	33.4	7.7	6.9	450	0.535	Agno River Wawa
3	6/28	13:00	37.0	33.7	7.6	6.1	300	0.558	Agno River Calbo Bridge
4	6/28	13:45	40.0	33.8	7.5	6.1	420	0.560	Agno River Alcala
5	6/28	14:15	39.0	33.6	8.4	6.8	310	0.558	Agno River Sto. Tomas
6	6/28	14:35	37.0	33.3	8.8	6.5	300	0.580	Agno River Plarede Bridge
7	6/28	15:20	38.0	35.3	8.7	8.0	150	0.396	Agno River Sta. Maria
8	6/28	16:45	30.0	31.5	7.9	5.9	75	0.683	Agno River San Vicente
9	6/28	17:25	32.0	30.0	8.8	6.5	200	0.655	Agno River ARIS intake
10	6/29	11:20	37.0	31.9	7.2	5.9	480	2.57	Tarlac River Culisaw Creek
11	6/25	13:20	32.0	30.8	7.5	4.7	25	48.1	Pantal River Pugaro
12	6/25	13:50	31.0	30.6	7.6	5.7	20	44.0	Pantal River Salapingao
13	6/25	14:05	31.0	31.0	8.0	6.3	20	36.3	Pantal River confluence with Sinocalan River
14	6/26	11:35	34.0	32.2	7.8	4.5	25	30.5	Sinocalan River Quintos Bridge
15	6/26	11:55	36.0	33.2	7.5	3.9	10	18.11	Sinocalan River Lasip Grande
16	6/26	12:30	36.0	32.7	7.5	4.2	5	6.51	Sinocalan River Nalsian
17	6/26	12:55	35.0	31.9	7.5	4.0	15	0.760	Sinocalan River San Vicente
18	6/27	13:00	40.0	31.9	7.4	5.6	80	0.615	Sinocalan River Calasiao Bridge
19	6/24	18:10	30.0	31.8	7.9	7.1	30	0.657	Sinocalan River Quesban
20	6/24	17:35	33.5	33.2	7.9	6.9	10	0.674	Sinocalan River Maramba Bridge
21	6/24	17:20	34.0	33.4	7.6	6.2	10	0.681	Sinocalan River Irrigation Intak
22	6/24	17:00	33.0	33.7	8.8	6.1	5	0.696	Sinocalan River Banaoang Bridge
23	6/24	16:40	33.0	33.8	8.9	6.6	10	0.677	Sinocalan River Maticmatic
24	6/24	16:05	34.0	33.6	8.7	6.0	20	0.689	Sinocalan River Calegu Bridge
25	6/24	15:20	37.0	35.9	9.4	8.6	<1	0.447	Sinacalan River Tulong Bridge
26	6/25	13:40	31.0	31.1	7.6	6.0	25	45.9	Bayaoas River Taytay Dawel Bridg
27	6/27	12:45	40.0	31.5	7.2	4.2	45	0.934	Ingalera River San Pablo Bridge
28	6/27	13:20	40.0	32.1	7.2	5.2	50	0.639	Ingalera River Longos Bridge
29	6/27	13:45	38.0	30.8	6.8	4.6	100	0.316	Ingalera River Doyong Bridge
30	6/27	14:10	35.0	31.7	8.7	6.5	50	0.302	Ingalera River Matagden
31	6/27	14:48	36.0	31.7	7.8	9.1	140	0.553	Ingalera River And Macabito Brid
32	6/27	15:05	37.0	30.6	6.9	6.0	100	0.604	Ingalera River Bogton Bridge
33	6/27	15:30	35.0	30.8	6.9	7.1	50	0.566	Ingalera River Embarca Dero Brid
34	6/27	15:55	34.0	30.8	7.2	6.0	50	0.653	Ingalera River Talospatang
35	6/25	14:25	31.5	31.7	7.9	6.0	15	39.6	Dagupan River Lucao
36	6/26	11:05	34.0	32.1	7.8	5.6	<1	42.6	Dagupan River Lucao
37	6/25	14:45	32.0	31.4	7.5	5.6	20	40.2	Dagupan River Gayaman
38	6/25	15:00	32.0	31.5	7.3	5.0	15	41.1	Dagupan River Manat Bridge
39	6/25	15:20	32.0	31.6	7.3	4.7	15	40.0	Dagupan River Balogo
40	6/26	15:50	34.0	33.1	8.4	8.3	100	41.0	Dagupan River Quintong Bridge
41	6/26	16:30	35.0	31.9	7.7	3.4	25	33.4	Dagupan River Pangpang Bridge
42	6/26	17:10	33.0	32.7	8.8	7.6	20	27.6	Dagupan River Palaris Bridge
43	6/26	17:30	33.0	34.3	8.5	7.3	50	29.1	Dagupan River Abanoon Bridge

E.C. : Electric Conductivity under controlled Temperature of 25 C

Table 6.2.4 FISH SPECIES IN PANGASINAN

Item	Name
1. Species of Freshwater Fish Caught/ Raised*	mudfish freshwater-shrimp catfish milkfish (bangus)* carp prawn* tilapia freshwater terapon eel climbing perch
2. Species of Marine Fishes Caught/ Raised* and Other Marine Species	tuna siganids mackerel crabs lizzard fish seacatfish mullet snow morral others: carfish anchovies oyster* squids parrotfish corals snappers nemipterids mollusks hairtail moonfish crustaceans caranx slipmouth sea cucumber shrimps flying fish shells goatfish baracuda shark groupers gizaed shad cavalla mojarra octopus etc.
3. Endangered Fish Species	freshwater terapon (ayungin) climbing perch eel freshwater goby

Sources: BFAR, Dagupan City

Table 6.2.5 NUMBER OF ESTABLISHMENTS AND EMPLOYMENT BY INDUSTRY GROUP AND TYPES OF MANUFACTURING ACTIVITIES IN PANGASINAN

A. Industry Group	No. of Establishments	Employment Rate %
	1983	4thQ 1988
1. Agriculture, Forestry and Fisheries	NDA	50.88
2. Mining and Quarrying	73	0.88
3. Manufacturing	3882	9.14
4. Electricity, Gas and Water	13	0.15
5. Construction	13	4.13
6. Commerce	9241	11.21
7. Transportation, Communications and Storage	366	5.61
8. Services	3286	17.85
9. Industry not Adequately Defined	NDA	0.15
T o t a l	16879	100 %
B. Major Manufacturing Activities		
	Shell Craft Rattan Craft Bamboo Craft Handicraft Metal Craft Furniture Ceramics Food Processing Garments Salt-Making Leather-Tanning Rice Milling	

Sources:
1. On No. of Establishments:
   1983 Census on Establishments, NCSO and UP - ISSI
2. On Employment Rate:
   Agri-Business Group, Dept. of Agriculture
3. On Manufacturing Activities:
   NACIDA,Lingayen,Pangasinan

Table 6.2.6 AREA AND PRODUCTION OF FISHERIES BY SOURCES IN PANGASINAN, 1987

Sources	Area (ha)	Production (mt)
1. Inland Fisheries		
1.1 Freshwater fishpond	958.69	1435.80 (tilapia)
1.2 Brackishwater fishpond	15450.70	23176.00 (milkfish, prawn)
1.3 Communal fishing grounds (lakes, rivers, creeks, reservoirs, swamps)	7303.84	759.49
1.4 Oyster farms	38.06	1758.52
1.5 Rice-fish Culture	10.63	4.46
T o t a l	23761.92	27134.27
2. Marine Fisheries		
2.1 Municipal Fisheries	NDA	13668.80
2.2 Commercial Fisheries (more than 7 fathous deep)	x	987.00
T o t a l	NDA	14655.30

Source: BFAR, Dagupan City
Note; NDA - No Data Available

x Fishing Grounds:

Lingayen Gulf	Olanen Bay	Dasol Bay	Lucap Bay
China Sea	Caquiputan Channel	Tamoac Bay	Sual Cove

Table 6.2.7 DAILY NAVIGATION IN DAGUPAN CITY

Items \ Route No.	1	2	3	4	5	6
Destination	Near DPWH office to Calmay-Carael	Magsaysay Market to Pantal	Magsaysay Market to Calmay	Magsaysay Market to Pugaro	Magsaysay Market to Salapingao	Magsaysay Market to Calmay-Carael
Type of ship	Small boat without engine (banca)	Small boat without engine (banca)	Small boat with engine	Small boat with engine	Small boat with engine	Small boat with engine
Number of passengers (person/ship)	5	5-6	25 (average)	25 (average)	25 (average)	11 (average)
Number of trips (trip/ship/day)	5	15	3-4	2-4	1	5
Number of ships	40-45	16	5	6	20	13
Daily total trips (person trip)	1,125	1,440	500	600	500	715

Remarks ; Route No. is to be refered in Fig.6.2.5.

Table 6.2.8 SIZE AND PURPOSE OF THE SHIP IN PANTAL-SINOCALAN AND DAGUPAN RIVER

	Purpose	Length (m)	Width (m)	Height (m)	Draft (m)	Number of ships	Remarks
Large size ship							
	Dredging	32.0	8.6	5.53 (to Pilot house) 13.0 (to frame)	1.0	1	DPWH Dredger
	Navy	19.8	6.1	9.1	1.8	1	Phil. Naval Guard ship
	Fishing	21.5*	12.2*	4.6*	3.0*	2*	Not in operation
		13.7				15	in operation
Middle size ship							
	Maintenance	10.4	3.9	2.5	0.8	1	DPWH Tug boat
	Fishing	10.5	1.5	1.5	N.D.	50	
Small size ship							
	Transport	11.0	1.3			44	W/E
	Transport	3.7	0.5			61	WO/E

Height : from water level
W/E : with engine
WO/E : without engine

Table 6.2.9 LEADING CAUSES OF MORBIDITY IN PANGASINAN

Unit : Rate/100,000 population

	CAUSES	1975	1976*	1977	1978	1979	1980	1981	1982	1983	1984*	1985*	1986*	1987	1988
1	Pneumonia	146.5	123.7	109.3	137.1	152.1	112.0	128.7	137.4	134.7	250.7	199.0	182.1	197.7	253
2	Heart Diseases	-	-	-	-	-	-	-	-	-	74.0	91.7	94.0	108.6	
3	Tuberculosis	368.4	337.6	193.0	182.2	125.8	190.9	140.0	85.8	66.9	219.0	204.4	268.8	321.6	580
4	Cererro-Vascular Acc.	-	-	-	-	-	-	-	-	-	-	-	-	-	
5	Malignanat Neoplasms	29.1	29.9	40.4	37.1	38.1	35.6	36.1	36.0	39.0	36.4	39.9	48.2	70.0	29
6	Diarrheas *	172.3	161.8	133.3	91.0	75.2	115.7	92.1	64.9	30.0	373.7	636.1	627.6	567.8	
7	Accidents	-	-	-	-	-	-	-	-	-	28.8	50.1	36.6	45.0	
8	Measles	23.9	21.7	17.3	20.7	14.6	20.8	21.2	13.9	19.3	43.2	56.0	48.4	70.4	85
9	Malnutrition	-	-	-	-	-	-	-	-	-	-	-	-	-	96
10	Nephritis, Nephritic Syndrome/Nephrosis	-	-	-	-	-	-	-	-	-	-	-	-	-	
11	Bronchitis	-	548.7	358.9	317.1	318.8	405.1	284.7	215.9	170.9	342.6	796.9	566.3	764.4	1030
12	Peptic Ulcer	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Malaria	10.7	11.2	6.8	5.2	5.2	12.0	6.6	3.2	3.1	6.7	20.2	12.8	23.1	
14	Dysentery	-	-	-	-	-	-	-	-	-	-	-	-	-	4
15	Whooping Cough	22.1	24.2	9.6	4.5	19.0	24.7	24.1	25.4	3.7	47.3	29.4	21.2	8.2	6
16	Influenza	470.4	218.9	379.9	203.2	170.5	244.9	166.1	123.5	73.8	335.8	474.1	405.7	64.4	810
17	Tetanus	9.2	6.2	10.9	11.0	2.4	2.2	2.3	1.4	2.2	3.6	3.1	3.4	3.4	
18	Viral Encephalitis	0.6	1.8	0.3	0.5	-	0.4	1.2	0.2	0.2	-	-	-	-	-
19	Rabies	0.8	0.1	0.6	0.1	0.3	0.8	0.5	0.1	0.3	-	-	-	-	-

Remarks ;

(1) DIARRHEAS include food poisoning, dysentery, anforms, gastro-enteritis

(2) Number of 1988 is 10 leading causes

(3) * ; large flood occurred year

Table 6.2.10 LEADING CAUSES OF MORTALITY IN PANGASINAN

Unit: Rate/100,000 population

CAUSES	1975	1976*	1977	1978	1979	1980	1981	1982	1983	1984*	1985*	1986*	1987	1988
1 Pneumonia	127.4	113.2	96.8	106.5	131.5	120.7	114.0	123.8	128.3	138.2	161.3	137.7	143.7	169
2 Heart Diseases	-	-	-	-	-	-	-	-	-	56.3	67.6	62.2	62.4	10
3 Tuberculosis	76.8	76.4	70.5	70.9	66.9	67.7	65.2	67.4	61.8	63.2	65.6	62.4	54.0	39
4 Cerrero-Vascular Acc.	-	-	-	-	-	-	-	-	-	-	-	-	-	40
5 Malignant Neoplasms	29.1	29.9	34.5	31.1	31.2	33.3	32.9	32.6	37.6	35.8	39.3	35.0	35.8	28
6 Diarrheas *	27.2	22.5	35.0	22.3	26.8	23.9	30.7	22.9	27.0	26.1	20.8	21.4	12.9	
7 Accidents	-	-	-	-	-	-	-	-	-	20.9	22.6	17.3	16.1	34
8 Measles	10.9	7.7	10.9	12.2	10.9	8.9	12.9	6.9	13.4	15.5	14.4	13.1	27.2	
9 Malnutrition	-	-	-	-	-	-	-	-	-	-	-	-	-	6
10 Nephritis, Nephritic Syndrome/Nephrosis	-	-	-	-	-	-	-	-	-	-	-	-	-	
11 Bronchitis	-	26.6	25.3	21.2	5.6	6.5	6.5	6.7	5.1	4.7	5.4	3.6	2.6	7
12 Peptic Ulcer	-	-	-	-	-	-	-	-	-	-	-	-	-	9
13 Malaria	0.2	0.3	0.5	0.6	0.5	1.0	0.5	0.4	0.3	0.1	0.7	0.3	0.4	
14 Dysentery	-	-	-	-	-	-	-	-	-	-	-	-	-	
15 Whooping Cough	0.1	0.2	0.2	0.1	0.3	0.1	0.1	0.2	0.2	-	0.3	0.1	0.1	
16 Influenza	15.4	17.1	18.6	12.8	14.9	10.9	12.0	9.6	9.4	8.8	9.8	10.8	11.3	
17 Tetanus	9.2	6.2	7.6	7.7	1.9	1.9	1.4	0.6	1.8	1.7	1.2	1.7	1.5	
18 Viral Encephalitis	0.6	0.7	0.3	0.4	-	-	-	-	-	-	-	-	-	
19 Rabies	0.8	0.1	0.6	0.1	0.3	0.8	0.5	0.1	0.3	-	-	-	-	

Remarks ;

(1) DIARRHEAS include food poisoning, dysentery, auforms, gastro-enteritis

(2) Number of 1988 is 10 leading causes

(3) * ; large flood occurred year

Table 6.3.1 PRELIMINARY RESULT OF EIA FOR THE PRIORITY PROJECTS

Checklist Item	Agno River		Pantal-Sinocalan River	
	River Improvement	Poponto Reter-ding Basin	River Improvement	Dagupan bypass
A) Problems due to the Location				
1. Resettlement	-/A	-/A	-/A	-/C
2. Encroachment of cultural tribes	o	o	o	o
3. Land value changes	+/A	=	+/A	+/A
4. Encroachment of agricultural lands	-/A	-/B	-/A	-/C
5. Depreciation of forestry	o	o	o	o
6. Inundation of mineral resources	o	o	o	o
7. Encroachment of historical/cultural values	o	o	o	o
8. Watershed erosion/silt runoff	o	o	o	o
9. Effects on groundwater hydrology	o	o	o	-/C
10. Impairment of navigation	o	o	-/C	o
11. Encroachment of precious ecology	o	o	o	o
12. Migrating valuable fish species	o	o	o	o
13. Road erosion	o	o	o	o
14. Water right conflicts	o	o	o	o
15. Loss of community and recreation areas	-/C	-/B	-/C	-/C
16. Intensification of traffic congestion	o	o	o	o
17. Aesthetic and landscape	o	o	o	o
18. Prevention of accessibility	o	o	o	o
B) Problems in Construction Stage				
1. Soil erosion and silt runoff	o	o	o	o
2. Hazards to workers and nearby residents	-/C	-/C	-/C	-/C
3. Spread to communicable diseases	o	o	o	o
4. Deterioration of water quality	-/C	o	-/C	o
C) Problems in Operation Stage				
1. Downstream erosion/aggradation	o	o	o	o
2. Deterioration of water quality	o	o	o	-/C
3. Intrusion of saline water	o	o	o	-/C
4. Eutrophication	o	o	o	o
5. Encroachment of precious ecology	o	o	o	o
6. Deperciation of fisheries	o	o	o	o
7. Aesthetic and landscape	o	o	o	o
8. Vector disease hazards	+/C	-/C	+/C	o
9. Public health hazards	+/C	-/C	+/C	o

Note : (1) /: Upper side is the expected effect, and lower side is its significance.
(2) o : Noeffect expected,
+ : Positive effect expected,
- : Negative effect expected,
= : Neutral effect expected, i.e. there may be a change but such change will be neither benefical and harmful,
(3) A : Effect which has relatively high level of significance,
B : Effect which has relatively medium level of significance,
C : Effect which has relatively low level of significance,

Table 6.3.2 AVERAGE NUTRIMENT LEVEL IN PRIORITY PROJECT AREA

Unit : $\mu g/\ell$

place	Nitrite (NO_2-N)			Nitrate (NO_3-N)			Phosphate(PO_{4-3})		
	1987		1988	1987		1988	1987		1988
	3 rd	4 rd	1 st	3 rd	4 th	1 st	3 rd	4 th	1 st
Agno offshore	5.31	2.70	1.59	3.96	0.92	4.29	42.05	10.09	7.98
Agno Mouth	-	11.93	2.94	-	2.70	4.76	-	17.06	23.87
Agno Upstream	-	2.71	1.60	-	0.92	3.28	-	10.81	15.73
Dagupan Offshore	8.74	1.44	1.18	7.34	1.01	5.04	7.93	6.29	9.27
Dagupan Mouth	6.75	4.08	2.36	14.21	5.47	4.09	29.74	9.25	6.84
Dagupan Upstream	15.74	20.02	4.22	16.04	7.29	25.51	63.75	39.43	12.58

Note: Offshore; 1,000~1,500m off the coastline
Mouth;Mouth of rivers
Upstream; 1,000~2,500m upstream from river mouth.

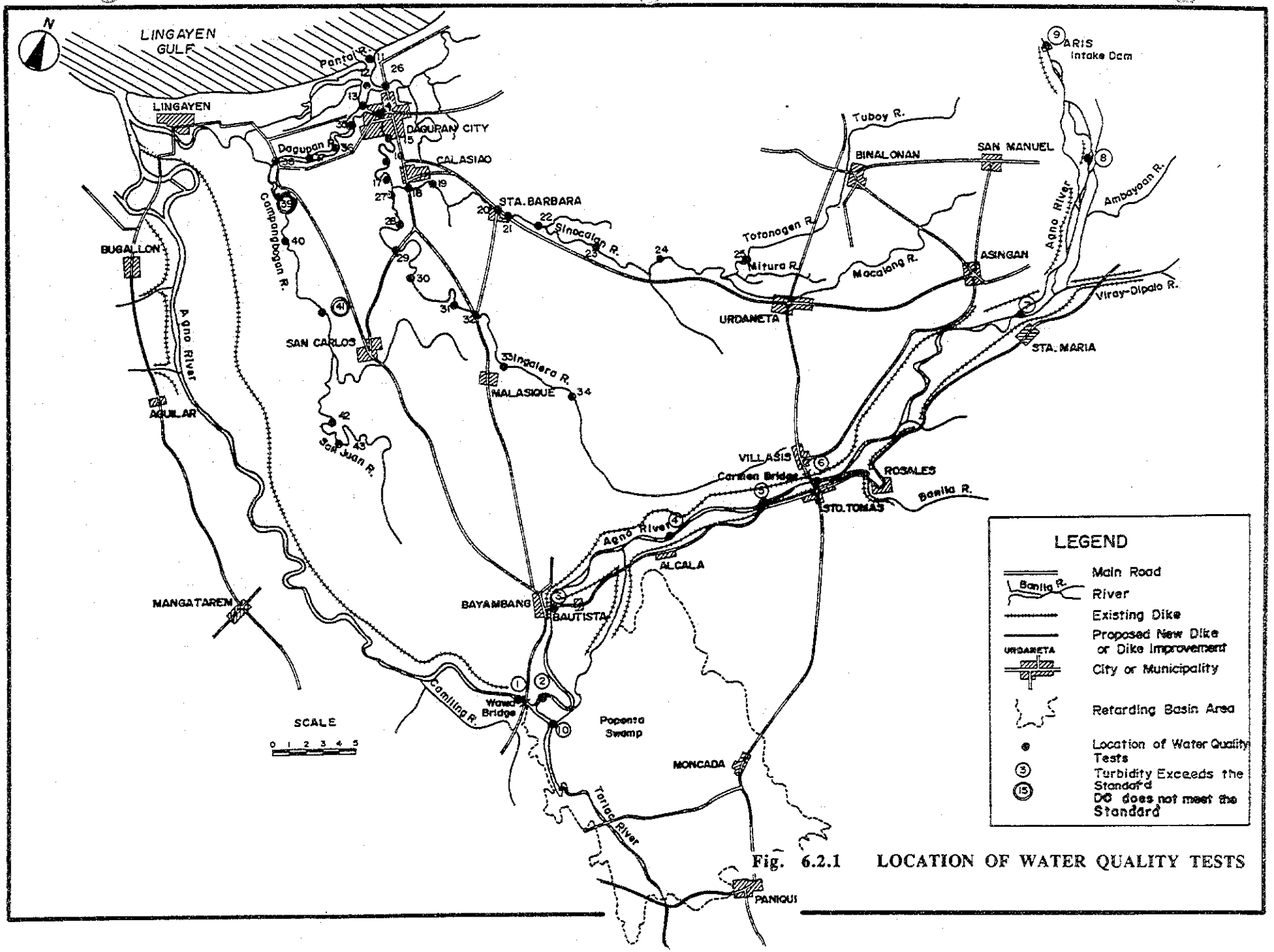


Fig. 6.2.1 LOCATION OF WATER QUALITY TESTS

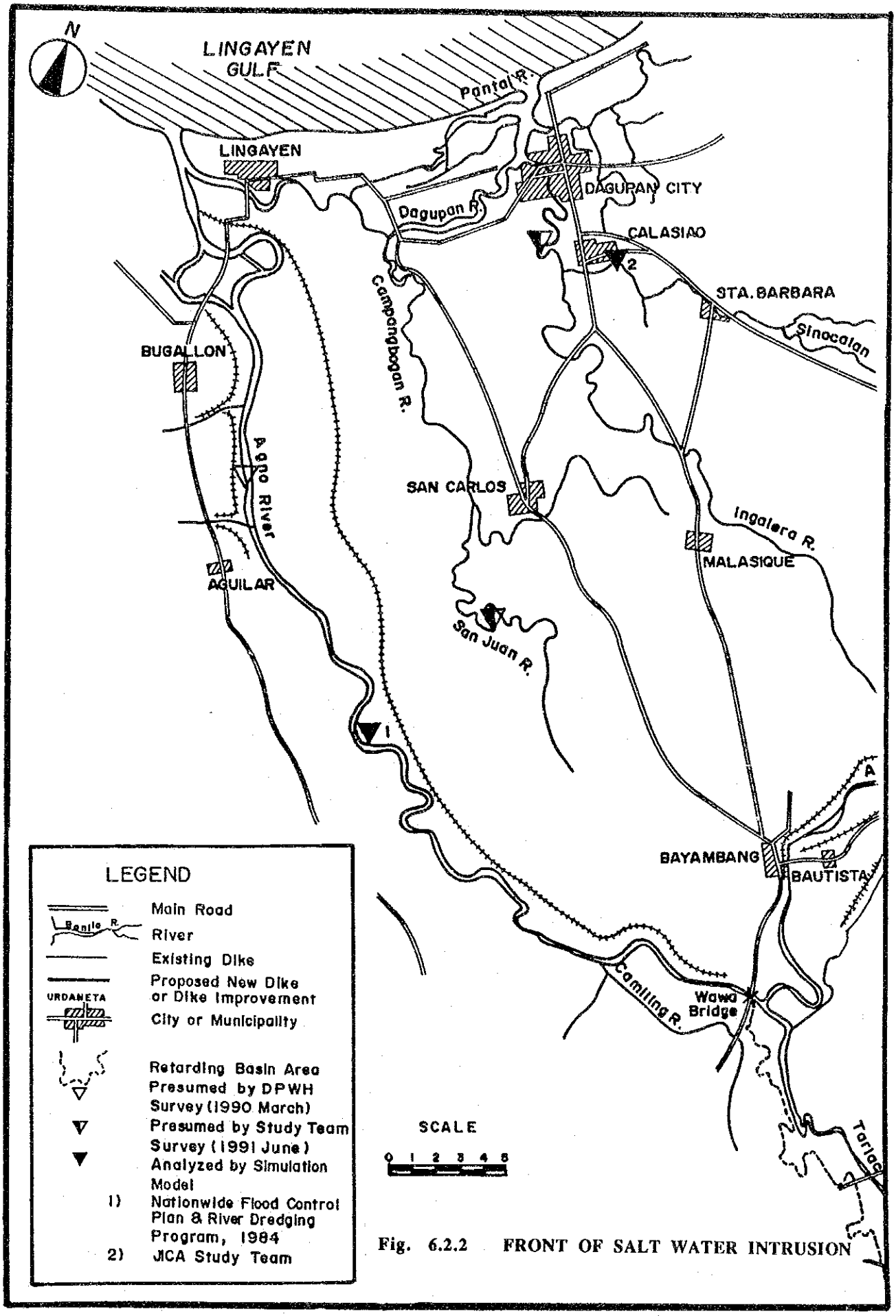


Fig. 6.2.2 FRONT OF SALT WATER INTRUSION

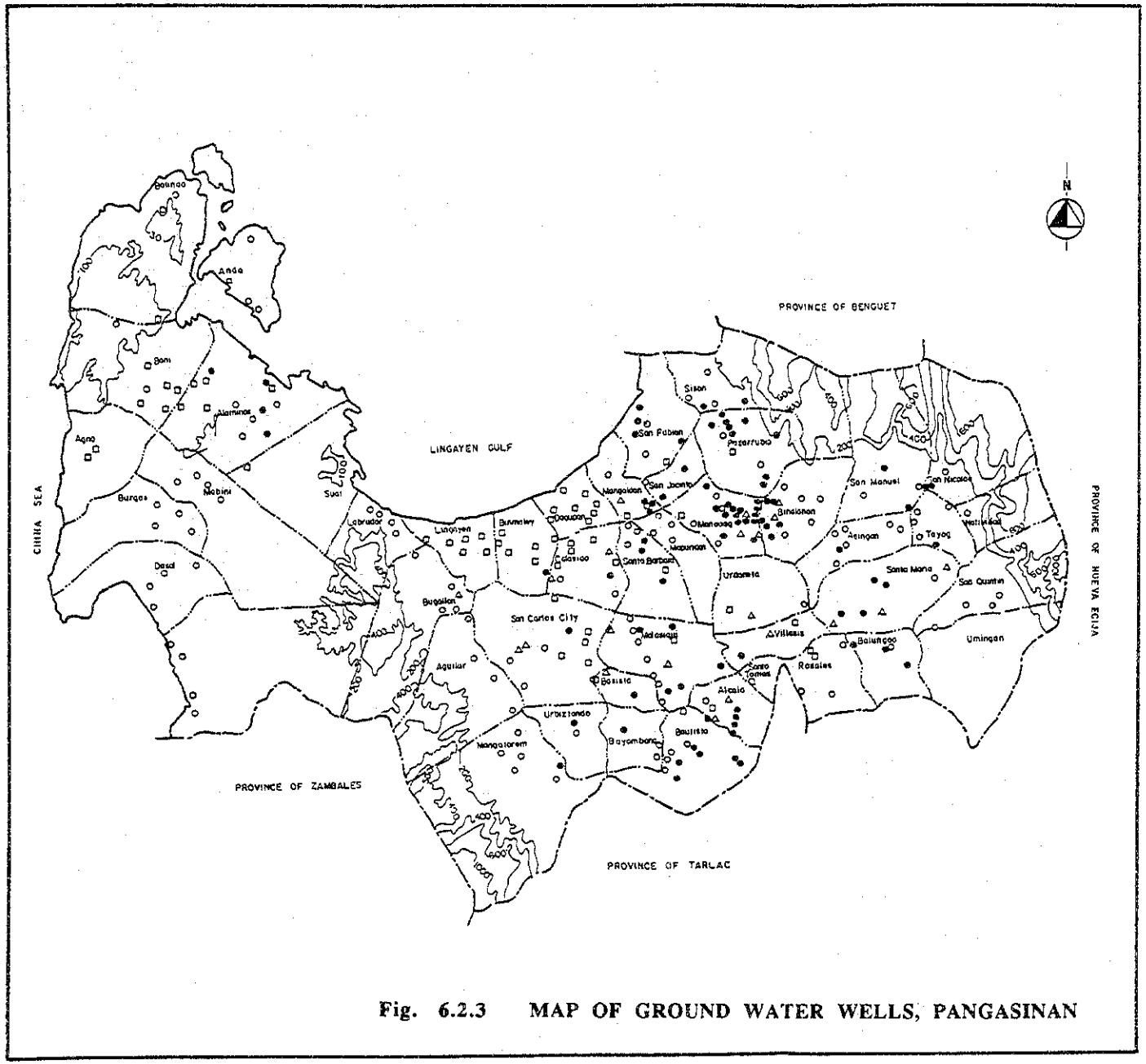


Fig. 6.2.3 MAP OF GROUND WATER WELLS, PANGASINAN

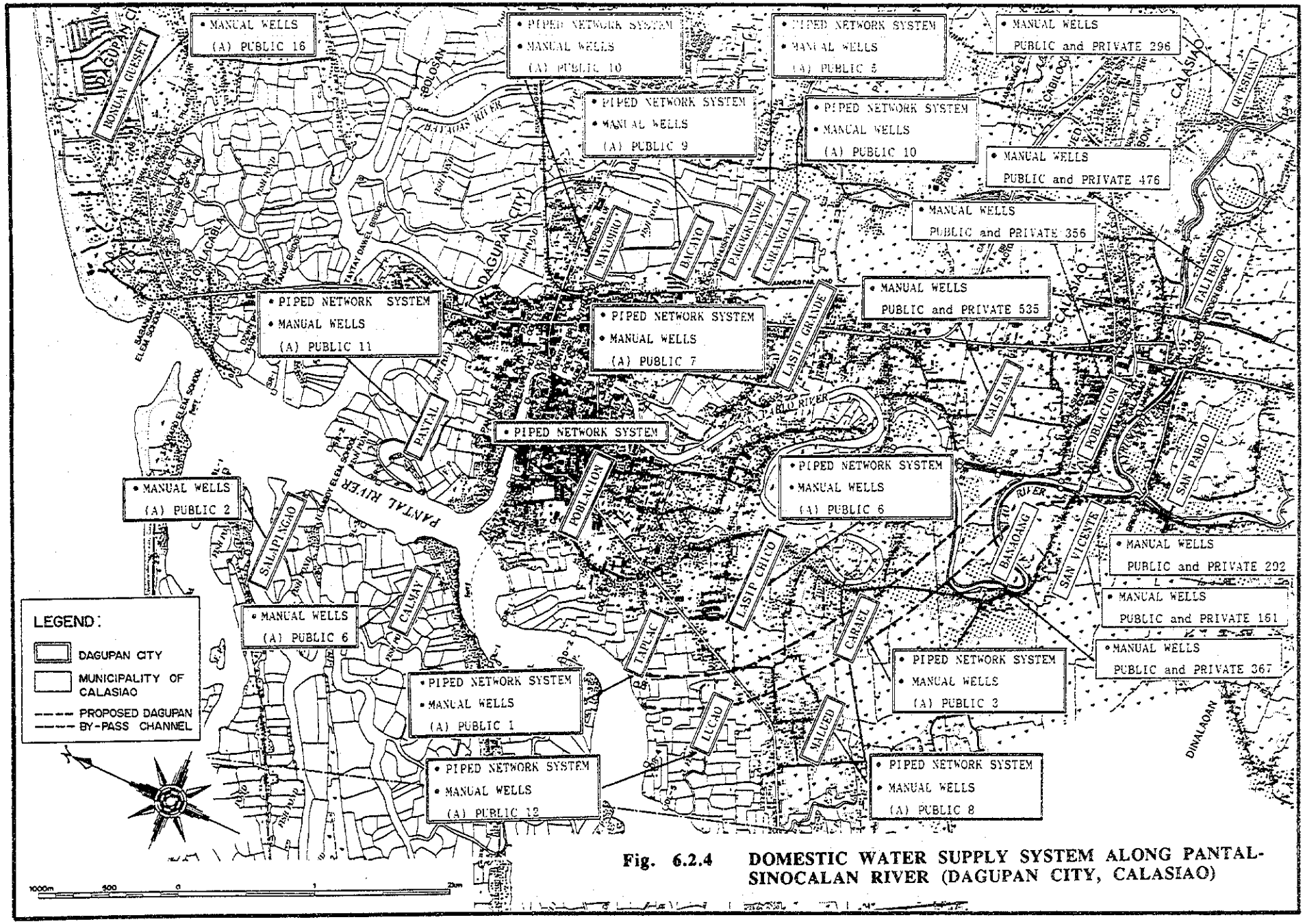
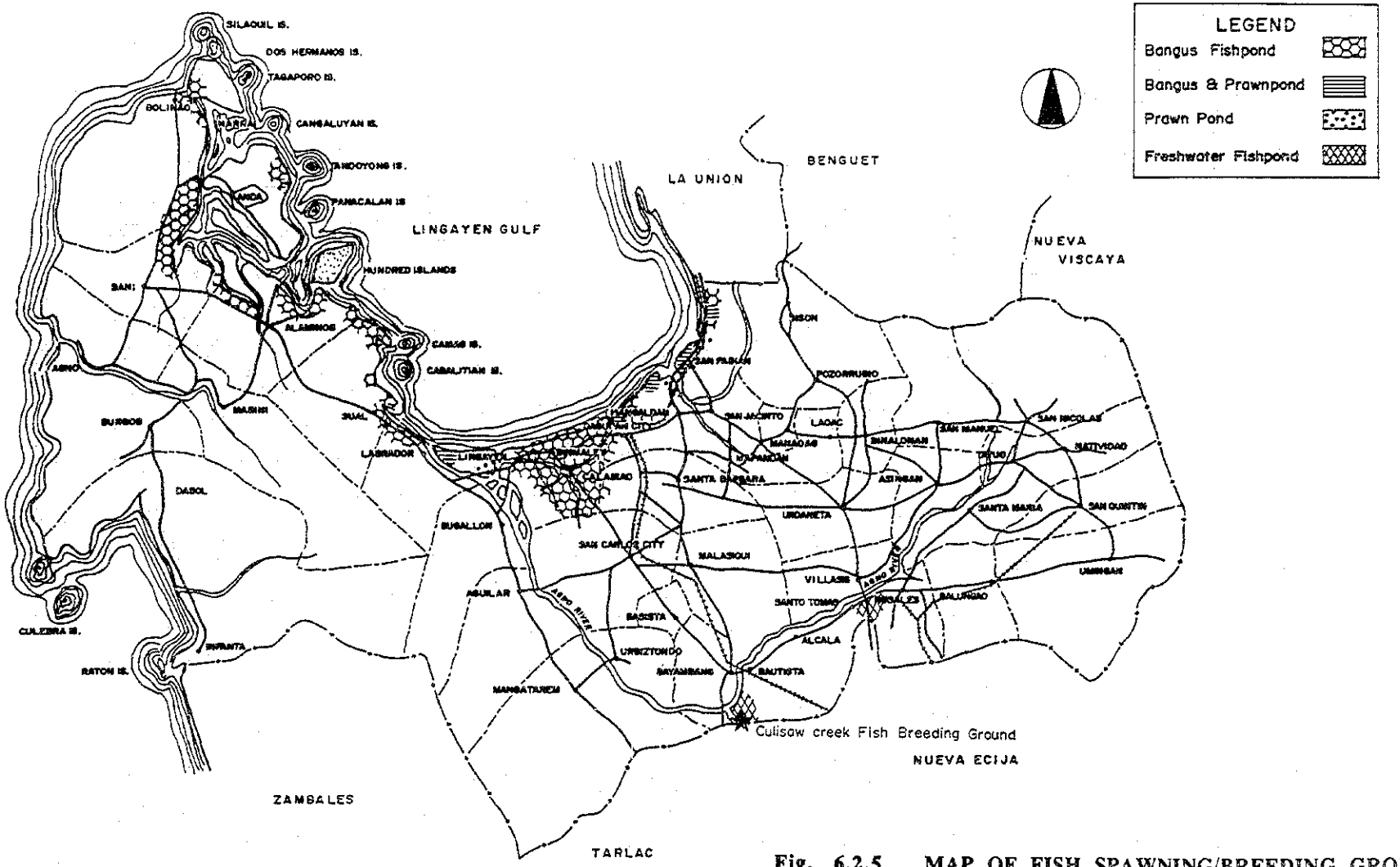


Fig. 6.2.4 DOMESTIC WATER SUPPLY SYSTEM ALONG PANTAL-SINOCALAN RIVER (DAGUPAN CITY, CALASIAO)



Source: Department of Agriculture, Region I
(Private Communication, 1989)

Fig. 6.2.5 MAP OF FISH SPAWNING/BREEDING GROUND AND FISHPOND AREA, PANGASINAN

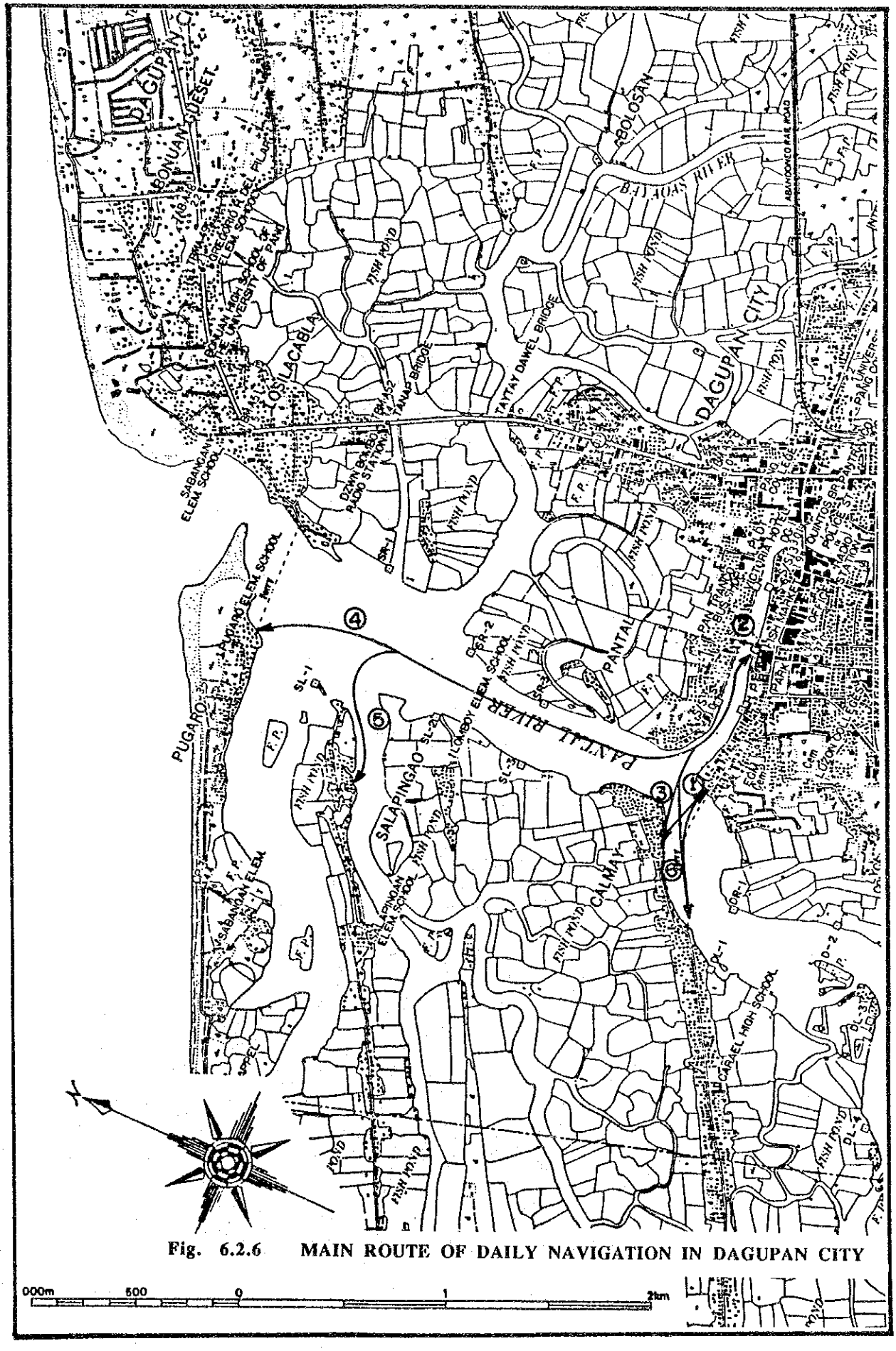
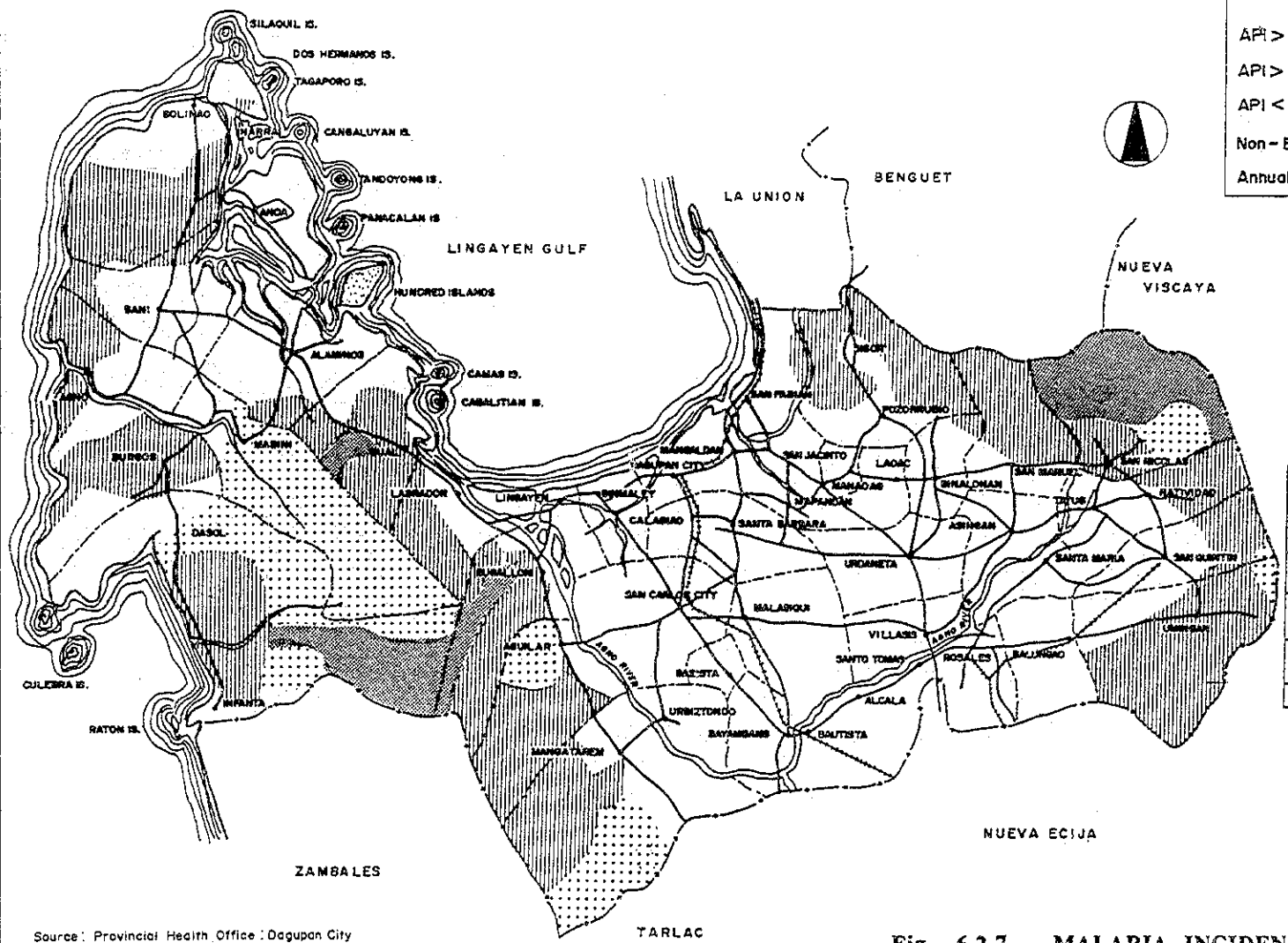


Fig. 6.2.6 MAIN ROUTE OF DAILY NAVIGATION IN DAGUPAN CITY

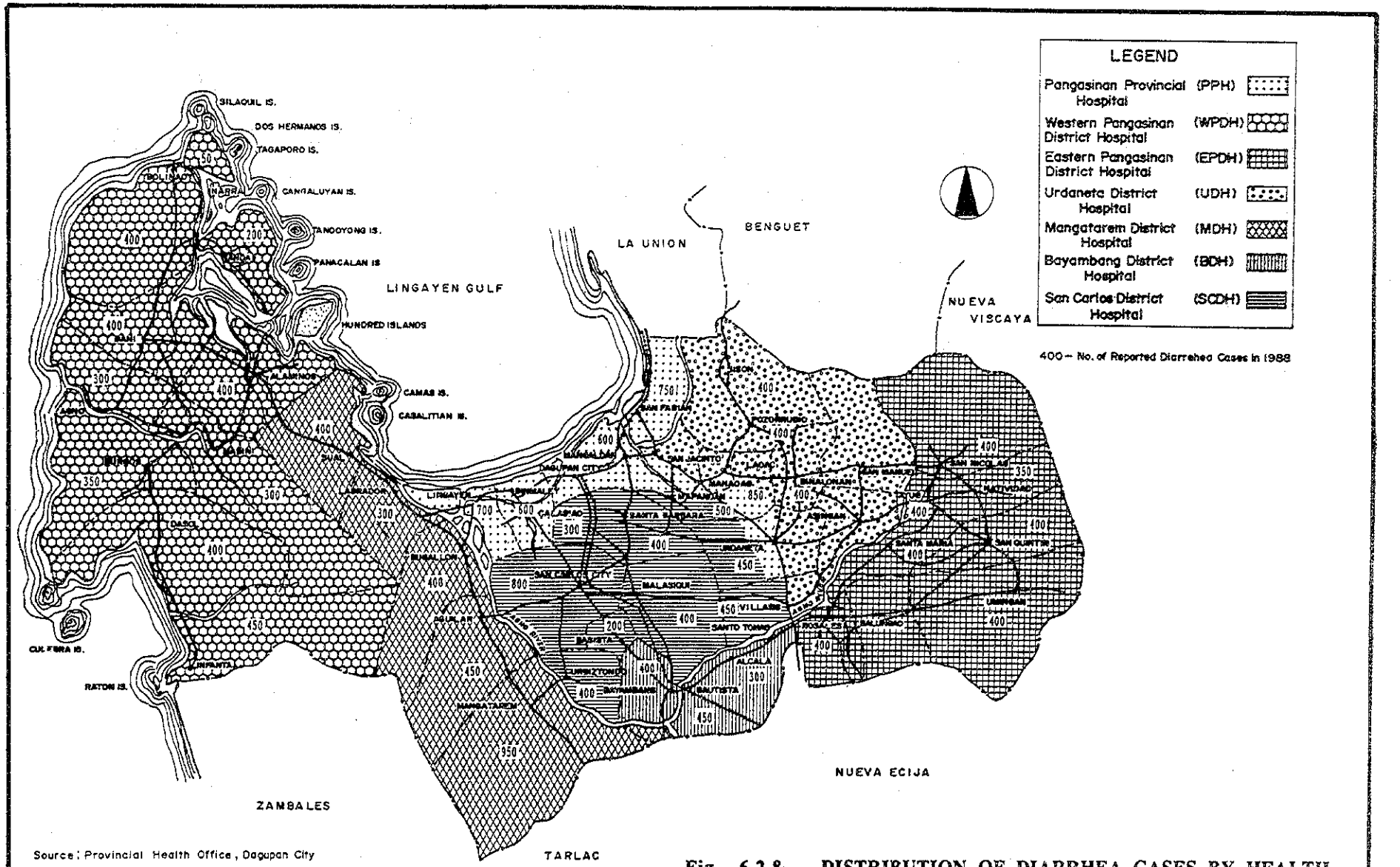


BASIC DATA

Stratification of Areas	LOC.	HSES.	POP
Non-Endemic Areas	618	240406	1,446,046
Areas with API <5/1000	403	32,867	187,741
Areas with API> 5 to 10/1000	125	5801	31543
Areas with API>10/1000	85	2295	12762
TOTAL	1231	281369	1,678,092

Source : Provincial Health Office : Dagupan City

Fig. 6.2.7 MALARIA INCIDENCE MAP, PANGASINAN



Source : Provincial Health Office , Dagupan City

Fig. 6.2.8 DISTRIBUTION OF DIARRHEA CASES BY HEALTH DISTRICT, PROVINCE OF PANGASINAN, 1988

7. COST ESTIMATES

7. COST ESTIMATES

7.1 Cost Estimation Criteria

7.1.1 Constitution of the Project Cost

The project cost is composed of main construction costs, compensation costs, administration and engineering services, and contingencies. The details of the basic constitution of the project cost is shown in Figure 7.1.1.

The project cost is classified into two categories: financial cost and economic cost. Financial cost is the budgetary cost required to implement the project and the economic cost is used for the economic evaluation of the project.

7.1.2 Basic Conditions

Project cost was estimated on the basis of the following assumptions:

a) Procurement of construction works are to be executed by bidding.
b) Unit costs of each construction work item is estimated on the unit price basis, except for some work items which are estimated on lump sum/percentage basis.
c) Unit prices are based on the price level as of May, 1991.
d) Foreign currency conversion rates are US$1.00 = ₱27.80 = ¥139.00

7.1.3 Compensation Cost

Compensation cost is composed of the cost for land acquisition and cost for house evacuation and improvement as classified below:

Land Acquisition	:	. Commercial area (Class 1 to 3)
		. Residential area (Class 1 to 3)
		. Farmland (Class 1 to 3)
		. Others
House Evacuation	:	. Building
		. House (Class I to IV)

The transaction price is adopted as the unit financial cost of land and houses, while the appraised commercial value is adopted as unit economic cost.

The land subject to right-of-ways is delineated by the following criteria:

a) The river area which has been confined by the existing dikes is not subject to compensation.
b) The river area which is planned to be confined by new dikes is subject to compensation. The following river areas which are to be confined by the new setback levees are subject to compensation:

Upper Agno River, Asingan-San Manuel stretch
Right bank : AG453 - AG470
AG407 - AG417
Left bank : AG408 - AG412
Right bank of the Poponto floodway

c) All the planned river areas of the Pantal-Sinocalan River are subject to compensation.
d) In the Poponto retarding basin area, the land occupied by ring levees and mounds for resettlement is subject to compensation. The other retarding basin areas are donated as natural conditions and are not subject to compensation.

7.2 Unit Costs

7.2.1 Component of Unit Costs

Foreign financing agencies are expected to extend assistance to the project, therefore, cost estimate consists of the Foreign Currency Portion (F.C) and the Local Currency Port (L.C). In estimating the project cost, the following basic conditions were assumed.

Foreign Currency Portion

a) All costs of construction equipment,
b) Part of construction material costs,

c) Part of indirect cost such as OCM, profit and mobilization/ demobilization, and

d) Part of engineering services cost.

Local Currency Portion

a) All labor costs,

b) Part of construction material costs,

c) Part of indirect cost such as OCM, profit and mobilization/ demobilization,

d) Value Added Tax,

e) All compensation costs for land acquisition and house evacuation,

f) All cost of administration for the government staff, and

g) Part of engineering services cost.

The components of unit costs are tabulated as follows:

Particulars	Portion of Unit Costs	
	Foreign Currency (%)	Local Currency (%)
(1) Labor Cost	0	100
(2) Equipment Cost	100	0
(3) Material Cost		
(a) Fuel	50	50
(b) Cement	65	35
(c) Re-bar	65	35
(d) Structural Steel	100	0
(e) Others	0	100
(4) Overhead (Excl. VAT)	(2+3) x 21	(1+3) x 21
(5) Value Added Tax (VAT)	0	(1+3) x 10
(6) Compensation	0	100
(7) Administration	0	100
(8) Engineering Services	90	10

7.2.2 Unit Costs

(1) Unit Costs for Construction Works

Unit costs for construction works were estimated by using the basic costs and actual unit costs adopted in the projects under construction in Pangasinan by AFSC/DPWH. The financial unit costs and the economic unit costs adopted are shown in Table 7.2.1 and Table 7.2.2. respectively.

The unit costs used in the Master Plan Stage (1989) and the unit costs adopted in this Feasibility Study were compared. The average escalation rates of materials, equipment, and labors are 50%, 30%, and 80% respectively in the period 1989 - 1991. The average escalation rate of the financial unit costs is about 40%.

(2) Unit Compensation Costs

The appraised value and transaction prices of land, buildings and residential houses were investigated and the following data was collected:

a) Schedule of Base Unit Market Values prepared annually by municipal assessors (called "Appraised Value" by the government).

b) Transaction Price of land and houses in the areas subject to compensation as gathered by interviews with residents, municipal assessors and realtors.

The average values of these data were adopted as the unit compensation costs and are tabulated in Tables 7.2.3 and 7.2.4. The Transaction Price which is a private selling and buying price is about 2 to 15 times the government's appraised value. Price difference is higher in urban areas.

(3) Unit Prices for River Structures

The unit prices for revetments, concrete dikes, groins, sluices, water gates, diversion structures, ground sills, box culverts, drainage ditches, and wells were estimated based on the unit costs as shown in Table 7.2.5.

7.3 Project Costs

7.3.1 Project Costs

The work quantities of the Upper Agno River and the Pantal-Sinocalan River are summarized:

Work Item	Unit	Upper Agno			Pantal-Sinocalan		
		Stage-1	Stage-2	Total	Stage-1	Stage-2	Total
Excavation	1000m^3	4,784	3,634	8,418	1,243	2,105	3,348
Dredging	1000m^3	0	0	0	160	20	180
Embankment	1000m^3	4,852	446	5,298	1,806	2,482	4,288
Revetment	km	32	20	52	12	12	24
Groyne	pc.	54	61	115	0	39	39
Sluiceway	pc.	32	6	38	14	30	44
Water Gate	pc.	0	0	0	4	5	9
Bridge	m^2	8,524	2,046	10,570	11,048	8,609	19,657
Compensation							
House	unit	4,692	188	4,880	1,442	1,084	2,526
Land	ha	1,179	28	1,207	273	299	572

(1) Agno River Project

The financial project cost and the economic project cost for the Upper Agno River were estimated at 3,913.2 million pesos and 3,475.9 million pesos, respectively, as shown in Table 7.3.1 and Table 7.3.2.

Unit: Million Pesos

Item	First Stage	Second Stage	Total
Financial Cost	2,923.4	989.8	3,913.2
Economic Cost	2,522.6	923.3	3,475.9

(2) Pantal-Sinocalan River Project

The financial project cost and the economic project cost for the Pantal-Sinocalan River were estimated at 3,895.7 million pesos and 3,306.9 million pesos, respectively, as shown in Table 7.3.3 and Table 7.3.4.

Unit: Million Pesos

Item	First Stage	Second Stage	Total
Financial Cost	1,977.3	1,918.4	3,895.7
Economic Cost	1,628.3	1,678.6	3,306.9

Tables 7.3.5 - 7.3.8 show the breakdown of financial project cost according to construction stretch and stage.

7.3.2 Compensation Cost

Breakdowns of the financial compensation costs are shown in Table 7.3.9 for the Upper Agno River and Table 7.3.10 for the Pantal-Sinocalan River. Those of the economic compensation costs are shown in Table 7.3.11 and Table 7.3.12.

7.4 Construction Plan

7.4.1 Basic Conditions

(1) Workable Days

The workable days for each project were estimated as follows:

a) Upper Agno River Project

	Official Holidays	Rain Days	Workable Days
Earth Works	69	106	190
Others	69	53	243

b) Pantal-Sinocalan River Project

	Official Holidays	Rain Days	Workable Days
Earth Works	69	73	223
Others	69	36	260

(2) Construction Materials

a) Embankment Materials

The riverbed materials in the project areas are mostly usable as

embankment materials, except in the San Manuel Stretch (A-1). Therefore, the excavated soil of the low water channel, as well as barrow material, will be used as embankment material.

Embankment materials from barrow pits TS-1 (San Manuel) and TS-2 (Rosales), as well as excavated materials from the nearby paddy land, will be used in the Asingan-San Manuel Stretch. The average hauling distances from these sources to the embankment sites were estimated to be 500 m and 3 km, respectively.

b) Concrete Aggregates

Riverbed materials in the upper reaches of the Agno River Project, the materials from barrow pits TA-1 (San Manuel), TA-2 (Asingan), and TA-4 (Carmen), will be used as concrete aggregates. Barrow pits TA-9 (Manaoag) and TA-10 (San Jacinto) are available for the Pantal-Sinocalan River Project.

The hauling distances vary from 500 m to 3.5 km. The difference in hauling distances among the concrete aggregate sources does not significantly affect concrete cost, since the share of aggregate cost in concrete cost is small (about 5 to 6%). Therefore, the average hauling distance of 20 km was employed for the cost estimate.

c) Boulders

Barrow pits of boulders for the Agno River Stretch are located in San Manuel (B-1), Ambayoan River (B-2) and Banila River (B-3). The barrow pits for the Pantal-Sinocalan River is located in the Bued River. These are presently used by the AFCS. The average hauling distance from these barrow pits to all the construction sites is around 30 km.

The location of these barrow pits are shown in Figure 7.4.1.

7.4.2 Standard Construction Method

(1) Excavation Works

Excavation works for the projects consist of the low water channel excavation. Excavated materials which are suitable in quality and available in quantity are to be used for dike embankment. Unsuitable materials or materials in excess of the required embankment are to be dumped in the spoil bank area. The hauling distance of excavated materials to the spoil bank is assumed at 1,000 m on average.

Excavation works per group are planned to be done by a combination of 4 bulldozers (11 tons), 2 pay loaders (1.3 m^3), 1 backhoe (0.66 m^3) and 5 dump trucks (6 m^3). The work capacity of each group is assumed to be 800 m^3/day.

(2) Embankment Works

Embankment works for heightening the existing dikes and constructing new dikes are classified into the following two categories:

Embankment 1 : Embankment materials to be obtained from river channel excavation. Average hauling distance 500 m.

Embankment 2 : Embankment materials to be obtained from barrow areas.

Embankment work 1 is planned to be done by a combination of 4 bulldozers (11 tons), 4 pay loaders (1.3 m^3), 5 dump trucks (6 m^3), 2 tire rollers (8 tons) and 2 water tankers (3.8 m^3). The work capacity of each group is assumed to be 800 m^3/day.

Embankment work 2 is planned to be done by a combination of 6 bulldozers (11 tons), 4 pay loaders (1.3 m^3), 15 dump trucks (6 m^3), 2 tire rollers (8 tons) and 2 water tanker (3.8 m^3). The work capacity of each group is assumed to be 640 m^3/day.

7.4.3 Construction Schedule

(1) Implementation Schedule

The Proposed Priority Projects are each split into two stages as shown in Figure 9.1.1. The construction time schedules of the Upper Agno River Project and the Pantal-Sinocalan River are shown in Figure 7.4.2 and Figure 7.4.3 respectively. These schedules were prepared in accordance with the two stage implementation schedule described in Section 9.1, and will be subject to change for further elaboration.

(2) Work Volume and Time Schedule

The following annual work volume, construction period, and number of work groups are assumed to complete the Project within the specified time schedule:

a) Upper Agno River Project

First Stage -

Excavation	:	2,103,000 m^3/year ;	14 groups, 3.0 years
Embankment 1	:	820,000 m^3/year ;	5 groups, 5.0 years
Embankment 2	:	248,000 m^3/year ;	2 groups, 2.0 years

Second Stage -

Excavation	:	1,420,000 m^3/year ;	9 groups, 4.0 years

b) Pantal-Sinocalan River Project

First Stage -

Excavation	:	236,000 m^3/year ;	1 group, 4.0 years
Embankment 1	:	532,000 m^3/year ;	3 groups, 5.0 years

Second Stage -

Excavation	:	547,000 m^3/year ;	3 groups, 4.0 years
Embankment 1	:	719,000 m^3/year ;	4 groups, 5.0 years

Table 7.2.1 FINANCIAL UNIT COST

(Unit: Pesos)

No.	Work Item	Refer. No.	Unit	Direct Cost					Indirect Cost					Unit Cost	L.C. Portion	F.C. Portion	Remarks
				Material	Equipment	Labor	Total	L.C. Portion	Cont'cy & Misc.	Profit	Mob. & Demob.	VAT	Total				
1	Excavation 1	EX-1	m3	9.21	37.55	4.96	51.72	9.57	4.65	3.62	2.59	4.25	15.11	67	16	51	Common soil
2	Excavation 2	EX-2	m3	12.50	44.47	6.06	63.03	12.30	5.67	4.41	3.15	5.05	18.28	81	20	61	Gravel
3	Dredging	DW	m3	15.36	7.49	5.26	28.11	12.94	2.53	1.97	1.41	1.28	7.19	35	17	18	Fine Sand
4	Embankment 1	EM-1	m3	15.48	57.14	8.47	81.09	17.01	7.30	5.68	4.05	6.56	23.59	105	27	78	Excavated Mat.
5	Embankment 2	EM-2	m3	22.15	91.73	12.63	126.51	24.51	11.39	8.86	6.33	10.44	37.02	164	40	124	Blended Mat.
6	Stone Masonry	SM	m3	799.19	102.22	245.27	1,146.68	627.89	103.20	80.27	57.33	34.75	275.55	1,422	794	628	
7	Back Filling Gravel	BG	m3	25.53	57.60	142.48	225.61	155.75	20.30	15.79	11.28	20.01	67.38	293	208	85	
8	Stone Filling	SF	m3	40.30	72.00	113.91	226.21	135.81	20.36	15.83	11.31	18.59	66.09	292	183	109	
8	Sodding	SO	m2	1.00	0.00	10.65	11.65	11.65	1.05	0.82	0.58	1.07	3.52	15	15	0	
9	Concrete(210kg/cm3)	CN-A	m3	2,069.76	48.60	350.74	2,469.10	1,483.30	222.22	172.84	123.46	39.93	558.45	3,028	1,835	1,193	Type A
10	Concrete(140kg/cm3)	CN-C	m3	1,769.95	48.96	350.74	2,169.65	1,349.43	195.27	151.88	108.48	39.97	495.60	2,665	1,673	992	Type B
11	R.C Concrete(Atype)	FC	m3	2,427.43	46.74	263.57	2,737.74	1,177.35	246.40	191.64	136.89	31.03	605.96	3,344	1,456	1,888	
12	Gabion Cylinder 1	GC-1	m	109.79	0.00	52.80	162.59	107.44	14.63	11.38	8.13	5.28	39.42	202	135	67	d=45
13	Gabion Cylinder 2	GC-2	m	159.28	0.00	78.52	237.80	157.69	21.40	16.65	11.89	7.85	57.79	296	199	97	d=60
14	Gabion Mattress	GM	m2	278.87	0.00	62.14	341.01	200.73	30.69	23.87	17.05	6.21	77.82	419	249	170	3.0m*1.5m*0.5m
15	RC Pile	RP	m	699.59	237.79	197.18	1,134.56	430.99	102.11	79.42	56.73	43.50	281.76	1,416	565	851	0.4m*0.4m
16	RC Pile	RP-2	m	67.03	92.40	75.09	234.52	101.57	21.11	16.42	11.73	16.75	66.01	301	140	161	0.15m*0.15m
17	PC Pile 1	PP-1	m	1,158.40	142.16	43.13	1,343.69	359.77	120.93	94.06	67.18	18.53	300.70	1,644	454	1,190	0.4m*0.4m
18	PC Pile 2	PP-2	m	1,565.31	157.95	47.92	1,771.18	472.07	159.41	123.98	88.56	20.59	392.54	2,164	592	1,572	0.5m*0.5m
19	Wooden Pile 1	WP-1	m	54.58	5.72	39.08	99.38	82.74	8.94	6.96	4.97	4.48	25.35	125	105	20	d=15cm,L=5mBase
20	Wooden Pile 2	WP-2	m	96.60	8.01	54.71	159.32	131.99	14.34	11.15	7.97	6.27	39.73	199	166	33	d=20cm,L=5mBase
21	RC Sheet Pile	RSP	m2	1,230.59	539.41	551.71	2,321.71	1,041.70	208.95	162.52	116.09	109.11	596.67	2,918	1,370	1,548	L=4.5m Base
22	Steel Sheet Pile	SSP	m2	3,028.75	62.61	21.07	3,112.43	35.44	280.12	217.87	155.62	8.37	661.98	3,774	51	3,723	Type III,L=7m
22	Tie Rod	TR	m	277.57	112.00	362.70	752.27	371.53	67.70	52.66	37.61	47.47	205.44	958	497	461	d=35mm
23	C.Pipe Culvert	PCP	m	700.00			700.00	245.00	63.00	49.00	35.00	0.00	147.00	847	296	551	d=36"(80cm)
23	Flap Gate	FG	m2	60,000.00	4,200.00	1,800.00	66,000.00	7,800.00	5,940.00	4,620.00	3,300.00	600.00	14,460.00	80,460	10,038	70,422	
24	Slide Gate	SG	m2	170,000.00	11,900.00	5,100.00	187,000.00	22,100.00	16,830.00	13,090.00	9,350.00	1,700.00	40,970.00	227,970	28,441	199,529	
25	Steel Roller Gate	RG	m2	450,000.00	45,000.00	22,500.00	517,500.00	67,500.00	46,575.00	36,225.00	25,875.00	6,750.00	115,425.00	632,925	88,425	544,500	Water Head=10 m
26	Bridge	BC	m2	6,870.00	2,450.00	2,540.00	11,860.00	4,744.00	1,067.40	830.20	593.00	499.00	2,989.60	14,850	6,239	8,611	
27	Demolish't Concrete	DC	m3	138.00	380.16	726.72	1,244.88	418.25	112.04	87.14	62.24	110.69	372.11	1,617	617	1,000	
28	Demolish't Metal	DM	tons	56.09	1,600.29	96.40	1,752.78	525.83	157.75	122.69	87.64	169.67	537.75	2,291	806	1,485	

Table 7.2.2 ECONOMIC UNIT COST

(Unit: Pesos)

No.	Work Item	Refer. No.	Unit	Direct Cost					Indirect Cost					Unit Cost	L.C. Portion	F.C. Portion	Remarks
				Material	Equipment	Labor	Total	L.C. Portion	Cont'cy & Misc.	Profit	Mob. & Demob.	VAT	Total				
1	Excavation 1	EX-1	m3	8.29	37.55	3.97	49.81	9.22	4.48	0.00	2.49	0.00	6.97	57	11	46	Common soil
2	Excavation 2	EX-2	m3	11.25	44.47	4.85	60.57	11.82	5.45	0.00	3.03	0.00	8.48	69	14	55	Gravel
3	Dredging	DW	m3	13.82	7.49	4.21	25.52	11.75	2.30	0.00	1.28	0.00	3.58	29	14	15	Fine Sand
4	Embankment 1	EM-1	m3	13.93	57.14	6.78	77.85	16.33	7.01	0.00	3.89	0.00	10.90	89	20	69	Excavated Mat.
5	Embankment 2	EM-2	m3	19.94	91.73	10.10	121.77	23.59	10.96	0.00	6.09	0.00	17.05	139	29	110	Blended Mat.
6	Stone Masonry	SM	m3	719.27	102.22	196.22	1,017.71	557.27	91.59	0.00	50.89	0.00	142.48	1,160	674	486	
7	Back Filling Gravel	BG	m3	22.98	57.60	113.98	194.56	134.32	17.51	0.00	9.73	0.00	27.24	222	163	59	
8	Stone Filling	SF	m3	36.27	72.00	91.13	199.40	119.71	17.95	0.00	9.97	0.00	27.92	227	145	82	
8	Sodding	SO	m2	0.90	0.00	8.52	9.42	9.42	0.85	0.00	0.47	0.00	1.32	11	11	0	
9	Concrete(210kg/cm3)	CN-A	m3	1,862.78	48.60	280.59	2,191.98	1,316.82	197.28	0.00	109.60	0.00	306.88	2,499	1,593	906	Type A
10	Concrete(140kg/cm3)	CN-C	m3	1,592.96	48.96	280.59	1,922.51	1,195.72	173.03	0.00	96.13	0.00	269.16	2,192	1,447	745	Type B
11	R.C Concrete(Atype)	FC	m3	2,184.69	46.74	210.86	2,442.28	1,050.29	219.81	0.00	122.11	0.00	341.92	2,784	1,271	1,513	
12	Gabion Cylinder 1	GC-1	m	98.81	0.00	42.24	141.05	93.21	12.69	0.00	7.05	0.00	19.74	161	113	48	d=45
13	Gabion Cylinder 2	GC-2	m	143.35	0.00	62.82	206.17	136.71	18.56	0.00	10.31	0.00	28.87	235	165	70	d=60
14	Gabion Mattress	GM	m2	250.98	0.00	49.71	300.70	177.00	27.06	0.00	15.03	0.00	42.09	343	214	129	3.0m*1.5m*0.5m
15	RC Pile	RP	m	629.63	237.79	157.74	1,025.17	389.43	92.26	0.00	51.26	0.00	143.52	1,169	471	698	0.4m*0.4m
16	RC Pile	RP-2	m	60.33	92.40	60.07	212.80	92.16	19.15	0.00	10.64	0.00	29.79	243	112	131	0.15m*0.15m
17	PC Pile 1	PP-1	m	1,042.56	142.16	34.50	1,219.22	326.44	109.73	0.00	60.96	0.00	170.69	1,390	395	995	0.4m*0.4m
18	PC Pile 2	PP-2	m	1,408.78	157.95	38.34	1,605.07	427.80	144.46	0.00	80.25	0.00	224.71	1,830	518	1,312	0.5m*0.5m
19	Wooden Pile 1	WP-1	m	49.12	5.72	31.26	86.11	71.69	7.75	0.00	4.31	0.00	12.06	98	87	11	d=15cm,L=5mBase
20	Wooden Pile 2	WP-2	m	86.94	8.01	43.77	138.72	114.92	12.48	0.00	6.94	0.00	19.42	158	138	20	d=20cm,L=5mBase
21	RC Sheet Pile	RSP	m2	1,107.53	539.41	441.37	2,088.31	936.98	187.95	0.00	104.42	0.00	292.37	2,381	1,134	1,247	L=4.5m Base
22	Steel Sheet Pile	SSP	m2	2,725.88	62.61	16.86	2,805.34	31.94	252.48	0.00	140.27	0.00	392.75	3,198	39	3,159	Type III,L=7m
22	Tie Rod	TR	m	249.81	112.00	290.16	651.97	322.00	58.68	0.00	32.60	0.00	91.28	743	390	353	d=35mm
23	C.Pipe Culvert	PCP	m	630.00	0.00	0.00	630.00	220.50	56.70	0.00	31.50	0.00	88.20	718	267	451	d=36"(80cm)
23	Flap Gate	FG	m2	54,000.00	4,200.00	1,440.00	59,640.00	7,048.36	5,367.60	0.00	2,982.00	0.00	8,349.60	67,990	8,529	59,461	
24	Slide Gate	SG	m2	153,000.00	11,900.00	4,080.00	168,980.00	19,970.36	15,208.20	0.00	8,449.00	0.00	23,657.20	192,637	24,164	168,473	
25	Steel Roller Gate	RG	m2	405,000.00	45,000.00	18,000.00	468,000.00	61,043.48	42,120.00	0.00	23,400.00	0.00	65,520.00	533,520	73,863	459,657	Water Head=10 m
26	Bridge	BC	m2	6,183.00	2,450.00	2,032.00	10,665.00	4,266.00	959.85	0.00	533.25	0.00	1,493.10	12,158	5,162	6,996	
27	Demolish't Concrete	DC	m3	124.20	380.16	581.38	1,085.74	354.78	97.72	0.00	54.29	0.00	152.01	1,238	441	797	
28	Demolish't Metal	DM	tons	50.48	1,600.29	77.12	1,727.89	518.37	155.51	0.00	86.39	0.00	241.90	1,970	627	1,343	

Table 7.2.3 UNIT COMPENSATION COST FOR LAND ACQUISITION

Land	Class	Financial Cost (Pesos/m2)	Economic Cost (Pesos/m2)
Residential	Class 1	400.00	60.00
	Class 2	250.00	40.00
	Class 3	80.00	20.00
Farmland	Class 1	14.00	1.80
	Class 2	10.00	1.50
	Class 3	5.00	1.20
Fishpond	Class 1	38.00	3.00
	Class 2	35.00	1.50
	Class 3	30.00	1.00
Others	Agno	1.00	0.50
	Pantal-Sinocalan	8.00	1.00

Table 7.2.4 UNIT COMPENSATION COST FOR HOUSE RESETTLEMENT

Building/House		Floor Area (m2)	Financial Unit Cost (Pesos/m2)	Financial Unit Cost (Pesos/Unit)	Economic Unit Cost (Pesos/m2)	Economic Unit Cost (Pesos/Unit)
Building	3 storise	750.00	3,000.00	2,250,000.00	1,500.00	1,125,000.00
House	Class I	100.00	1,750.00	175,000.00	1,400.00	140,000.00
	Class II	90.00	1,400.00	126,000.00	900.00	81,000.00
	Class III	70.00	750.00	52,500.00	600.00	42,000.00
	Class IV	40.00	400.00	16,000.00	250.00	10,000.00

Note ; 50 % of house depreciaton is considered in the unit costs.

Table 7.2.5 SUMMARY OF UNIT PRICES FOR RIVER STRUCTURES

Work Item	Ref.No.	Unit	Financial Unit Cost			Economic Unit Cost		
			L/C	F/C	Total	L/C	F/C	Total
Revetment							759056.11	759,056
River Mouth	PS.R-1	m	23,058	22,030	45,088	19,038	20,915	39,953
Cl.Dike L.W.	PS.R-2	m	27,798	99,512	127,311	22,759	99,477	122,236
Cl.Dike H.W.	PS.R-3	m	14,935	39,227	54,161	12,239	38,933	51,172
Dike on R-Bed	PS.R-4	m	7,722	5,737	13,459	6,546	5,289	11,835
Cl.Dike	PS.R-5	m	20,743	18,825	39,568	17,409	17,812	35,221
H.W.Revetment	PS.R-6	m	4,564	3,342	7,906	3,868	3,078	6,946
L.W.Revetment	PS.R-7	m	2,049	1,053	3,102	1,616	925	2,541
Type A-1	AG.R-1	m	6,974	4,967	11,941	5,932	4,556	10,488
Type A-2	AG.R-2	m	11,096	7,850	18,946	9,425	7,199	16,624
Type B-1	AG.R-3	m	5,809	2,692	8,500	4,816	2,318	7,134
Type B-2	AG.R-4	m	9,702	4,528	14,229	8,041	3,903	11,944
Type C	AG.R-5	m	7,757	3,935	11,692	6,411	3,424	9,836
Type D	AG.R-6	m	11,626	8,241	19,868	9,743	7,550	17,292
Type I	AG.R-7	m	3,383	1,886	5,269	2,675	1,683	4,358
Type II	AG.R-8	m	7,672	5,089	12,761	6,334	4,646	10,980
Type III	AG.R-9	m	6,569	4,257	10,827	5,551	3,853	9,404
Spurdike	AG.R-10	m	1,331	765	2,097	1,054	687	1,740
Type IV	AG.R-11	m	10,821	7,974	18,795	9,099	7,337	16,436
Concrete Dike	AG.R-12	m	13,011	11,875	24,886	10,908	11,269	22,177
Poponto R-1	AG.R-13	m	2,827	2,230	5,056	2,407	2,068	4,475
Poponto R-2	AG.R-14	m	14,941	10,092	25,032	12,668	9,210	21,877
Groin								
L=16.5 m	GR-1	pcs.	67,581	64,673	132,255	56,733	61,527	118,259
L=30.0 m	GR-2	pcs.	114,906	110,883	225,789	96,393	105,582	201,975
Sluice							ERR	ERR
Type A	PS.S-1	pcs.	887,989	1,429,156	2,317,145	754,984	1,399,208	2,154,192
Type B-1	PS.S-2-1	pcs.	979,351	1,824,615	2,803,966	833,947	1,796,722	2,630,669
Type B-2	PS.S-2-2	pcs.	1,378,624	2,992,857	4,371,481	1,174,707	2,963,512	4,138,219
Type B-3	PS.S-2-3	pcs.	1,798,280	4,187,530	5,985,810	1,533,260	4,155,720	5,688,980
Type C	PS.S-3	pcs.	647,787	786,114	1,433,901	548,433	759,056	1,307,489
Type A-1	AG.S-1-1	pcs.	332,056	317,284	649,340	281,523	300,345	581,868
Type A-2	AG.S-1-2	pcs.	385,655	411,705	797,360	326,712	393,281	719,993
Type B	AG.S-2	pcs.	962,703	1,524,088	2,486,791	818,319	1,491,145	2,309,465
Type C-1	AG.S-3-1	pcs.	1,093,281	1,974,788	3,068,069	930,534	1,942,564	2,873,098
Type C-2	AG.S-3-2	pcs.	1,600,524	3,286,159	4,886,683	1,364,220	3,247,819	4,612,039
Type D	AG.S-4	pcs.	1,872,648	4,364,433	6,237,081	1,597,561	4,331,036	5,928,597
Type E	AG.S-5	pcs.	743,459	919,532	1,662,992	629,640	889,134	1,518,774
Water Gate								
10x5mx1	WG-1	pcs.	10,524,615	48,931,313	59,455,928	8,897,063	49,374,864	58,271,927
10x5mx2	WG-2	pcs.	19,606,433	95,703,497	115,309,930	16,546,536	96,644,933	113,191,469
7.5x4mx1	WG-3	pcs.	15,508,204	72,998,578	88,506,782	13,107,409	73,673,884	86,781,293
5 x3mx1	WG-4-2	pcs.	4,304,857	18,854,733	23,159,590	3,647,591	19,005,673	22,653,264
Diversion Structures								
Dive. Channel	PDS	pcs.	5,239,017	5,875,940	11,114,957	4,523,502	5,605,443	10,128,945
Closing Dike	AG.R-15	m	25,166	58,383	83,549	20,798	57,676	78,474
Ground Sill	PS.GS	pcs.	3,832,745	2,587,883	6,420,629	3,190,852	2,362,794	5,553,647
Box Culvert	BXC	pcs.	447,824	580,695	1,028,519	390,923	558,427	949,350
Drainage Ditch	DT	m	265,350	194,700	460,050	226,950	183,780	410,730
Well	WL	pcs.	12,000,000	8,000,000	20,000,000	9,600,000	9,216,000	18,816,000

Table 7.3.1 SUMMARY OF FINANCIAL PROJECT COST FOR UPPER AGNO RIVER PROJECT

Work Items		1st Stage		2nd Stage		Total	
		Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)
Excavation	1000m3	4,784.0	213.0	3,634.0	243.5	8,418.0	456.5
Dredging	1000m3	0.0	0.0	0.0	0.0	0.0	0.0
Embankment	1000m3	4,852.0	466.0	446.0	34.8	5,298.0	500.8
Revetment	km	32.0	343.0	20.0	175.7	52.0	518.7
Groin	pcs	54.0	12.2	61.0	13.8	115.0	26.0
Sluiceway	pcs	32.0	72.7	6.0	10.2	38.0	82.9
Water Gate	pcs	0.0	0.0	0.0	0.0	0.0	0.0
Bridge	m2	8,524.0	126.6	2,046.0	30.4	10,570.0	157.0
Others	Lot	1.0	178.8	1.0	54.2	1.0	233.0
Preparatory Works	Lot	1.0	141.1	1.0	56.2	1.0	197.3
Miscellaneous W.	Lot	1.0	232.9	1.0	92.7	1.0	325.6
Main Construction			1,786.3		711.5		2,497.8
Compensation			398.0		14.0		412.0
Adminstration			109.2		36.3		145.5
Contingency			344.0		114.3		458.3
Engneering Services			285.8		113.8		399.6
Project Cost			2,923.4		989.8		3,913.2

Table 7.3.2 SUMMARY OF ECONOMIC PROJECT COST FOR UPPER AGNO RIVER PROJECT

Work Items		1st Stage		2nd Stage		Total	
		Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)
Excavation	1000m3	4,784.0	210.6	3,634.0	240.6	8,418.0	451.2
Dredging	1000m3	0.0	0.0	0.0	0.0	0.0	0.0
Embankment	1000m3	4,852.0	456.2	446.0	33.9	5,298.0	490.1
Revetment	km	32.0	294.3	20.0	149.7	52.0	444.0
Groin	pcs	54.0	10.9	61.0	12.3	115.0	23.2
Sluiceway	pcs	32.0	68.0	6.0	9.5	38.0	77.5
Water Gate	pcs	0.0	0.0	0.0	0.0	0.0	0.0
Bridge	m2	8,524.0	115.6	2,046.0	27.7	10,570.0	143.3
Others	Lot	1.0	155.3	1.0	53.2	1.0	208.5
Preparatory Works	Lot	1.0	131.1	1.0	52.6	1.0	183.7
Miscellaneous W.	Lot	1.0	216.2	1.0	86.8	1.0	303.0
Main Construction	mil.P		1,658.2		666.3		2,324.5
Compensation			236.0		10.0		246.0
Adminstration			94.7		33.8		128.5
Contingency			298.3		106.5		404.9
Engneering Services			265.3		106.6		371.9
Project Cost			2,552.6		923.3		3,475.9

Table 7.3.3 SUMMARY OF FINANCIAL PROJECT COST FOR PANTAL-SINOCALAN RIVER PROJECT

Work Items		1st Stage		2nd Stage		Total	
		Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)
Excavation	1000m3	1,243.0	35.5	2,105.0	82.2	3,348.0	117.7
Dredging	1000m3	160.0	5.6	20.0	0.7	180.0	6.3
Embankment	1000m3	1,806.0	189.6	2,482.0	260.6	4,288.0	450.2
Revetment	km	12.0	171.0	12.0	141.2	24.0	312.2
Groin	pcs	0.0	0.0	39.0	5.2	39.0	5.2
Sluiceway	pcs	14.0	32.4	30.0	87.8	44.0	120.2
Water Gate	pcs	4.0	236.5	5.0	178.5	9.0	415.0
Bridge	m2	11,048.0	164.1	8,609.0	127.8	19,657.0	291.9
Others	Lot	1.0	76.0	1.0	80.5	1.0	156.5
Preparatory Works	Lot	1.0	91.1	1.0	96.4	1.0	187.5
Miscellaneous W.	Lot	1.0	150.2	1.0	159.1	1.0	309.4
Main Construction			1,151.9		1,220.0		2,371.9
Compensation			333.0		207.0		540.0
Adminstration			74.2		71.4		145.6
Contingency			233.9		224.8		458.6
Engneering Services			184.3		195.2		379.5
Project Cost			1,977.3		1,918.4		3,895.7

Table 7.3.4 SUMMARY OF ECONOMIC PROJECT COST FOR PANTAL-SINOCALAN RIVER PROJECT

Work Items		1st Stage		2nd Stage		Total	
		Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)	Work Quantity	Cost (mill. P)
Excavation	1000m3	1,243.0	35.1	2,105.0	81.2	3,348.0	116.2
Dredging	1000m3	160.0	5.1	20.0	0.6	180.0	5.7
Embankment	1000m3	1,806.0	185.6	2,482.0	255.2	4,288.0	440.8
Revetment	km	12.0	153.3	12.0	126.2	24.0	279.5
Groin	pcs	0.0	0.0	39.0	4.6	39.0	4.6
Sluiceway	pcs	14.0	30.2	30.0	82.3	44.0	112.5
Water Gate	pcs	4.0	238.7	5.0	180.1	9.0	418.8
Bridge	m2	11,048.0	149.8	8,609.0	116.7	19,657.0	266.5
Others	Lot	1.0	63.8	1.0	67.1	1.0	130.9
Preparatory Works	Lot	1.0	86.2	1.0	91.4	1.0	177.6
Miscellaneous W.	Lot	1.0	142.2	1.0	150.8	1.0	293.0
Main Construction			1,089.9		1,156.2		2,246.0
Compensation			114.2		80.8		195.0
Adminstration			60.2		61.8		122.0
Contingency			189.6		194.8		384.4
Engneering Services			174.4		185.0		359.4
Project Cost			1,628.3		1,678.6		3,306.9

Table 7.3.5 SUMMARY OF FINANCIAL PROJECT COST OF EACH STRETCH FOR UPPER AGNO RIVER PROJECT (1ST STAGE)

Work Items		Bayambang-Floodway		Alcala-Asingan		Asingan-Sanmanuel		Popont Swamp		Total	
		Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)
Excavation	1000m3	4,519.0	207.9	264.8	5.3	0.0	0.0	0.0	0.0	4,783.8	213.2
Dredging	1000m3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Embankment	1000m3	1,487.5	156.2	1,161.0	121.9	501.4	78.6	1,405.4	109.6	4,555.3	466.3
Revetment	km	9.9	104.6	10.4	82.1	14.8	153.2	0.1	3.0	35.2	343.0
Groin	pcs	15.0	3.4	30.0	6.8	9.0	2.0	0.0	0.0	54.0	12.2
Sluiceway	pcs	0.0	33.1	7.0	19.9	3.0	6.2	28.0	13.5	38.0	72.7
Water Gate	pcs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bridge	m2	5,344.0	79.4	3,180.0	47.2	0.0	0.0	0.0	0.0	8,524.0	126.6
Others	Lot	1.0	42.5	1.0	93.3	1.0	9.0	1.0	33.6	1.0	178.3
Preparatory Works	Lot	1.0	62.7	1.0	37.7	1.0	24.9	1.0	15.9	1.0	141.2
Miscellaneous W.	Lot	1.0	103.5	1.0	62.1	1.0	41.1	1.0	26.3	1.0	232.9
Main Construction			793.2		476.4		315.0		201.8		1,786.3
Compensation			116.0		55.0		26.0		201.0		398.0
Adminstration			45.5		26.6		17.0		20.1		109.2
Contingency			143.2		83.7		53.7		63.4		344.0
Engneering Services			126.9		76.2		50.4		32.3		285.8
Project Cost			1,224.7		717.8		462.1		518.7		2,923.4

Table 7.3.6 SUMMARY OF FINANCIAL PROJECT COST OF EACH STRETCH FOR UPPER AGNO RIVER PROJECT (2ND STAGE)

Work Items		Bayambang-Floodway		Alcala-Asingan		Asingan-Sanmanuel		Popont Swamp		Total	
		Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)
Excavation	1000m3	1,419.9	95.1	2,209.1	148.0	0.0	0.0	4.8	0.3	3,633.8	243.5
Dredging	1000m3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Embankment	1000m3	0.0	0.0	0.0	0.0	0.0	0.0	446.4	34.8	446.4	34.8
Revetment	km	0.2	1.9	16.6	126.9	2.7	43.8	0.6	3.0	20.1	175.7
Groin	pcs	0.0	0.0	61.0	13.8	0.0	0.0	0.0	0.0	61.0	13.8
Sluiceway	pcs	0.0	0.0	2.0	5.6	0.0	0.0	4.0	4.7	6.0	10.2
Water Gate	pcs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bridge	m2	1,171.0	17.4	0.0	0.0	0.0	0.0	875.0	13.0	2,046.0	30.4
Others	Lot	1.0	0.0	1.0	0.0	1.0	0.0	1.0	54.2	1.0	54.2
Preparatory Works	Lot	1.0	11.4	1.0	29.4	1.0	4.4	1.0	10.9	1.0	56.2
Miscellaneous W.	Lot	1.0	18.9	1.0	48.6	1.0	7.2	1.0	18.0	1.0	92.7
Main Construction			144.8		372.2		55.4		139.0		711.5
Compensation			0.0		0.0		0.0		14.0		14.0
Adminstration			7.2		18.6		2.8		7.7		36.3
Contingency			22.8		58.6		8.7		24.1		114.3
Engneering Services			23.2		59.5		8.9		22.2		113.8
Project Cost			198.0		509.0		75.8		207.0		989.8

Table 7.3.7 SUMMARY OF FINANCIAL PROJECT COST OF EACH STRETCH FOR PANTAL-SINOCALAN RIVER PROJECT (1ST STAGE)

Work Items		Pantal-Sinocalan		Dagupan River		Ingarela River		Total	
		Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)
Excavation	1000m3	1,243.3	35.5	0.0	0.0	0.0	0.0	1,243.3	35.5
Dredging	1000m3	159.8	5.6	0.0	0.0	0.0	0.0	159.8	5.6
Embankment	1000m3	1,705.7	179.1	99.8	10.5	0.0	0.0	1,805.5	189.6
Revetment	km	12.0	171.0	0.0	0.0	0.0	0.0	12.0	171.0
Groin	pcs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sluiceway	pcs	14.0	32.4	0.0	0.0	0.0	0.0	14.0	32.4
Water Gate	pcs	4.0	236.5	0.0	0.0	0.0	0.0	4.0	236.5
Bridge	m2	11,048.0	164.1	0.0	0.0	0.0	0.0	11,048.0	164.1
Others	Lot	1.0	76.0	1.0	0.0	1.0	0.0	1.0	76.0
Preparatory Works	Lot	1.0	90.0	1.0	1.0	1.0	0.0	1.0	91.1
Miscellaneous W.	Lot	1.0	148.5	1.0	1.7	1.0	0.0	1.0	150.2
Main Construction			1,138.7		13.3		0.0		1,151.9
Compensation			332.0		1.0		0.0		333.0
Adminstration			73.5		0.7		0.0		74.2
Contingency			231.6		2.2		0.0		233.9
Engneering Services			182.2		2.1		0.0		184.3
Project Cost			1,958.0		19.3		0.0		1,977.3

Table 7.3.8 SUMMARY OF FINANCIAL PROJECT COST OF EACH STRETCH FOR PANTAL-SINOCALAN RIVER PROJECT (2ND STAGE)

Work Items		Pantal-Sinocalan		Dagupan River		Ingarela River		Total	
		Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)	Work Quantity	Cost (mill.P)
Excavation	1000m3	254.7	5.3	663.7	13.3	1,187.0	63.5	2,105.4	82.2
Dredging	1000m3	0.0	0.0	0.0	0.0	20.0	0.7	20.0	0.7
Embankment	1000m3	608.8	63.9	1,580.3	165.9	293.2	30.8	2,482.2	260.6
Revetment	km	3.7	58.7	5.8	55.9	2.5	26.5	12.0	141.2
Groin	pcs	0.0	0.0	39.0	5.2	0.0	0.0	39.0	5.2
Sluiceway	pcs	3.0	6.6	24.0	68.1	3.0	13.2	30.0	87.8
Water Gate	pcs	1.0	48.9	3.0	110.7	1.0	18.9	5.0	178.5
Bridge	m2	0.0	0.0	4,889.0	72.6	3,720.0	55.2	8,609.0	127.8
Others	Lot	1.0	17.6	1.0	49.0	1.0	13.8	1.0	80.5
Preparatory Works	Lot	1.0	20.1	1.0	54.1	1.0	22.3	1.0	96.4
Miscellaneous W.	Lot	1.0	33.2	1.0	89.2	1.0	36.7	1.0	159.1
Main Construction			254.4		684.0		281.6		1,220.0
Compensation			64.0		63.0		80.0		207.0
Adminstration			15.9		37.4		18.1		71.4
Contingency			50.1		117.7		57.0		224.8
Engneering Services			40.7		109.4		45.1		195.2
Project Cost			425.1		1,011.5		481.7		1,918.4

Table 7.3.9 TRANSACTION PRICE AND FINANCIAL COMPENSATION COST FOR AGNO RIVER

Description	Class	U.COST (Peso/m2)	Bayambang-Bypass		Alcala-Asingan		Asingan-San Manuel		Poponto Swamp		Total	
			Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)
1. Land Acquisition												
Residential	1	400.00	0	0	0	0	0	0	0	0	0	0
	2	250.00	0	0	0	0	0	0	0	0	0	0
	3	80.00	508,305	41	322,680	26	40,000	3	24,200	2	895,185	72
Farmland	1	14.00	0	0	0	0	0	0	0	0	0	0
	2	10.00	3,160,890	32	358,700	4	0	0	1,634,100	16	5,153,690	52
	3	5.00	0	0	98,970	0	2,253,500	11	0	0	2,352,470	12
Fishpond	1	38.00	0	0	0	0	0	0	0	0	0	0
	2	35.00	0	0	0	0	0	0	0	0	0	0
	3	30.00	9,000	0	0	0	0	0	0	0	9,000	0
Others		1.00	455,100	0	2,990	0	3,200,000	3	0	0	3,658,090	4
Sub-Total			4,133,295	73	783,340	30	5,493,500	18	1,658,300	18	12,068,435	139
2. House Evacuation												
Building		2,250,000	9	20	6	14	2	5	0	0	17	38
House(100m2*P3500)I		175,000	15	3	10	2	4	1	137	24	166	29
(90m2*P2800)II		103,500	60	6	36	4	14	1	806	83	916	95
(70m2*P1500)III		52,500	169	9	70	4	21	1	1,134	60	1,394	73
(40m2*P 800)IV		16,000	293	5	163	3	48	1	1,883	30	2,387	38
Sub-Total			546	43	285	25	89	9	3,960	197	4,880	273
Total				116		55		26		215		412

Table 7.3.10 TRANSACTION PRICE AND FINANCIAL COMPENSATION COST FOR PANTAL-SINOCALAN RIVER

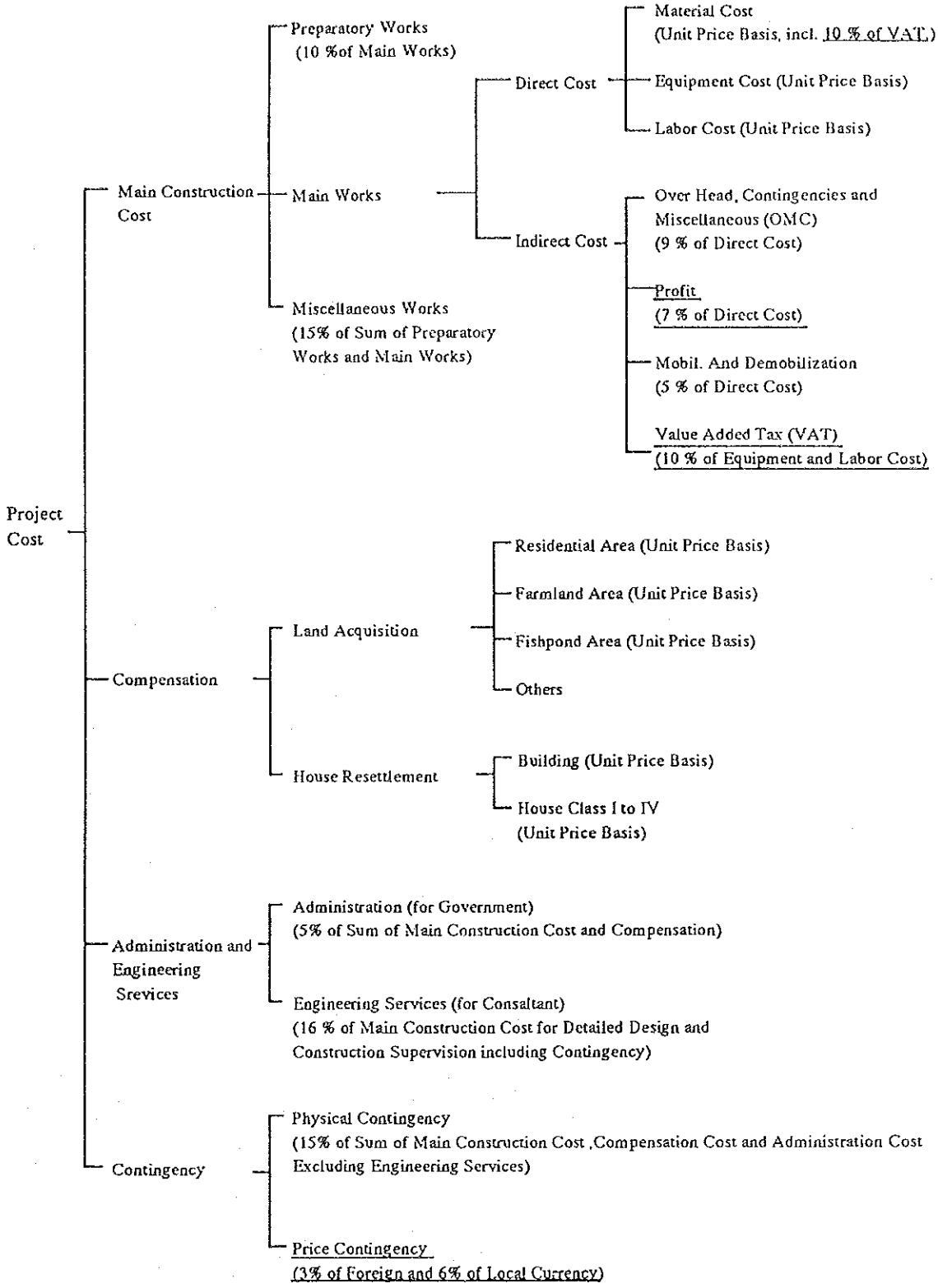
Description	Class	U.COST (Peso/m2)	Pantal-Sinocalan Area (m2)	Pantal-Sinocalan Cost (mil.Pesos)	Dagupan River Area (m2)	Dagupan River Cost (mil.Pesos)	Ingalera River Area (m2)	Ingalera River Cost (mil.Pesos)	Total Area (m2)	Total Cost (mil.Pesos)
1. Land Acquisition										
Residential	1	400.00	121,500	49	0	0	0	0	121,500	49
	2	250.00	599,900	150	0	0	0	0	599,900	150
	3	80.00	0	0	218,100	17	378,000	30	596,100	48
Farmland	1	14.00	981,900	14	431,800	6	428,000	6	1,841,700	26
	2	10.00	383,360	4	0	0	0	0	383,360	4
	3	5.00	0	0	0	0	0	0	0	0
Fishpond	1	38.00	79,000	3	0	0	0	0	79,000	3
	2	35.00	236,500	8	0	0	0	0	236,500	8
	3	30.00	0	0	792,500	24	0	0	792,500	24
Others		8.00	938,000	8	14,000	0	0	0	952,000	8
Sub-Total			3,340,160	235	1,456,400	47	121,500	36	5,602,560	319
2. House Evacuation										
Building		2,250,000	37	83	0	0	13	29	50	113
House(100m2*P3500)I		175,000	98	17	10	2	18	3	126	22
(90m2*P2800)II		103,500	230	24	39	4	44	5	313	32
(70m2*P1500)III		52,500	413	22	130	7	69	4	612	32
(40m2*P 800)IV		16,000	964	15	302	5	159	3	1,425	23
Sub-Total			1,742	161	481	17	303	43	2,526	222
Total				396		65		80		541

Table 7.3.11 APPRAISED COMMERCIAL VALUE AND ECONOMIC COMPENSATION COST FOR AGNO RIVER

Description	Class	U.COST (Peso/m2)	Bayambang-Bypass		Alcala-Asingan		Asingan-San Manuel		Poponto Swamp		Total	
			Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)	Area (m2)	Cost (mil.Pesos)
1. Land Acquisition												
Residential	1	60.00	0	0	0	0	0	0	0	0	0	0
	2	40.00	508,305	20	322,680	13	40,000	2	0	0	870,985	35
	3	20.00	0	0	0	0	0	0	24,200	0	24,200	0
Farmland	1	1.80	0	0	0	0	0	0	0	0	0	0
	2	1.50	0	0	0	0	0	0	1,634,100	2	1,634,100	2
	3	1.20	3,160,890	4	457,670	1	2,253,500	3	0	0	5,872,060	7
Fishpond	1	3.00	0	0	0	0	0	0	0	0	0	0
	2	1.50	0	0	0	0	0	0	0	0	0	0
	3	1.00	9,000	0	0	0	0	0	0	0	9,000	0
Others		0.50	455,100	0	2,990	0	3,200,000	2	0	0	3,658,090	2
Sub-Total			4,133,295	24	783,340	13	5,493,500	6	1,658,300	3	12,068,435	47
2. House Evacuation												
Building		1,125,000	9	10	6	7	2	2	0	0	17	19
House(100m2*P3500)I		140,000	15	2	10	1	4	1	137	19	166	23
(90m2*P2800)II		81,000	60	5	36	3	14	1	806	65	916	74
(70m2*P1500)III		42,000	169	7	70	3	21	1	1,134	48	1,394	59
(40m2*P 800)IV		10,000	293	3	163	2	48	0	1,883	19	2,387	24
Sub-Total			546	27	285	16	89	5	3,960	151	4,880	199
Total				51		29		11		154		246

Table 7.3.12 APPRAISED COMMERCIAL VALUE AND ECONOMIC COMPENSATION COST FOR PANTAL-SINOCALAN RIVER

Description	Class	U.COST (Peso/m2)	Pantal-Sinocalan Area (m2)	Pantal-Sinocalan Cost (mil.Pesos)	Dagupan River Area (m2)	Dagupan River Cost (mil.Pesos)	Ingalera River Area (m2)	Ingalera River Cost (mil.Pesos)	Total Area (m2)	Total Cost (mil.Pesos)
1. Land Acquisition										
Residential	1	60.00	53,000	3	0	0	0	0	53,000	3
	2	40.00	668,400	27	0	0	378,000	15	1,046,400	42
	3	20.00	0	0	218,100	4	0	0	218,100	4
Farmland	1	1.80	1,028,100	2	0	0	428,000	1	1,456,100	3
	2	1.50	0	0	0	0	0	0	0	0
	3	1.20	337,160	0	431,800	1	0	0	768,960	1
Fishpond	1	3.00	315,500	1	0	0	0	0	315,500	1
	2	1.50	0	0	590,900	1	0	0	590,900	1
	3	1.00	0	0	201,600	0	0	0	201,600	0
Others		1.50	978,500	1	14,000	0	0	0	992,500	1
Sub-Total			3,380,660	35	1,456,400	6	806,000	16	5,643,060	56
2. House Evacuation					35		115		499	
Building		1,125,000	36	41	0	0	13	15	49	55
House(100m2*P3500)I		140,000	99	14	10	1	18	3	127	18
(90m2*P2800)II		81,000	235	19	39	3	44	4	318	26
(70m2*P1500)III		42,000	420	18	130	5	69	3	619	26
(40m2*P 800)IV		10,000	989	10	302	3	159	2	1,450	15
Sub-Total			1,779	101 0	481	13	303	25	2,563	139
Total				136		19		41		196



Note : For Financial Project Cost, all items Are included.
For Economic Project Cost, under lined items are excluded.

Fig. 7.1.1 CONSTITUTION OF PROJECT COST (CONTRACT SYSTEM)

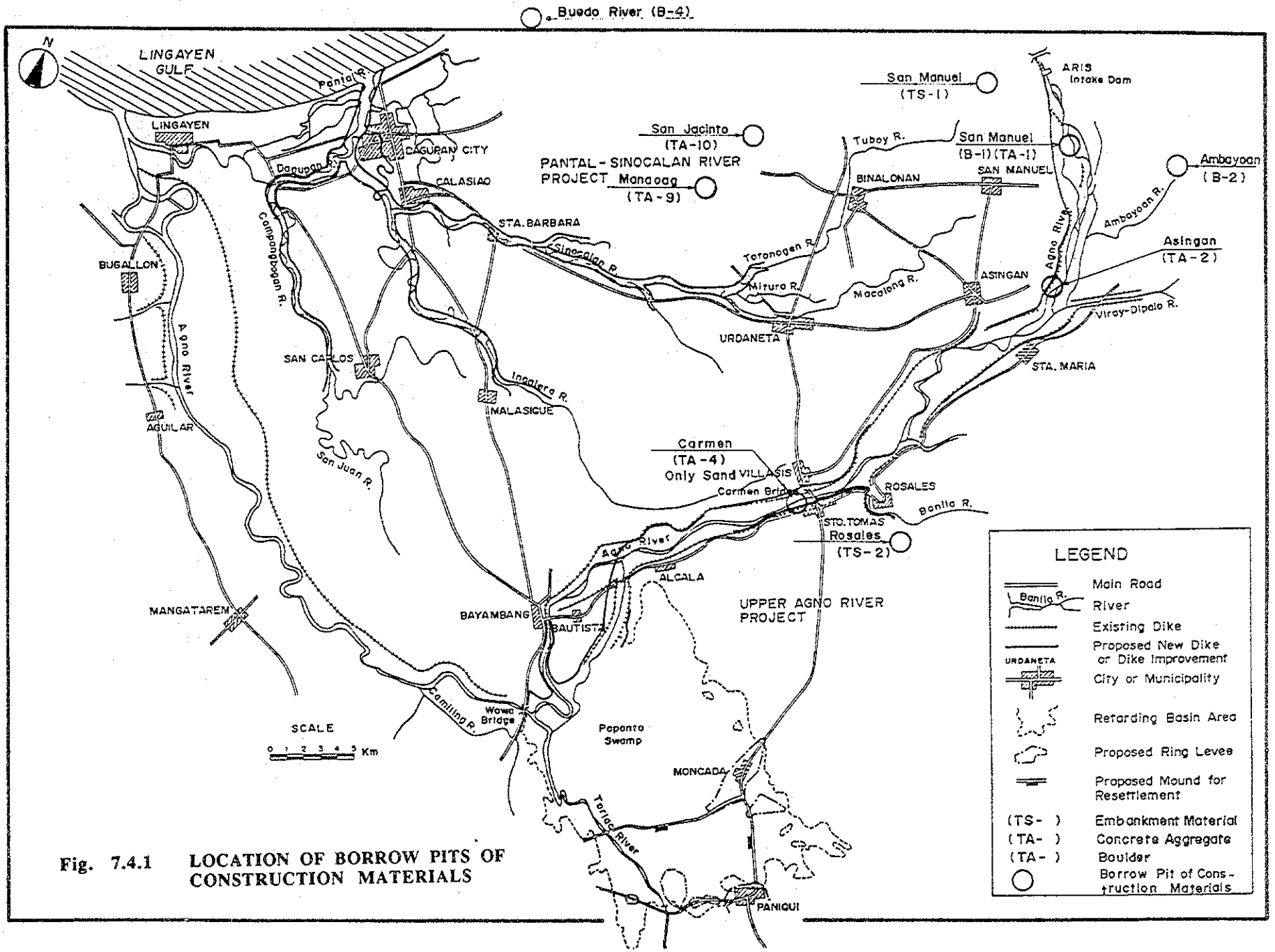


Fig. 7.4.1 LOCATION OF BORROW PITS OF CONSTRUCTION MATERIALS

		Unit	Quantity	1st Stage					2nd Stage				
				1st Year	2nd Year	3rd Year	4th Year	5th Year	1st Year	2nd Year	3rd Year	4th Year	5th Year
AG-1	(1) Excavation	cu.m	4,522,448										
	(2) Embankment	cu.m	1,487,503										
	(3) Revetment	m	8,964										
	(4) Bridge	sq.m	6,515										
AG-2	(1) Excavation	cu.m	1,024,075										
	(2) Embankment	cu.m	753,940										
	(3) Revetment	m	13,400										
	(4) Bridge	sq.m	3,180										
AG-3	(1) Excavation	cu.m	1,264,481										
	(2) Embankment	cu.m	407,066										
	(3) Revetment	m	11,000										
	(4) Bridge	sq.m	0										
AG-4	(1) Excavation	cu.m	0										
	(2) Embankment	cu.m	479,081										
	(3) Revetment	m	17,450										
	(4) Bridge	sq.m	0										
POPONTO SWAMP	(1) Excavation	cu.m	4,800										
	(2) Embankment	cu.m	1,355,810										
	(3) Revetment	m	719										
	(4) Bridge	sq.m	875										
	(5) Mound	cu.m	496,000										

Fig. 7.4.2 CONSTRUCTION TIME SCHEDULE OF UPPER AGNO RIVER

		Unit	Quantity	1st Stage					2nd Stage				
				1st Year	2nd Year	3rd Year	4th Year	5th Year	1st Year	2nd Year	3rd Year	4th Year	5th Year
PANTAL-SINOCALAN	(1) Excavation	cu.m	608,450										
	(2) Embankment	cu.m	2,314,500										
	(3) Revetment	m	15,640										
	(4) Bridge	sq.m	11,048										
DAGUPAN	(1) Excavation	cu.m	199,110										
	(2) Embankment	cu.m	1,680,100										
	(3) Revetment	m	5,760										
	(4) Bridge	sq.m	4,889										
INGALERA	(1) Excavation	cu.m	948,450										
	(2) Embankment	cu.m	293,150										
	(3) Revetment	m	2,520										
	(4) Bridge	sq.m	3,720										

Fig. 7.4.3 CONSTRUCTION TIME SCHEDULE OF PANTAL-SINOCALAN RIVER

8. PROJECT EVALUATION

8. PROJECT EVALUATION

8.1 Project Benefit

8.1.1 Framework of Benefit Analysis

Figure 8.1.1 provides a framework for benefit analysis of a flood control project. There are two types of flood control benefits: (a) direct benefits stemming from reduction or prevention of flood damages (deterrent effects); and (b) other benefits arising from positive effects of flood control.

Direct benefits refer to prevention or reduction of direct and indirect damages due to flood. Direct damage consists of: (a) agricultural damage to crops, livestock, and aquaculture; and (b) non-agricultural damage to houses, buildings and infrastructures. Indirect damage arises from suspension of economic activity; (c) additional transport expenditures owing to traffic blockades; and (d) costs of rescue and relief activities. Flood damage analysis provides a quantification of these benefits.

Other benefits also arise as a result of flood control. Acting as a growth catalyst to reinforce the development process in a given area, flood protection has beneficial effects. In the short run, these include: (a) land enhancement; (b) greater agricultural production; and (c) improved agricultural productivity. Long run effects include: (d) development of agro-industries and aqua-based industries; (e) changes in economic and employment structures; (f) increase in per capita income and consumption; and (g) improvement in quality of life. These effects can be attributed to flood protection in the sense that it makes possible, enhances, or accelerates their occurrence or development.

The benefits from these effects are difficult to quantify. Lack of time series data prevents use of correlation analysis to test the cause-and-effect relationships and to come out with estimating equations. In this regard, two methods have been tried to estimate these benefits: (a) Input-Output (I/O) analysis, and (b) "What-if cases". I/O analysis attempts to show the impact, particularly the linkage effects, of flood control as infrastructure projects. "What-if" cases use simplifying assumptions to

quantify several effects of flood control. The results are not intended to give precise figures but to come out with orders of magnitudes. Their utility lies in showing that the contribution and impact of flood control to socio-economic development is significant.

8.1.2 Estimation of Direct Benefits

(1) Results of Flood Damage Analysis

Flood damage analysis estimates the probable flood damages in the maximum inundation areas for flood frequencies of 1.05, 2, 5, 10, 25, 50, and 100 years. The amount of damages which can be prevented by structural measures constitute the direct benefits of flood control.

Probable and Annual Average Flood Damages (In Million Pesos)

Return Period (Year)	Upper Agno		Pantal-Sinocalan	
	Probable Flood Damage	Annual Average Flood Damage	Probable Flood Damage	Annual Average Flood Damage
1.05	101.0	0.0	0.0	0.0
2.00	250.0	79.1	501.0	113.2
5.00	705.0	222.7	791.0	307.5
10.00	1,196.0	317.6	985.0	396.1
25.00	1,579.0	400.9	1,206.0	461.3
50.00	1,976.0	436.3	1,509.0	488.5
100.00	2,277.0	457.7	1,706.0	504.4

In a 100-year flood return period the annual average flood damage was estimated at ₱457.7 million and ₱504.4 million in 1989 prices for the Upper Agno and the Pantal-Sinocalan basins, respectively, or an aggregate of ₱962.1 million for the two basins. In a 10-year flood return period, the cumulative annual average flood damages were placed at ₱317.6 million and ₱396.1 million from the Upper Agno and Pantal-Sinocalan basins, respectively, or some ₱713.7 million for both basins.

(2) Adjustments of Benefit Flows

The above magnitudes are the maximum benefits obtainable on the basis of flood damage analysis. Adjustments were made to reflect the flood protection level, service areas under the Priority Projects.

The benefit flow of the Upper Agno project is reduced by the negative benefits arising from the broader inundation area of the Poponto Swamp. Countermeasures such as ring levees and heightening of roads will recover some of the losses. The river improvement component of the Pantal-Sinocalan project does not extend up to the upper reaches of Ingalera, Macalong, Tagamusing, and Tuboy Rivers. This means a reduction in the Pantal-Sinocalan benefit flow.

In summary, the adjusted benefit flows in the 1991 price level come to ₱283.4 million and ₱207.0 million for the Upper Agno and Pantal-Sinocalan projects, respectively, or some ₱582.4 million for the two projects.

8.1.3 Estimation of Other Benefits

(1) Monetary Benefit

The potential contribution and impact of flood control to socio-economic development appears substantial. However, only the benefits due to the prevention of direct and indirect damages are quantifiable. The other benefits are less straightforward to quantify.

I/O analysis measures the linkage effects of flood control as an infrastructure project. Through the use of simplifying assumptions, quantification of the monetary impact of land enhancement, increased farm production, and greater farm productivity has been tried.

Beyond this, estimation of the long-run benefits has not been attempted. In this regard, the intention in making the I/O analysis and the "what-if" cases was not to augment the benefit flow by adding whatever is quantifiable from other benefits to the direct benefits. Rather, the intention was to demonstrate that it was realistic to use a growth factor for the benefit flow to reflect future development in an area that would be benefiting from flood control. The results of the I/O analysis and the "what-if" cases indicated that such growth was significant as seen in the linkage effects and in the measured monetary impact. Potential values that can be created are conservatively estimated at ₱1.1 billion annually exceeding the direct benefits derived in the flood damage analysis (refer to details in Section 5.5 of the Supporting Report, Socio-Economy).

Measured Monetary Impact of Other Benefits
Through Use of Simplifying Assumptions (P'000)

Benefits	Upper Agno	Pantal-Sinocalan	Cayanga-Pataran	Total
Land Enhancement	111,658	583,146	123,402	818,206
Greater Farm Production	15,383	35,187	10,977	61,547
Improved Farm Productivity	50,071	136,414	35,604	222,089
Total	177,112	754,747	169,983	1,101,842

The future growth of assets within the project beneficial areas will largely be a function of: (a) continued recovery of Pangasinan's and of the Ilocos Region's economies within the context of macroeconomic structural adjustments; and (b) the direction of Pangasinan's development from a largely agri-based economy to an agro-industrial one. Flood protection serves to reinforce the development process.

Hence, it is deemed conservative to use a growth factor for the benefit flow to reflect future development in an area that would benefit from flood control. This growth factor is assumed at 4.9% in real terms, the same rate as the projected real growth of GRDP (refer to Section 2.2.2).

(2) Other Intangible Benefits

Flood control will have long run, intangible effects, namely, enhancement of agricultural development, emergence of industries, structural changes in economic base and employment, increase in income and consumption, and improvement in quality of life. These have not been quantified.

Development of Agro-Industrialization

Increased agricultural production and productivity brought about by flood protection generates surpluses of farm produce that can be made available for agro-processing. The potential and comparative advantage for agro-based and aqua-based industries in Pangasinan, already substantial at present, becomes greater.

Changes in Economic and Job Structure

The emergence of more manufacturing and processing enterprises should slowly broaden the local economic base. The economic structure will gradually shift from largely agricultural-based to a broader-based economy; from cottage, craft-based industries to higher scale, greater value-added manufacturing industries.

Increase in Domestic Output, Income, and Consumption

Short-run improvements in farm production and productivity and long-run structural shifts will lead to increased domestic output and increased average household incomes. Following the first round of investments and expenditures, there will be additional rounds of spending, the so-called multiplier effects. This will expand the consumer markets of Pangasinan. Benefits to society also accrue in the form of an expanded revenue base.

Improvement in Quality of Life

All of the above will induce an improvement in the quality of life for Pangasinan's society. Higher incomes translate to improved living standards as workers enjoy greater access to social services such as health, nutrition, welfare, and education. Corollarily, the expanded tax base will increase government capability to provide social services.

8.2 Economic Benefit Cost Analysis

8.2.1 Methodology

Economic evaluation reviews the economic justification of the flood control projects by use of the cost-benefit analysis. The future benefit and cost streams are discounted to their present values and compared to assess economic efficiency on the basis of: (a) Economic Internal Rate of Return (EIRR) and (b) Net Present Value (NPV).

A project is considered acceptable (a) if the EIRR equals or exceeds the social discount rate; or (b) if the NPV is greater than zero. The social discount rate is defined as the opportunity cost of capital or the

rate of return at which the funds would have earned in its best alternative use. This is obtained from NEDA which currently sets it at 15%.

8.2.2 Project Economic Costs

In estimating project economic costs, all components of project costs have been included except for price contingencies, taxes, and profits. The recurrent costs comprise operations and maintenance of the flood control structures.

The cost estimates consist of the foreign currency portion and the local currency portion. Costs of construction equipment and construction materials account for the bulk of foreign costs. Labor costs and compensation costs make up most of local costs. The foreign currency portion and unskilled labor are reckoned in terms of shadow prices. Based on NEDA guidelines, a shadow price of 60% is set for unskilled labor, and 120% for foreign exchange component.

Summarized below are the economic cost estimates of the proposed Priority Projects:

Summary of Economic Cost (P'000,000)

	Upper Agno	Pantal-Sinocalan
Main Construction Costs	2,324	2,246
Other Costs		
Compensation	246	195
Administration	129	122
Physical Contingency	405	384
Engineering Services	372	359
Total Project Costs	3,476	3,307

8.2.3 Benefit Growth Factor and Cost-Benefit Criteria

(1) Growth Factor for Benefit Flows

Four cost-benefit runs are made on:

(i) Case A: Upper Agno project alone;

(ii) Case B: Pantal-Sinocalan project alone;

(iii) Case C: Upper Agno and Pantal-Sinocalan projects together (Simultaneous Implementation); and

(iv) Case D: Upper Agno and Pantal-Sinocalan combination but with the former project implemented ahead of the latter project by 5 years as is recommended in Section 9.1.

The most likely project implementation scenario is Case D: Combination/ Stepwise Implementation. However, the other cases are shown here to demonstrate varying conditions.

Further, the study employs two benefit flows:

(i) Case 1: Current Development Condition (Constant Benefit Flow)
This case assumes that the value of assets within the project beneficial areas remains unchanged through the project life.

(ii) Case 2: Future Development Condition (Future Benefit Flow)
This case assumes that the value of assets within the project beneficial area increases at 4.9%, the same rate as the likely GRDP growth rate.

The benefit flow of Case 2 is used in economic evaluation of the projects as it reflects the probable future development conditions within the beneficial areas. The benefit flow of Case 1 is used as supplementary information to gauge the possibility of reduced economic growth and to demonstrate viability under highly restrictive conditions.

For purposes of calculating an economic rate of return, only the direct benefits and the related costs have been included in the cost-benefit runs. The results of "what-if" cases serve to support the use of a growth factor for the benefit flow (refer to Section 8.1.3).

(2) Criteria in Cost-Benefit Analysis

The criteria in the cost-benefit analysis are as follows:

(i)	Base Year	Beginning of 1990.
(ii)	Project Life	50 years (from 1995-2044).
(iii)	Economic Life	50 years (from 1995-2044).
(iv)	Construction Period	10 years (starting 1995).
(v)	Disbursement Schedule	Uniform distribution of project costs during construction period.
(vi)	Annual Operation and Maintenance Cost	0.5% of main construction cost and physical contingency of completed works.
(vii)	Price Levels	Projections of costs and benefits based on 1991 price levels. Benefits which have been computed on the basis of 1989 prices, adjusted to 1991 prices, using the following price inflators: (a) 1990 = 13.0%; (b) 1991 = 17.0%
(viii)	Timing of Benefits	In proportion to works already completed.
(ix)	Growth Factor (GF) of Benefit Flow	(a) Constant (GF = 1.0); and (b) GRDP Growth (GF = 1.049).
(x)	Social Discount Rate	15%.
(xi)	Foreign Currency Conversion Rates	US$1.00 = ₱ 27.80 = ¥ 137.

8.2.4 Results of the Cost-Benefit Analysis

The results of the cost-benefit analysis are detailed in Tables 8.2.1 to 8.2.8 and summarized in the following page.

Costs and Benefits of Priority Projects

Priority Project	Case 1 Current Development	Case 2 Future Development
Case A: Upper Agno		
Costs (Million Pesos)	3,476	3,476
Benefits (Million Pesos/year)	283	283
EIRR (%)	10.32	20.58
NPV (Million Pesos)	(532)	976
Case B: Pantal-Sinocalan		
Costs (Million Pesos)	3,307	3,307
Benefits (Million Pesos/year)	207	207
EIRR (%)	7.64	16.96
NPV (Million Pesos)	(783)	318
Case C: Combination/ Simultaneous Implementation		
Costs (Million Pesos)	6,783	6,783
Benefits (Million Pesos/year)	490	490
EIRR (%)	9.03	18.83
NPV (Million Pesos)	(1,315)	1,295
Case D: Combination/ Stepwise Implementation		
Costs (Million Pesos)	6,783	6,783
Benefits (Million Pesos/year)	490	490
EIRR (%)	9.29	20.47
NPV (Million Pesos)	(922)	1,393

Under the Current Development Condition, none of the cases shows positive NPV and EIRRs higher than 15%. The highest EIRR under this condition is at 10.32% for Case A1: Upper Agno project.

Under the Future Development Condition, Case A2 has the highest EIRR at 20.58%. Flood conditions, however, warrant implementing Upper Agno project before Pantal-Sinocalan project. Case B2 has a lower EIRR at 16.96%.

Case D2: Stepwise Implementation shows an EIRR of 20.47%, higher than the 18.83% EIRR of Case C2: Simultaneous Implementation. Cost-benefit analysis appears to validate the stepwise implementation, considering that it has the second highest EIRR but the highest NPV. Case D2 is also the most appropriate from the viewpoint of GOP's budget considerations. Therefore, it will be the best choice for GOP.

8.2.5 Sensitivity Analysis

Table 8.2.9 shows the sensitivity of Case D2, taken as the best option, to possible changes in future economic conditions. The results are summarized below:

Sensitivity Analysis	EIRR (%)
Base Case	20.47
Case 1: 10% Increase in Costs	19.07
Case 2: Reduction in Growth Factor to 3.9%	18.10

The Project is highly sensitive to an economic slowdown as it will mean a slowdown in the growth of assets within the project beneficial areas. Every 1% decline in the growth factor leads to a 2.37 basis point decrease in EIRR. The Project is less sensitive to changes in costs. Every 10% increase in costs leads to a 1.4 basis point reduction in EIRR.

Nonetheless, the Project remains viable under both conditions.

8.3 Evaluation of Socio-Economic Impact of the Project

8.3.1 General

The two priority projects are expected to have significant effects on socio-economic conditions, not only in the project beneficial areas, but also in the Impact Area as a whole. There will be negative as well as positive social impacts on human settlements, labor and employment, urbanization, living standards and poverty incidence, social services, vital rates, and population.

Spread effects are also likely, given the standing of Pangasinan as the premier province of the Ilocos Region. Moreover, the strategic location of the river basins in the heartland of Luzon gives rise to an external effect that extends beyond the confines of the province itself.

8.3.2 Impact on Socio-Economic Conditions

(1) Social Costs

The proposed flood control works will have adverse effects on specific areas. Table 8.3.1 summarizes the affected population and properties. Government authorities will have to initiate public hearings to discuss the probable social and environmental impacts of the projects and thereby design programs that will mitigate the adverse effects. These social impact includes enchroachment of land, inundation of land, social conflicts arising from land acquisition and Resettlement, damage to infrastructures, incidence of diseases, water right conflicts, and seawater intrusion, and is described in Section 6.3.

(2) Social Benefits

The social benefits are expected to outweigh these social costs.

Effect on Human Settlements

With the flood control works, river basin communities will be less troubled by the onset of the typhoon season. Flood damage analysis reveals that estimates of persons affected by floods range from 61,000 to 1,589,000 depending on the flood return period. Likewise, there will be less casualties, deaths, and illnesses due to floods. Flood protection will reduce casualty, mortality, and morbidity rates significantly. Economic activity will also greatly stabilize.

Effect on Labor and Employment

Flood protection will have several effects on labor and employment. The first run effect is on construction work opportunities arising from the flood control projects. During project implementation, a large number of skilled and unskilled workers will be needed. After construction, authorities need to hire additional staff to operate and maintain the facilities.

The second run effect is on work opportunities stemming from increased

farm production, although this should be weighed against the loss of jobs arising from the encroachment of certain farmlands and fishponds. But the third run, and perhaps most significant effect, is on jobs arising from changes in the economic and job structure.

Effect on Urbanization

The probable immigration of workers and shifts in agricultural-nonagricultural labor force will accelerate the pace of urbanization. This is often an attendant consequence of industrialization. The emergence of Dagupan City, San Carlos City, and Urdaneta, as well as Alaminos and Sual which are both outside the beneficial areas, as urban centers of note is expected.

Effect on Living Standards and Poverty Incidence

If the expected increases in business economic activity, improvement in economic performance, and gains in incomes materialize from the fuller exploitation of river basin potentials, there will be a significant improvement in living standards and a decrease in poverty incidence. This is the expected "trickle-down" effect of the benefits expected from the flood control projects in long run.

Effect on Social Services

Demand for social services will increase due to a growing population and increasing purchasing power. Appreciating land values and higher incomes will substantially increase revenues, enhancing the government's capability to deliver basic services.

Effect on Vital Rates and Population

A direct consequence is the reduction of flood-related deaths and casualties, although areas near Poponto might see an increase in water-borne sicknesses.

In the long run, access to social services should improve vital rates such as life expectancy at birth, crude death rates, and infant mortality

rates. The general improvement in health and welfare is already evident without the projects. This will manifest more with the projects.

Combined with the expected reversal of the outmigration patterns in Ilocos Region and Pangasinan, improved health conditions will lead to population growth in the river basin communities higher than that projected by NEDA.

8.3.3 Spread Effects: Impact on the Regional and Macro Economies

(1) Impact on the Regional Economy

If flood control succeeds in containing damages, the basin economy of Pangasinan will become more productive. With the province generating agricultural surpluses, the economic basis for processing and trading of farm produce will become stronger.

In this context, agriculture will live up to its defined development role as the lead sector to stimulate regional growth. With rural development spurring indigenous industries, Dagupan City, San Carlos City, Urdaneta, Alaminos, and Sual as agro-processing centers in the province will eventually emerge and develop linkages with the proposed RIC in San Fernando and the emerging industrial estates in Poro Point and Rosario (refer to Section 2.1.3). Spread effects of flood protection will come in terms of stronger intra-regional links for the production, processing and distribution of goods.

In short, flood protection allows Pangasinan's river basin economy to achieve its potentials and this, in turn, makes it possible for the province to set a faster growth for the Ilocos Region. The regional economy will then be able to meet, and perhaps even exceed, the projected GRDP growth.

(2) Impact on the National Economy

Stronger Pangasinan-led regional growth will contribute to attaining national development goals, as Ilocos will then be able to cast off its lagging performance. This will allow Ilocos to bridge the development gap with the more advanced regions of the country. Inter-regional commerce and

trade should increase. The expanded consumer markets will redound to the benefit of the national economy.

A positive external effect arises from the strategic location of the river basins. These straddle the vital North-South trunkline roads passing through Urdaneta and Dagupan City and linking points of Northern Luzon with points in the southern part of the island. Given this spatial dimension, floods particularly in the Upper Agno area lead to widespread traffic blockades and affect the land flow of goods and services throughout the Luzon heartland.

Considering that the river basins are located in the middle of the North-South road axis, the impact of flood control is likely to be felt beyond the confines of the region and to the other points of Luzon.

Table 8.2.1 COST-BENEFIT ANALYSIS : AGNO RIVER BASIN FLOOD CONTROL PROJECT

CASE A1 : UPPER AGNO PROJECT (CONSTANT GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Upper Agno	GROWTH FACTOR	1.000
Main Constr Costs	2,324	2000	1.000
Other Costs	1,152	2010	1.000
Total Costs	3,476	2045	1.000
ANNUAL BENEFITS			
1989 Prices	283	CALCULATED EIRR	10.32%
1991 Prices	375	CALCULATED NPV	(532)

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.000
3	1993						1.000
4	1994						1.000
5	1995	347.60	0.00	347.60	0.00	(347.60)	1.000
6	1996	347.60	1.16	348.76	37.47	(311.29)	1.000
7	1997	347.60	2.32	349.92	74.94	(274.99)	1.000
8	1998	347.60	3.49	351.09	112.40	(238.68)	1.000
9	1999	347.60	4.65	352.25	149.87	(202.37)	1.000
10	2000	347.60	5.81	353.41	187.34	(166.07)	1.000
11	2001	347.60	6.97	354.57	224.81	(129.76)	1.000
12	2002	347.60	8.13	355.73	262.28	(93.46)	1.000
13	2003	347.60	9.30	356.90	299.75	(57.15)	1.000
14	2004	347.60	10.46	358.06	337.21	(20.84)	1.000
15	2005		11.62	11.62	374.68	363.06	1.000
16	2006		11.62	11.62	374.68	363.06	1.000
17	2007		11.62	11.62	374.68	363.06	1.000
18	2008		11.62	11.62	374.68	363.06	1.000
19	2009		11.62	11.62	374.68	363.06	1.000
20	2010		11.62	11.62	374.68	363.06	1.000
21	2011		11.62	11.62	374.68	363.06	1.000
22	2012		11.62	11.62	374.68	363.06	1.000
23	2013		11.62	11.62	374.68	363.06	1.000
24	2014		11.62	11.62	374.68	363.06	1.000
25	2015		11.62	11.62	374.68	363.06	1.000
26	2016		11.62	11.62	374.68	363.06	1.000
27	2017		11.62	11.62	374.68	363.06	1.000
28	2018		11.62	11.62	374.68	363.06	1.000
29	2019		11.62	11.62	374.68	363.06	1.000
30	2020		11.62	11.62	374.68	363.06	1.000
31	2021		11.62	11.62	374.68	363.06	1.000
32	2022		11.62	11.62	374.68	363.06	1.000
33	2023		11.62	11.62	374.68	363.06	1.000
34	2024		11.62	11.62	374.68	363.06	1.000
35	2025		11.62	11.62	374.68	363.06	1.000
36	2026		11.62	11.62	374.68	363.06	1.000
37	2027		11.62	11.62	374.68	363.06	1.000
38	2028		11.62	11.62	374.68	363.06	1.000
39	2029		11.62	11.62	374.68	363.06	1.000
40	2030		11.62	11.62	374.68	363.06	1.000
41	2031		11.62	11.62	374.68	363.06	1.000
42	2032		11.62	11.62	374.68	363.06	1.000
43	2033		11.62	11.62	374.68	363.06	1.000
44	2034		11.62	11.62	374.68	363.06	1.000
45	2035		11.62	11.62	374.68	363.06	1.000
46	2036		11.62	11.62	374.68	363.06	1.000
47	2037		11.62	11.62	374.68	363.06	1.000
48	2038		11.62	11.62	374.68	363.06	1.000
49	2039		11.62	11.62	374.68	363.06	1.000
50	2040		11.62	11.62	374.68	363.06	1.000
51	2041		11.62	11.62	374.68	363.06	1.000
52	2042		11.62	11.62	374.68	363.06	1.000
53	2043		11.62	11.62	374.68	363.06	1.000
54	2044		11.62	11.62	374.68	363.06	1.000

Table 8.2.2 COST-BENEFIT ANALYSIS : AGNO RIVER BASIN FLOOD CONTROL PROJECT

CASE A2 : UPPER AGNO PROJECT (FUTURE GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Upper Agno	GROWTH FACTOR	1.049
Main Constr Costs	2,324	2000	1.538
Other Costs	1,152	2010	2.482
Total Costs	3,476	2045	12.621
ANNUAL BENEFITS			
1989 Prices	283	CALCULATED EIRR	20.58%
1991 Prices	375	CALCULATED NPV	976

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.049
3	1993						1.100
4	1994						1.154
5	1995	347.60	0.00	347.60	0.00	(347.60)	1.211
6	1996	347.60	1.16	348.76	47.59	(301.17)	1.270
7	1997	347.60	2.32	349.92	99.85	(250.07)	1.332
8	1998	347.60	3.49	351.09	157.11	(193.97)	1.398
9	1999	347.60	4.65	352.25	219.75	(132.50)	1.466
10	2000	347.60	5.81	353.41	288.15	(65.26)	1.538
11	2001	347.60	6.97	354.57	362.72	8.15	1.613
12	2002	347.60	8.13	355.73	443.91	88.17	1.693
13	2003	347.60	9.30	356.90	532.18	175.29	1.775
14	2004	347.60	10.46	358.06	628.04	269.98	1.862
15	2005		11.62	11.62	732.02	720.40	1.954
16	2006		11.62	11.62	767.89	756.27	2.049
17	2007		11.62	11.62	805.51	793.89	2.150
18	2008		11.62	11.62	844.98	833.36	2.255
19	2009		11.62	11.62	886.39	874.77	2.366
20	2010		11.62	11.62	929.82	918.20	2.482
21	2011		11.62	11.62	975.38	963.76	2.603
22	2012		11.62	11.62	1,023.17	1,011.55	2.731
23	2013		11.62	11.62	1,073.31	1,061.69	2.865
24	2014		11.62	11.62	1,125.90	1,114.28	3.005
25	2015		11.62	11.62	1,181.07	1,169.45	3.152
26	2016		11.62	11.62	1,238.94	1,227.32	3.307
27	2017		11.62	11.62	1,299.65	1,288.03	3.469
28	2018		11.62	11.62	1,363.33	1,351.71	3.639
29	2019		11.62	11.62	1,430.14	1,418.52	3.817
30	2020		11.62	11.62	1,500.21	1,488.59	4.004
31	2021		11.62	11.62	1,573.72	1,562.10	4.200
32	2022		11.62	11.62	1,650.84	1,639.22	4.406
33	2023		11.62	11.62	1,731.73	1,720.11	4.622
34	2024		11.62	11.62	1,816.58	1,804.96	4.848
35	2025		11.62	11.62	1,905.60	1,893.98	5.086
36	2026		11.62	11.62	1,998.97	1,987.35	5.335
37	2027		11.62	11.62	2,096.92	2,085.30	5.597
38	2028		11.62	11.62	2,199.67	2,188.05	5.871
39	2029		11.62	11.62	2,307.45	2,295.83	6.158
40	2030		11.62	11.62	2,420.52	2,408.90	6.460
41	2031		11.62	11.62	2,539.12	2,527.50	6.777
42	2032		11.62	11.62	2,663.54	2,651.92	7.109
43	2033		11.62	11.62	2,794.05	2,782.43	7.457
44	2034		11.62	11.62	2,930.96	2,919.34	7.823
45	2035		11.62	11.62	3,074.58	3,062.96	8.206
46	2036		11.62	11.62	3,225.23	3,213.61	8.608
47	2037		11.62	11.62	3,383.27	3,371.65	9.030
48	2038		11.62	11.62	3,549.05	3,537.43	9.472
49	2039		11.62	11.62	3,722.95	3,711.33	9.936
50	2040		11.62	11.62	3,905.38	3,893.76	10.423
51	2041		11.62	11.62	4,096.74	4,085.12	10.934
52	2042		11.62	11.62	4,297.48	4,285.86	11.470
53	2043		11.62	11.62	4,508.06	4,496.44	12.032
54	2044		11.62	11.62	4,728.95	4,717.33	12.621

Table 8.2.3 COST-BENEFIT ANALYSIS : AGNO RIVER BASIN FLOOD CONTROL PROJECT

CASE B1 : PANTAL-SINOCALAN PROJECT (CONSTANT GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Panto-Sino	GROWTH FACTOR	1.000
Main Construction Costs	2,246	2000	1.000
Other Costs	1,061	2010	1.000
Total Costs	3,307	2045	1.000
ANNUAL BENEFITS			
1989 Prices	207	CALCULATED EIRR	7.64%
1991 Prices	274	CALCULATED NPV	(783)

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.000
3	1993						1.000
4	1994						1.000
5	1995	330.70	0.00	330.70	0.00	(330.70)	1.000
6	1996	330.70	1.12	331.82	27.37	(304.46)	1.000
7	1997	330.70	2.25	332.95	54.73	(278.21)	1.000
8	1998	330.70	3.37	334.07	82.10	(251.97)	1.000
9	1999	330.70	4.49	335.19	109.47	(225.72)	1.000
10	2000	330.70	5.62	336.32	136.84	(199.48)	1.000
11	2001	330.70	6.74	337.44	164.20	(173.23)	1.000
12	2002	330.70	7.86	338.56	191.57	(146.99)	1.000
13	2003	330.70	8.98	339.68	218.94	(120.74)	1.000
14	2004	330.70	10.11	340.81	246.31	(94.50)	1.000
15	2005		11.23	11.23	273.67	262.44	1.000
16	2006		11.23	11.23	273.67	262.44	1.000
17	2007		11.23	11.23	273.67	262.44	1.000
18	2008		11.23	11.23	273.67	262.44	1.000
19	2009		11.23	11.23	273.67	262.44	1.000
20	2010		11.23	11.23	273.67	262.44	1.000
21	2011		11.23	11.23	273.67	262.44	1.000
22	2012		11.23	11.23	273.67	262.44	1.000
23	2013		11.23	11.23	273.67	262.44	1.000
24	2014		11.23	11.23	273.67	262.44	1.000
25	2015		11.23	11.23	273.67	262.44	1.000
26	2016		11.23	11.23	273.67	262.44	1.000
27	2017		11.23	11.23	273.67	262.44	1.000
28	2018		11.23	11.23	273.67	262.44	1.000
29	2019		11.23	11.23	273.67	262.44	1.000
30	2020		11.23	11.23	273.67	262.44	1.000
31	2021		11.23	11.23	273.67	262.44	1.000
32	2022		11.23	11.23	273.67	262.44	1.000
33	2023		11.23	11.23	273.67	262.44	1.000
34	2024		11.23	11.23	273.67	262.44	1.000
35	2025		11.23	11.23	273.67	262.44	1.000
36	2026		11.23	11.23	273.67	262.44	1.000
37	2027		11.23	11.23	273.67	262.44	1.000
38	2028		11.23	11.23	273.67	262.44	1.000
39	2029		11.23	11.23	273.67	262.44	1.000
40	2030		11.23	11.23	273.67	262.44	1.000
41	2031		11.23	11.23	273.67	262.44	1.000
42	2032		11.23	11.23	273.67	262.44	1.000
43	2033		11.23	11.23	273.67	262.44	1.000
44	2034		11.23	11.23	273.67	262.44	1.000
45	2035		11.23	11.23	273.67	262.44	1.000
46	2036		11.23	11.23	273.67	262.44	1.000
47	2037		11.23	11.23	273.67	262.44	1.000
48	2038		11.23	11.23	273.67	262.44	1.000
49	2039		11.23	11.23	273.67	262.44	1.000
50	2040		11.23	11.23	273.67	262.44	1.000
51	2041		11.23	11.23	273.67	262.44	1.000
52	2042		11.23	11.23	273.67	262.44	1.000
53	2043		11.23	11.23	273.67	262.44	1.000
54	2044		11.23	11.23	273.67	262.44	1.000

Table 8.2.4 COST-BENEFIT ANALYSIS : AGNO RIVER BASIN FLOOD CONTROL PROJECT

CASE B2 : PANTAL-SINOCALAN PROJECT (FUTURE GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Panto-Sino	GROWTH FACTOR	
Main Construction Costs	2,246	2000	1.049
Other Costs	1,061	2010	1.538
Total Costs	3,307	2045	2.482
ANNUAL BENEFITS			12.621
1989 Prices	207	CALCULATED EIRR	16.96%
1991 Prices	274	CALCULATED NPV	318

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.049
3	1993						1.100
4	1994						1.154
5	1995	330.70	0.00	330.70	0.00	(330.70)	1.211
6	1996	330.70	1.12	331.82	34.76	(297.06)	1.270
7	1997	330.70	2.25	332.95	72.93	(260.01)	1.332
8	1998	330.70	3.37	334.07	114.76	(219.31)	1.398
9	1999	330.70	4.49	335.19	160.51	(174.68)	1.466
10	2000	330.70	5.62	336.32	210.47	(125.85)	1.538
11	2001	330.70	6.74	337.44	264.94	(72.50)	1.613
12	2002	330.70	7.86	338.56	324.24	(14.32)	1.693
13	2003	330.70	8.98	339.68	388.71	49.03	1.775
14	2004	330.70	10.11	340.81	458.73	117.92	1.862
15	2005		11.23	11.23	534.68	523.45	1.954
16	2006		11.23	11.23	560.88	549.65	2.049
17	2007		11.23	11.23	588.36	577.13	2.150
18	2008		11.23	11.23	617.19	605.96	2.255
19	2009		11.23	11.23	647.43	636.20	2.366
20	2010		11.23	11.23	679.16	667.93	2.482
21	2011		11.23	11.23	712.43	701.20	2.603
22	2012		11.23	11.23	747.34	736.11	2.731
23	2013		11.23	11.23	783.96	772.73	2.865
24	2014		11.23	11.23	822.38	811.15	3.005
25	2015		11.23	11.23	862.67	851.44	3.152
26	2016		11.23	11.23	904.94	893.71	3.307
27	2017		11.23	11.23	949.29	938.06	3.469
28	2018		11.23	11.23	995.80	984.57	3.639
29	2019		11.23	11.23	1,044.60	1,033.37	3.817
30	2020		11.23	11.23	1,095.78	1,084.55	4.004
31	2021		11.23	11.23	1,149.47	1,138.24	4.200
32	2022		11.23	11.23	1,205.80	1,194.57	4.406
33	2023		11.23	11.23	1,264.88	1,253.65	4.622
34	2024		11.23	11.23	1,326.86	1,315.63	4.848
35	2025		11.23	11.23	1,391.88	1,380.65	5.086
36	2026		11.23	11.23	1,460.08	1,448.85	5.335
37	2027		11.23	11.23	1,531.62	1,520.39	5.597
38	2028		11.23	11.23	1,606.67	1,595.44	5.871
39	2029		11.23	11.23	1,685.40	1,674.17	6.158
40	2030		11.23	11.23	1,767.99	1,756.76	6.460
41	2031		11.23	11.23	1,854.62	1,843.39	6.777
42	2032		11.23	11.23	1,945.49	1,934.26	7.109
43	2033		11.23	11.23	2,040.82	2,029.59	7.457
44	2034		11.23	11.23	2,140.82	2,129.59	7.823
45	2035		11.23	11.23	2,245.72	2,234.49	8.206
46	2036		11.23	11.23	2,355.76	2,344.53	8.608
47	2037		11.23	11.23	2,471.20	2,459.97	9.030
48	2038		11.23	11.23	2,592.28	2,581.05	9.472
49	2039		11.23	11.23	2,719.31	2,708.08	9.936
50	2040		11.23	11.23	2,852.55	2,841.32	10.423
51	2041		11.23	11.23	2,992.33	2,981.10	10.934
52	2042		11.23	11.23	3,138.95	3,127.72	11.470
53	2043		11.23	11.23	3,292.76	3,281.53	12.032
54	2044		11.23	11.23	3,454.10	3,442.87	12.621

Table 8.2.5 COST-BENEFIT ANALYSIS : AGNO RIVER BASIN FLOOD CONTROL PROJECT

CASE C1 : SIMULTANEOUS IMPLEMENTATION (CONSTANT GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Upper Agno	Panto-Sino	GROWTH FACTOR	
Main Constr Costs	2,324	2,246	2000	1.000
Other Costs	1,152	1,061	2010	1.000
Total Costs	3,476	3,307	2045	1.000
ANNUAL BENEFITS				
1989 Prices	283	207	CALCULATED EIRR	9.03%
1991 Prices	375	274	CALCULATED NPV	(1,315)

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.000
3	1993						1.000
4	1994						1.000
5	1995	678.30	0.00	678.30	0.00	(678.30)	1.000
6	1996	678.30	2.29	680.58	64.84	(615.75)	1.000
7	1997	678.30	4.57	682.87	129.67	(553.20)	1.000
8	1998	678.30	6.86	685.16	194.51	(490.65)	1.000
9	1999	678.30	9.14	687.44	259.34	(428.10)	1.000
10	2000	678.30	11.43	689.72	324.18	(365.55)	1.000
11	2001	678.30	13.71	692.01	389.01	(303.00)	1.000
12	2002	678.30	16.00	694.30	453.85	(240.44)	1.000
13	2003	678.30	18.28	696.58	518.69	(177.89)	1.000
14	2004	678.30	20.57	698.87	583.52	(115.34)	1.000
15	2005		22.85	22.85	648.36	625.51	1.000
16	2006		22.85	22.85	648.36	625.51	1.000
17	2007		22.85	22.85	648.36	625.51	1.000
18	2008		22.85	22.85	648.36	625.51	1.000
19	2009		22.85	22.85	648.36	625.51	1.000
20	2010		22.85	22.85	648.36	625.51	1.000
21	2011		22.85	22.85	648.36	625.51	1.000
22	2012		22.85	22.85	648.36	625.51	1.000
23	2013		22.85	22.85	648.36	625.51	1.000
24	2014		22.85	22.85	648.36	625.51	1.000
25	2015		22.85	22.85	648.36	625.51	1.000
26	2016		22.85	22.85	648.36	625.51	1.000
27	2017		22.85	22.85	648.36	625.51	1.000
28	2018		22.85	22.85	648.36	625.51	1.000
29	2019		22.85	22.85	648.36	625.51	1.000
30	2020		22.85	22.85	648.36	625.51	1.000
31	2021		22.85	22.85	648.36	625.51	1.000
32	2022		22.85	22.85	648.36	625.51	1.000
33	2023		22.85	22.85	648.36	625.51	1.000
34	2024		22.85	22.85	648.36	625.51	1.000
35	2025		22.85	22.85	648.36	625.51	1.000
36	2026		22.85	22.85	648.36	625.51	1.000
37	2027		22.85	22.85	648.36	625.51	1.000
38	2028		22.85	22.85	648.36	625.51	1.000
39	2029		22.85	22.85	648.36	625.51	1.000
40	2030		22.85	22.85	648.36	625.51	1.000
41	2031		22.85	22.85	648.36	625.51	1.000
42	2032		22.85	22.85	648.36	625.51	1.000
43	2033		22.85	22.85	648.36	625.51	1.000
44	2034		22.85	22.85	648.36	625.51	1.000
45	2035		22.85	22.85	648.36	625.51	1.000
46	2036		22.85	22.85	648.36	625.51	1.000
47	2037		22.85	22.85	648.36	625.51	1.000
48	2038		22.85	22.85	648.36	625.51	1.000
49	2039		22.85	22.85	648.36	625.51	1.000
50	2040		22.85	22.85	648.36	625.51	1.000
51	2041		22.85	22.85	648.36	625.51	1.000
52	2042		22.85	22.85	648.36	625.51	1.000
53	2043		22.85	22.85	648.36	625.51	1.000
54	2044		22.85	22.85	648.36	625.51	1.000

Table 8.2.6 COST-BENEFIT ANALYSIS : AGNO RIVER BASIN FLOOD CONTROL PROJECT

CASE C2 : SIMULTANEOUS IMPLEMENTATION (FUTURE GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Upper Agno	Panto-Sino	GROWTH FACTOR	
Main Constr Costs	2,324	2,246	2000	1.049
Other Costs	1,152	1,061	2010	1.538
Total Costs	3,476	3,307	2045	2.482
ANNUAL BENEFITS				12.621
1989 Prices	283	207	CALCULATED EIRR	18.83%
1991 Prices	375	274	CALCULATED NPV	1,295

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.049
3	1993						1.100
4	1994						1.154
5	1995	678.30	0.00	678.30	0.00	(678.30)	1.211
6	1996	678.30	2.29	680.58	82.36	(598.23)	1.270
7	1997	678.30	4.57	682.87	172.78	(510.09)	1.332
8	1998	678.30	6.86	685.16	271.87	(413.28)	1.398
9	1999	678.30	9.14	687.44	380.26	(307.18)	1.466
10	2000	678.30	11.43	689.72	498.61	(191.11)	1.538
11	2001	678.30	13.71	692.01	627.65	(64.36)	1.613
12	2002	678.30	16.00	694.30	768.14	73.85	1.693
13	2003	678.30	18.28	696.58	920.90	224.32	1.775
14	2004	678.30	20.57	698.87	1,086.77	387.91	1.862
15	2005		22.85	22.85	1,266.69	1,243.84	1.954
16	2006		22.85	22.85	1,328.76	1,305.91	2.049
17	2007		22.85	22.85	1,393.87	1,371.02	2.150
18	2008		22.85	22.85	1,462.17	1,439.32	2.255
19	2009		22.85	22.85	1,533.82	1,510.97	2.366
20	2010		22.85	22.85	1,608.97	1,586.12	2.482
21	2011		22.85	22.85	1,687.81	1,664.96	2.603
22	2012		22.85	22.85	1,770.52	1,747.67	2.731
23	2013		22.85	22.85	1,857.27	1,834.42	2.865
24	2014		22.85	22.85	1,948.28	1,925.43	3.005
25	2015		22.85	22.85	2,043.74	2,020.89	3.152
26	2016		22.85	22.85	2,143.89	2,121.04	3.307
27	2017		22.85	22.85	2,248.94	2,226.09	3.469
28	2018		22.85	22.85	2,359.14	2,336.29	3.639
29	2019		22.85	22.85	2,474.73	2,451.88	3.817
30	2020		22.85	22.85	2,596.00	2,573.15	4.004
31	2021		22.85	22.85	2,723.20	2,700.35	4.200
32	2022		22.85	22.85	2,856.64	2,833.79	4.406
33	2023		22.85	22.85	2,996.61	2,973.76	4.622
34	2024		22.85	22.85	3,143.45	3,120.60	4.848
35	2025		22.85	22.85	3,297.47	3,274.62	5.086
36	2026		22.85	22.85	3,459.05	3,436.20	5.335
37	2027		22.85	22.85	3,628.54	3,605.69	5.597
38	2028		22.85	22.85	3,806.34	3,783.49	5.871
39	2029		22.85	22.85	3,992.85	3,970.00	6.158
40	2030		22.85	22.85	4,188.50	4,165.65	6.460
41	2031		22.85	22.85	4,393.74	4,370.89	6.777
42	2032		22.85	22.85	4,609.03	4,586.18	7.109
43	2033		22.85	22.85	4,834.88	4,812.03	7.457
44	2034		22.85	22.85	5,071.78	5,048.93	7.823
45	2035		22.85	22.85	5,320.30	5,297.45	8.206
46	2036		22.85	22.85	5,581.00	5,558.15	8.608
47	2037		22.85	22.85	5,854.47	5,831.62	9.030
48	2038		22.85	22.85	6,141.33	6,118.48	9.472
49	2039		22.85	22.85	6,442.26	6,419.41	9.936
50	2040		22.85	22.85	6,757.93	6,735.08	10.423
51	2041		22.85	22.85	7,089.07	7,066.22	10.934
52	2042		22.85	22.85	7,436.43	7,413.58	11.470
53	2043		22.85	22.85	7,800.82	7,777.97	12.032
54	2044		22.85	22.85	8,183.06	8,160.21	12.621

Table 8.2.7 COST-BENEFIT ANALYSIS : AGNO RIVER FLOOD CONTROL PROJECT

CASE D1 : STEPWISE IMPLEMENTATION (CONSTANT GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Upper Agno	Panto-Sino	GROWTH FACTOR	1
Main Constr Costs	2,324	2,246	2000	1.000
Other Costs	1,152	1,061	2010	1.000
Total Costs	3,476	3,307	2045	1.000
ANNUAL BENEFITS				
1989 Prices	283	207	CALCULATED EIRR	9.29%
1991 Prices	375	274	CALCULATED NPV	(922)

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.000
3	1993						1.000
4	1994						1.000
5	1995	347.60	0.00	347.60	0.00	(347.60)	1.000
6	1996	347.60	1.16	348.76	37.47	(311.29)	1.000
7	1997	347.60	2.32	349.92	74.94	(274.99)	1.000
8	1998	347.60	3.49	351.09	112.40	(238.68)	1.000
9	1999	347.60	4.65	352.25	149.87	(202.37)	1.000
10	2000	678.30	5.81	684.11	187.34	(496.77)	1.000
11	2001	678.30	8.10	686.40	252.18	(434.22)	1.000
12	2002	678.30	10.38	688.68	317.01	(371.67)	1.000
13	2003	678.30	12.67	690.96	381.85	(309.12)	1.000
14	2004	678.30	14.95	693.25	446.68	(246.57)	1.000
15	2005	330.70	17.24	347.94	511.52	163.59	1.000
16	2006	330.70	18.36	349.06	538.89	189.83	1.000
17	2007	330.70	19.48	350.18	566.26	216.07	1.000
18	2008	330.70	20.60	351.30	593.62	242.32	1.000
19	2009	330.70	21.73	352.43	620.99	268.56	1.000
20	2010		22.85	22.85	648.36	625.51	1.000
21	2011		22.85	22.85	648.36	625.51	1.000
22	2012		22.85	22.85	648.36	625.51	1.000
23	2013		22.85	22.85	648.36	625.51	1.000
24	2014		22.85	22.85	648.36	625.51	1.000
25	2015		22.85	22.85	648.36	625.51	1.000
26	2016		22.85	22.85	648.36	625.51	1.000
27	2017		22.85	22.85	648.36	625.51	1.000
28	2018		22.85	22.85	648.36	625.51	1.000
29	2019		22.85	22.85	648.36	625.51	1.000
30	2020		22.85	22.85	648.36	625.51	1.000
31	2021		22.85	22.85	648.36	625.51	1.000
32	2022		22.85	22.85	648.36	625.51	1.000
33	2023		22.85	22.85	648.36	625.51	1.000
34	2024		22.85	22.85	648.36	625.51	1.000
35	2025		22.85	22.85	648.36	625.51	1.000
36	2026		22.85	22.85	648.36	625.51	1.000
37	2027		22.85	22.85	648.36	625.51	1.000
38	2028		22.85	22.85	648.36	625.51	1.000
39	2029		22.85	22.85	648.36	625.51	1.000
40	2030		22.85	22.85	648.36	625.51	1.000
41	2031		22.85	22.85	648.36	625.51	1.000
42	2032		22.85	22.85	648.36	625.51	1.000
43	2033		22.85	22.85	648.36	625.51	1.000
44	2034		22.85	22.85	648.36	625.51	1.000
45	2035		22.85	22.85	648.36	625.51	1.000
46	2036		22.85	22.85	648.36	625.51	1.000
47	2037		22.85	22.85	648.36	625.51	1.000
48	2038		22.85	22.85	648.36	625.51	1.000
49	2039		22.85	22.85	648.36	625.51	1.000
50	2040		22.85	22.85	648.36	625.51	1.000
51	2041		22.85	22.85	648.36	625.51	1.000
52	2042		22.85	22.85	648.36	625.51	1.000
53	2043		22.85	22.85	648.36	625.51	1.000
54	2044		22.85	22.85	648.36	625.51	1.000

Table 8.2.8 COST-BENEFIT ANALYSIS : AGNO RIVER FLOOD CONTROL PROJECT

CASE D2 : STEPWISE IMPLEMENTATION (FUTURE GROWTH CONDITION)

ASSUMPTIONS (1991 Prices)

PROJECT COSTS	Upper Agno	Panto-Sino	GROWTH FACTOR	
Main Constr Costs	2,324	2,246	2000	1.049
Other Costs	1,152	1,061	2010	1.538
Total Costs	3,476	3,307	2045	2.482
ANNUAL BENEFITS				12.621
1989 Prices	283	207	CALCULATED EIRR	20.47%
1991 Prices	375	274	CALCULATED NPV	1,393

No.	Year	Cost Stream Proj Costs	OM	Total	Benefit Stream	B-C	Growth Factor
1	1991						1.000
2	1992						1.049
3	1993						1.100
4	1994						1.154
5	1995	347.60	0.00	347.60	0.00	(347.60)	1.211
6	1996	347.60	1.16	348.76	47.59	(301.17)	1.270
7	1997	347.60	2.32	349.92	99.85	(250.07)	1.332
8	1998	347.60	3.49	351.09	157.11	(193.97)	1.398
9	1999	347.60	4.65	352.25	219.75	(132.50)	1.466
10	2000	678.30	5.81	684.11	288.15	(395.96)	1.538
11	2001	678.30	8.10	686.40	406.87	(279.52)	1.613
12	2002	678.30	10.38	688.68	536.55	(152.13)	1.693
13	2003	678.30	12.67	690.96	677.95	(13.02)	1.775
14	2004	678.30	14.95	693.25	831.92	138.67	1.862
15	2005	330.70	17.24	347.94	999.36	651.42	1.954
16	2006	330.70	18.36	349.06	1,104.41	755.35	2.049
17	2007	330.70	19.48	350.18	1,217.36	867.18	2.150
18	2008	330.70	20.60	351.30	1,338.73	987.43	2.255
19	2009	330.70	21.73	352.43	1,469.07	1,116.65	2.366
20	2010		22.85	22.85	1,608.97	1,586.12	2.482
21	2011		22.85	22.85	1,687.81	1,664.96	2.603
22	2012		22.85	22.85	1,770.52	1,747.67	2.731
23	2013		22.85	22.85	1,857.27	1,834.42	2.865
24	2014		22.85	22.85	1,948.28	1,925.43	3.005
25	2015		22.85	22.85	2,043.74	2,020.89	3.152
26	2016		22.85	22.85	2,143.89	2,121.04	3.307
27	2017		22.85	22.85	2,248.94	2,226.09	3.469
28	2018		22.85	22.85	2,359.14	2,336.29	3.639
29	2019		22.85	22.85	2,474.73	2,451.88	3.817
30	2020		22.85	22.85	2,596.00	2,573.15	4.004
31	2021		22.85	22.85	2,723.20	2,700.35	4.200
32	2022		22.85	22.85	2,856.64	2,833.79	4.406
33	2023		22.85	22.85	2,996.61	2,973.76	4.622
34	2024		22.85	22.85	3,143.45	3,120.60	4.848
35	2025		22.85	22.85	3,297.47	3,274.62	5.086
36	2026		22.85	22.85	3,459.05	3,436.20	5.335
37	2027		22.85	22.85	3,628.54	3,605.69	5.597
38	2028		22.85	22.85	3,806.34	3,783.49	5.871
39	2029		22.85	22.85	3,992.85	3,970.00	6.158
40	2030		22.85	22.85	4,188.50	4,165.65	6.460
41	2031		22.85	22.85	4,393.74	4,370.89	6.777
42	2032		22.85	22.85	4,609.03	4,586.18	7.109
43	2033		22.85	22.85	4,834.88	4,812.03	7.457
44	2034		22.85	22.85	5,071.78	5,048.93	7.823
45	2035		22.85	22.85	5,320.30	5,297.45	8.206
46	2036		22.85	22.85	5,581.00	5,558.15	8.608
47	2037		22.85	22.85	5,854.47	5,831.62	9.030
48	2038		22.85	22.85	6,141.33	6,118.48	9.472
49	2039		22.85	22.85	6,442.26	6,419.41	9.936
50	2040		22.85	22.85	6,757.93	6,735.08	10.423
51	2041		22.85	22.85	7,089.07	7,066.22	10.934
52	2042		22.85	22.85	7,436.43	7,413.58	11.470
53	2043		22.85	22.85	7,800.82	7,777.97	12.032
54	2044		22.85	22.85	8,183.06	8,160.21	12.621

Table 8.2.9 SENSITIVITY ANALYSIS

CASE D2 : STEPWISE IMPLEMENTATION (FUTURE GROWTH CONDITION)

CALCULATED EIRR			19.07%	CALCULATED EIRR		18.10%
CALCULATED NPV			1,130	CALCULATED NPV		710
	10% Increase in Costs			Reduction in Growth Factor to 3.9%		
Year	Costs	Benefits	B-C	Costs	Benefits	B-C
1991						
1992						
1993						
1994						
1995	382.36	0.00	(382.36)	347.60	0.00	(347.60)
1996	383.64	47.59	(336.05)	348.76	45.37	(303.39)
1997	384.92	99.85	(285.07)	349.92	94.27	(255.65)
1998	386.19	157.11	(229.08)	351.09	146.92	(204.16)
1999	387.47	219.75	(167.72)	352.25	203.54	(148.71)
2000	752.52	288.15	(464.37)	684.11	264.35	(419.76)
2001	755.03	406.87	(348.16)	686.40	369.71	(316.68)
2002	757.55	536.55	(221.00)	688.68	482.89	(205.79)
2003	760.06	677.95	(82.11)	690.96	604.34	(86.63)
2004	762.58	831.92	69.35	693.25	734.52	41.27
2005	382.73	999.36	616.63	347.94	873.94	526.00
2006	383.96	1,104.41	720.45	349.06	956.60	607.54
2007	385.20	1,217.36	832.16	350.18	1,044.39	694.21
2008	386.43	1,338.73	952.30	351.30	1,137.56	786.26
2009	387.67	1,469.07	1,081.40	352.43	1,236.42	883.99
2010	25.14	1,608.97	1,583.84	22.85	1,341.25	1,318.40
2011	25.14	1,687.81	1,662.68	22.85	1,393.56	1,370.71
2012	25.14	1,770.52	1,745.38	22.85	1,447.91	1,425.06
2013	25.14	1,857.27	1,832.14	22.85	1,504.38	1,481.53
2014	25.14	1,948.28	1,923.14	22.85	1,563.05	1,540.20
2015	25.14	2,043.74	2,018.61	22.85	1,624.01	1,601.16
2016	25.14	2,143.89	2,118.75	22.85	1,687.34	1,664.49
2017	25.14	2,248.94	2,223.80	22.85	1,753.15	1,730.30
2018	25.14	2,359.14	2,334.00	22.85	1,821.52	1,798.67
2019	25.14	2,474.73	2,449.60	22.85	1,892.56	1,869.71
2020	25.14	2,596.00	2,570.86	22.85	1,966.37	1,943.52
2021	25.14	2,723.20	2,698.06	22.85	2,043.06	2,020.21
2022	25.14	2,856.64	2,831.50	22.85	2,122.74	2,099.89
2023	25.14	2,996.61	2,971.48	22.85	2,205.53	2,182.68
2024	25.14	3,143.45	3,118.31	22.85	2,291.54	2,268.69
2025	25.14	3,297.47	3,272.34	22.85	2,380.91	2,358.06
2026	25.14	3,459.05	3,433.92	22.85	2,473.77	2,450.92
2027	25.14	3,628.54	3,603.41	22.85	2,570.24	2,547.39
2028	25.14	3,806.34	3,781.21	22.85	2,670.48	2,647.63
2029	25.14	3,992.85	3,967.72	22.85	2,774.63	2,751.78
2030	25.14	4,188.50	4,163.37	22.85	2,882.84	2,859.99
2031	25.14	4,393.74	4,368.60	22.85	2,995.27	2,972.42
2032	25.14	4,609.03	4,583.90	22.85	3,112.09	3,089.24
2033	25.14	4,834.88	4,809.74	22.85	3,233.46	3,210.61
2034	25.14	5,071.78	5,046.65	22.85	3,359.57	3,336.72
2035	25.14	5,320.30	5,295.17	22.85	3,490.59	3,467.74
2036	25.14	5,581.00	5,555.86	22.85	3,626.72	3,603.87
2037	25.14	5,854.47	5,829.33	22.85	3,768.17	3,745.32
2038	25.14	6,141.33	6,116.20	22.85	3,915.12	3,892.27
2039	25.14	6,442.26	6,417.12	22.85	4,067.81	4,044.96
2040	25.14	6,757.93	6,732.79	22.85	4,226.46	4,203.61
2041	25.14	7,089.07	7,063.93	22.85	4,391.29	4,368.44
2042	25.14	7,436.43	7,411.30	22.85	4,562.55	4,539.70
2043	25.14	7,800.82	7,775.68	22.85	4,740.49	4,717.64
2044	25.14	8,183.06	8,157.92	22.85	4,925.37	4,902.52

Table 8.3.1 ESTIMATE OF AFFECTED POPULATION PROPERTIES

Item	UPPER AGNO		PANTAL-SINOCALAN					
	Agno R. Stretches	Poponto Right-of-Way	Pantal-Sinocalan	Dagupan R. Stretch	Ingarela R. Stretch	Affected by Right-of-Way	Affected by Poponto Inundation	TOTAL AFFECTED BY ALL PROJECT COMPONENTS
Population (no)	2,244	3,276	11,358	2,886	3,024	22,788	68,340	91,128
Buildings/ Houses (no)	374	546	1,893	481	504	3,798	11,390	15,188
Urban Commercial Area (ha)			12			12		12
Commercial/ Residential Area (ha)	87	2	109	22	50	270	550	820
Farmland (ha)	587	163	225	43	71	1,089	18,810	19,899
Fish Pond (ha)	1		32	79		112	640	752
Other Land (ha)	366		154	1		522		522
National Road (km)						0	9	9
Provincial Road (km)						0	8	8
Municipal Road (km)						0	11	11
Barangay Road (km)						0	25	25
Railway (km)						0	23	23
Bridge (lm)						0	83	83

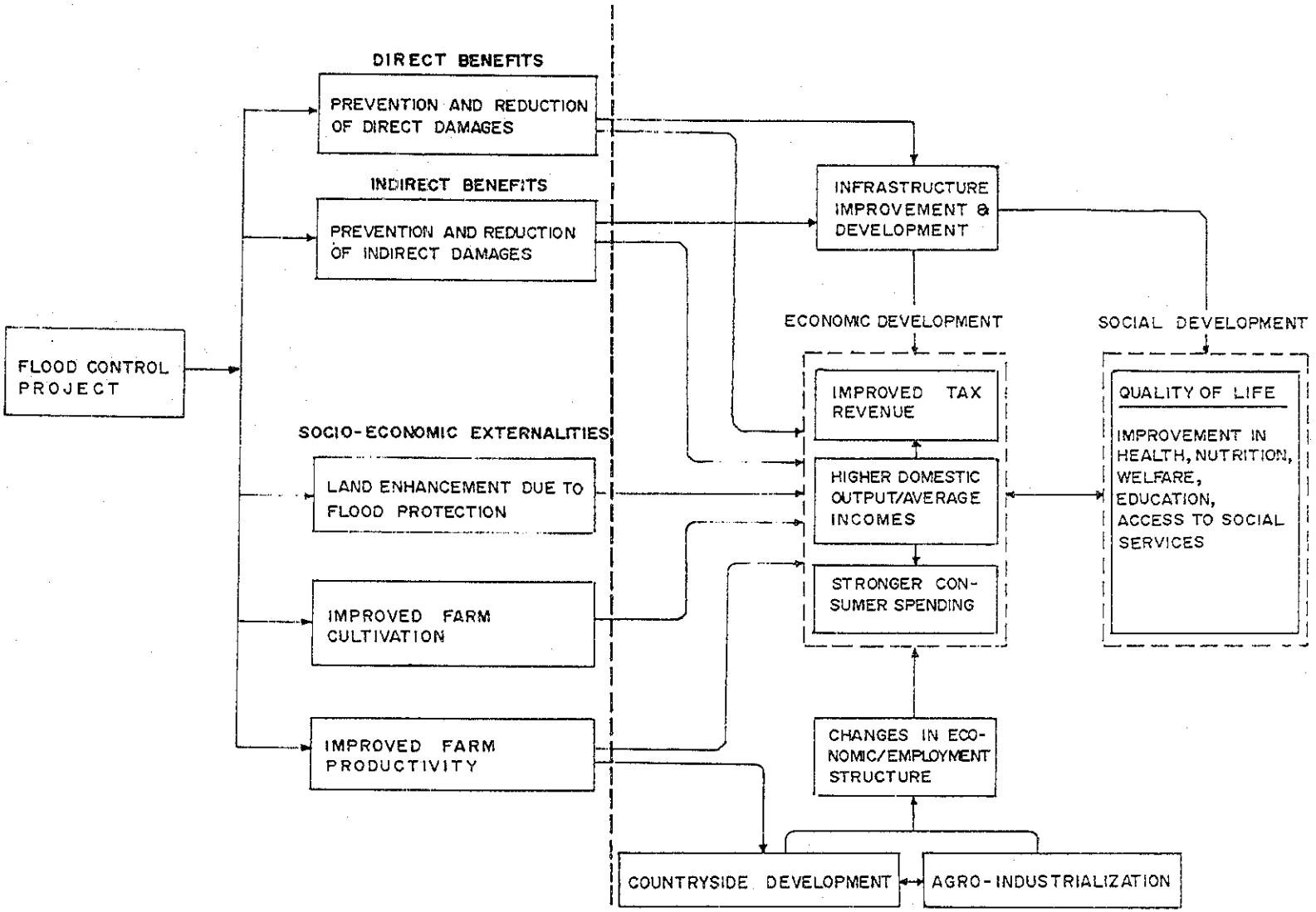


Fig. 8.1.1 FRAMEWORK FOR BENEFIT ANALYSIS OF A FLOOD CONTROL PROJECT

9. PROJECT IMPLEMENTATION SCHEDULE

9. PROJECT IMPLEMENTATION SCHEDULE

9.1 Project Implementation Schedule

9.1.1 Two Stage Implementation Schedule

The financial project cost is estimated to be 3,912 million pesos for the Upper Agno River Project and 3,896 million pesos for the Pantal-Sinocalan River Project. If two projects are implemented simultaneously from 1995 in 5 year period, annual average project fund requirement is 1,560 million Pesos which corresponds to 3.8% of the projected GRDP 40.8 billion pesos (at 1990 price) in 1995 in the Study Area. In Ilocos Region the public investment to the infrastructures is recorded at about 1.9% of the GRDP in 1990.

Although the flood control in the Dagupan-Calasiao-Santa Barbara area can be achieved fully by construction of both the Upper Agno and Pantal-Sinocalan Projects, it is realistic to implement these projects at least each in two stages to meet the available amount of public fund in this region. The first priority is given on the Upper Agno River and, the second priority on the Pantal-Sinocalan River. Each project is planned to be implemented in two stages in each 10 year period. All the projects are planned to be completed in 15 years. In this case, the annual investment fund corresponds to the level of 1% of the region's GRDP. The project implementation schedule shown in Figure 9.1.1 is prepared with the target construction commencement of the Upper Agno River in 1995 and that of the Pantal-Sinocalan River in 2000. This schedule assumes:

1) Detailed design of the first stage will begin following submission of the Final Report (the Feasibility Study).

2) The project will be financed by international financing organizations which will require time for negotiation and agreement.

3) Loan agreement between the Government of the Republic of the Philippines and the financing agencies will be made by the time the detail design is completed.

4) Land acquisition and compensation payment will be completed before commencing of construction works.

5) A study for Environmental Impact Statement and technical studies recommended in Section 9.2 will be completed in the detailed design stage.

The first stage of the Upper Agno River Project aims primarily to restore and reinforce the existing diking system against a 10-year design flood discharge, together with construction of the new Poponto floodway and natural retarding basin. The second stage consists of excavating low water channels, installing revetments, and other remaining works. Location of the two stage works is illustrated in Figure 9.1.2.

The financial costs of the first and the second stages are 2,923 million pesos and 890 million pesos respectively. The breakdowns of these project costs and work quantities are shown in Table 7.3.1, Table 7.3.5, and Table 7.3.6.

The first stage of the Pantal-Sinocalan River Project aims to protect the three municipalities, Dagupan city, Calasiao, and Santa Barbara from a 10-year design flood discharge with the provision of a proposed by-pass channel, the diking system from the river mouth to the upstream of Santa Barbara on the right bank of the Sinocalan River, the diking system for the Santa Barbara stretch on the left bank of the Sinocalan River, and bank protection on both banks of the Pantal River. The second stage consists of the remaining diking systems for the Sinocalan, Dagupan, and Ingarela Rivers, low water channel improvement, revetments, and other remaining works. Location of the two stage works is illustrated in Figure 9.1.3.

The financial costs of the first and second stages are 1,977 million pesos and 1,918 million pesos respectively. The breakdown of these project costs and work quantities are shown in Table 7.3.3, Table 7.3.7, and Table 7.3.8.

As discussed in Section 3.1, construction of a new diking system in the upstream stretch confines flood runoff inside the new river area and induces a significant increase of flood discharge in the downstream reaches.

Special care needs to be paid to implement the first stage works of these projects, in particular to the Upper Agno River, to avoid adverse flood incidence due to such increase in flood discharge. The streches of Bayambang-Alcala including the Poponto floodway and swamp, Alcala-Asingan, and Asingan-San Manuel shall be implemented simultaneousely.

9.1.2 Project Fund Required

The project cost is estimated at the price level as of May, 1991 and a preliminary annual disbursement schedule is shown in Table 9.1.1 for the Upper Agno River Project and Table 9.1.2 for the Pantal-Sinocalan River Project, based on the foregoing two-stage implementation schedule.

9.2 Recommendation for Further Study

9.2.1 Environmental Impact Statement

The Government of the Philippines is recommended to conduct a detailed environmental impact assessment study to prepare the Environmental Impact Statement. The major items to be assessed are:

1) Social impact with respect to land acquisition and resettlement issues especially in the following stretches:

   a) Upper Agno River
      . Poponto floodway and retarding basin
      . Carmen stretch
      . Asingan - San Manuel stretches
   b) Pantal-Sinocalan River
      . Pantal-Sinocalan River stretches
      . By-pass route

2) Water use, water quality and related issues in the dry and wet seasons especially in the following stretches:

   a) Upper Agno River
      . Bayambang stretch

b) Pantal-Sinocalan River

. Urban stretch of the Sinocalan River (Marasay River)

c) Fish ponds along the Dagupan River

3) Other particulars

9.2.2 Laboratory Tests

The following laboratory hydraulic model tests are recommended to determine the alignment and detailed dimension of the structures concerned and to confirm the stability of river channels and beds before the detail design:

a) Upper Agno River

. Alignment and dimension of the diversion dike and the channels leading to the Poponto Floodway and the Bayambang stretch and those of the floodway dikes.

. Alignment and dimension of the setback levees in the Carmen and the San Manuel stretches.

b) Pantal-Sinocalan River

. Alignment and dimension of the by-pass channel, the intake channel, and the watergate at the junction of the existing Sinocalan River.

9.2.3 Seismic Resistance Design

The seismic resistance survey and design done in this Study is preliminary, and thus further detailed survey and design on this subject are recommended to be conducted in the detailed design stage.

Table 9.1.1 PRELIMINARY ANNUAL DISBURSEMENT SCHEDULE FOR UPPER AGNO RIVER PROJECT

Upper Agno River: 1st Stage

Umit: Mil. Pesos

Item	Detai Design			Compensasion	1995			1996			1997			1998			1999			Total		
	L/C	F/C	Total	(L/C)	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Main Works			0	0	108	191	299	100	193	293	139	145	284	100	131	230	125	181	306	572	840	1,412
Prepara. Works			0	0	11	19	30	10	19	29	14	14	28	10	13	23	12	18	31	57	84	141
Misc. Works			0	0	18	31	49	17	32	48	23	24	47	16	22	38	21	30	50	94	139	233
Main Construction			0	0	137	241	378	127	244	371	176	183	359	126	165	291	158	229	387	724	1,062	1,786
Compensation			0	398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	398	0	398
Physical Cont.			0	63	23	36	60	22	37	58	29	27	57	21	25	46	27	34	61	185	159	344
Administration			0	20	19	0	19	19	0	19	18	0	18	15	0	15	19	0	19	109	0	109
E/S	15	135	150	0	4	34	38	4	33	37	4	32	36	3	26	29	4	35	39	33	296	328
G. Total	15	135	150	481	183	311	494	171	314	485	227	243	470	165	216	381	208	298	506	1,449	1,517	2,966

Upper Agno : 2nd Stage

Umit: Mil. Pesos

Item	D/D Stage			Comp.Stage	2000			2001			2002			2003			2004			Total		
	L/C	F/C	Total	(L/C)	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Main Works			0	0	31	83	114	58	56	113	49	65	114	44	66	110	35	75	110	217	345	562
Prepara. Works			0	0	3	8	11	6	6	11	5	6	11	4	7	11	3	8	11	22	34	56
Misc. Works			0	0	5	14	19	10	9	19	8	11	19	7	11	18	6	12	18	36	57	93
Main Construction			0	0	40	105	145	73	71	144	62	82	144	56	83	140	44	95	139	275	436	711
Compensation			0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	14
Physical Cont.			0	2	7	16	23	12	11	23	10	12	23	9	13	22	8	14	22	49	65	114
Administration			0	1	7	0	7	7	0	7	7	0	7	7	0	7	7	0	7	36	0	36
E/S	0	0	0	0	1	13	14	1	13	14	1	13	14	1	13	14	1	13	14	7	64	71
G. Total	0	0	0	17	55	134	189	93	94	188	81	107	188	74	108	183	60	122	182	381	565	946

1,830 2,083 3,912

Table 9.1.2 PRELIMINARY ANNUAL DISBURSEMENT SCHEDULE FOR PANTAL-SINOCALAN RIVER PROJECT

Pantal Sinocalan River: 1st Stage

Umit: Mil. Pesos

Item	Detai Design			Compensation	2000			2001			2002			2003			2004			Total		
	L/C	F/C	Total	(L/C)	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Main Works			0	0	47	112	159	52	163	216	71	115	186	80	119	199	40	111	151	290	620	911
Prepara. Works			0	0	5	11	16	5	16	22	7	11	19	8	12	20	4	11	15	29	62	91
Misc. Works			0	0	8	19	26	9	27	36	12	19	31	13	20	33	7	18	25	48	102	150
Main Construction			0	0	59	142	202	66	207	273	90	145	235	101	151	251	50	140	191	367	785	1,152
Compensation			0	333	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	333	0	333
Physical Cont.			0	52	10	21	32	12	31	43	15	22	37	17	23	40	9	21	30	116	118	234
Administration			0	17	10	0	10	14	0	14	12	0	12	13	0	13	10	0	10	74	0	74
E/S	14	128	142	0	2	18	20	3	25	27	2	21	24	3	23	25	2	17	19	26	232	258
G. Total	14	128	142	402	82	182	264	95	262	357	120	188	308	133	196	329	71	179	249	916	1,134	2,051

Pantal Sinocalan River: 2nd Stage

Umit: Mil. Pesos

Item	Detai Design			Compensation	2005			2006			2007			2008			2009			Total		
	L/C	F/C	Total	(L/C)	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total	L/C	F/C	Total
Main Works			0	0	57	148	205	72	114	186	69	133	201	50	156	206	64	103	167	311	654	964
Prepara. Works			0	0	6	15	20	7	11	19	7	13	20	5	16	21	6	10	17	31	65	96
Misc. Works			0	0	9	24	34	12	19	31	11	22	33	8	26	34	11	17	28	51	108	159
Main Construction			0	0	72	187	259	91	144	235	87	168	254	63	198	261	81	130	211	393	827	1,220
Compensation			0	207	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	207	0	207
Physical Cont.			0	33	13	28	41	15	22	37	15	25	40	11	30	41	14	19	33	101	124	225
Administration			0	10	13	0	13	12	0	12	13	0	13	13	0	13	11	0	11	71	0	71
E/S	0	0	0	0	3	23	26	2	21	23	3	23	25	3	23	26	2	19	21	12	110	122
G. Total	0	0	0	250	100	239	339	120	187	307	117	216	333	90	251	341	108	168	276	785	1,061	1,845
																				1,701	2,195	3,896

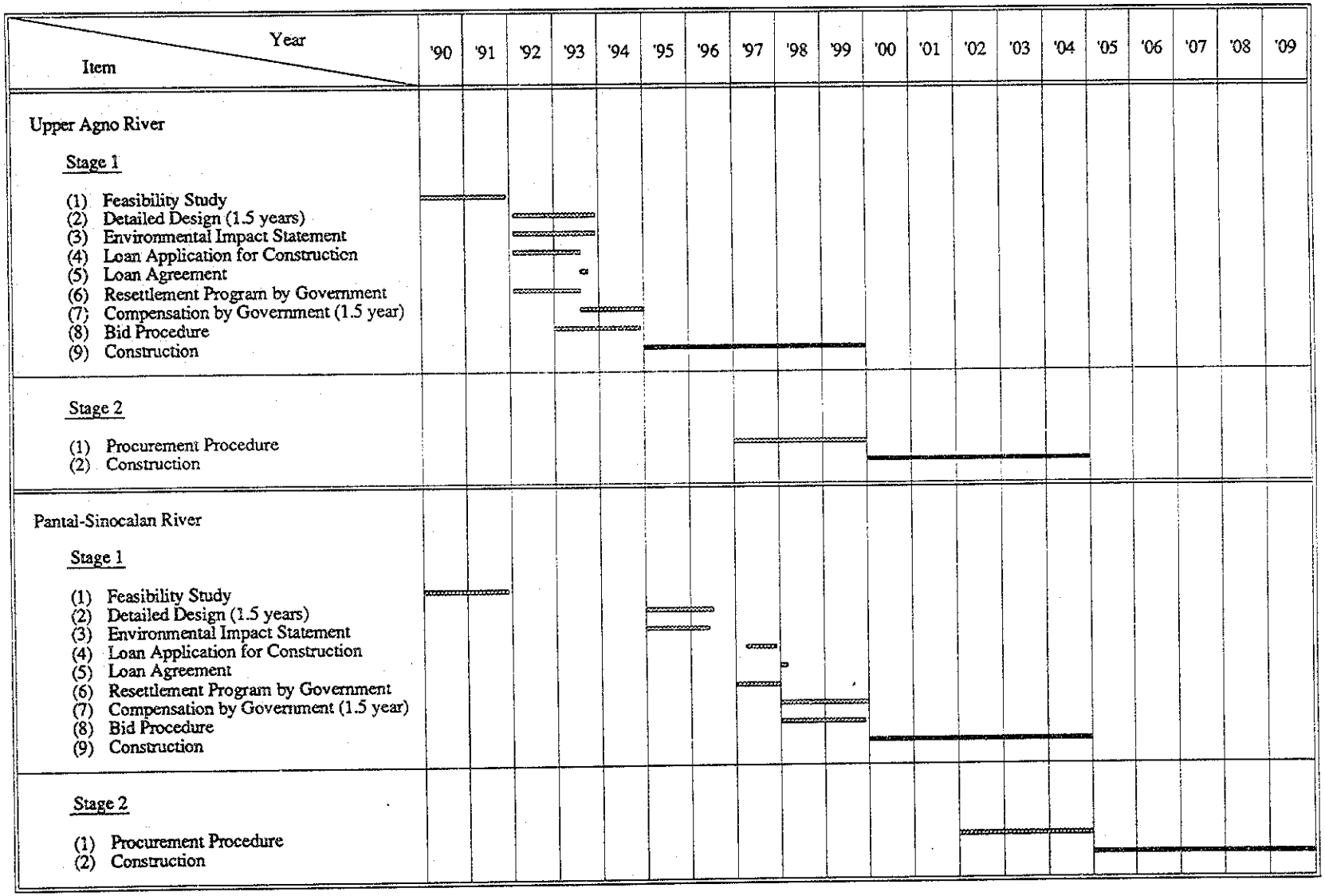


Fig. 9.1.1 IMPLEMENTATION SCHEDULE OF THE PRIORITY PROJECT

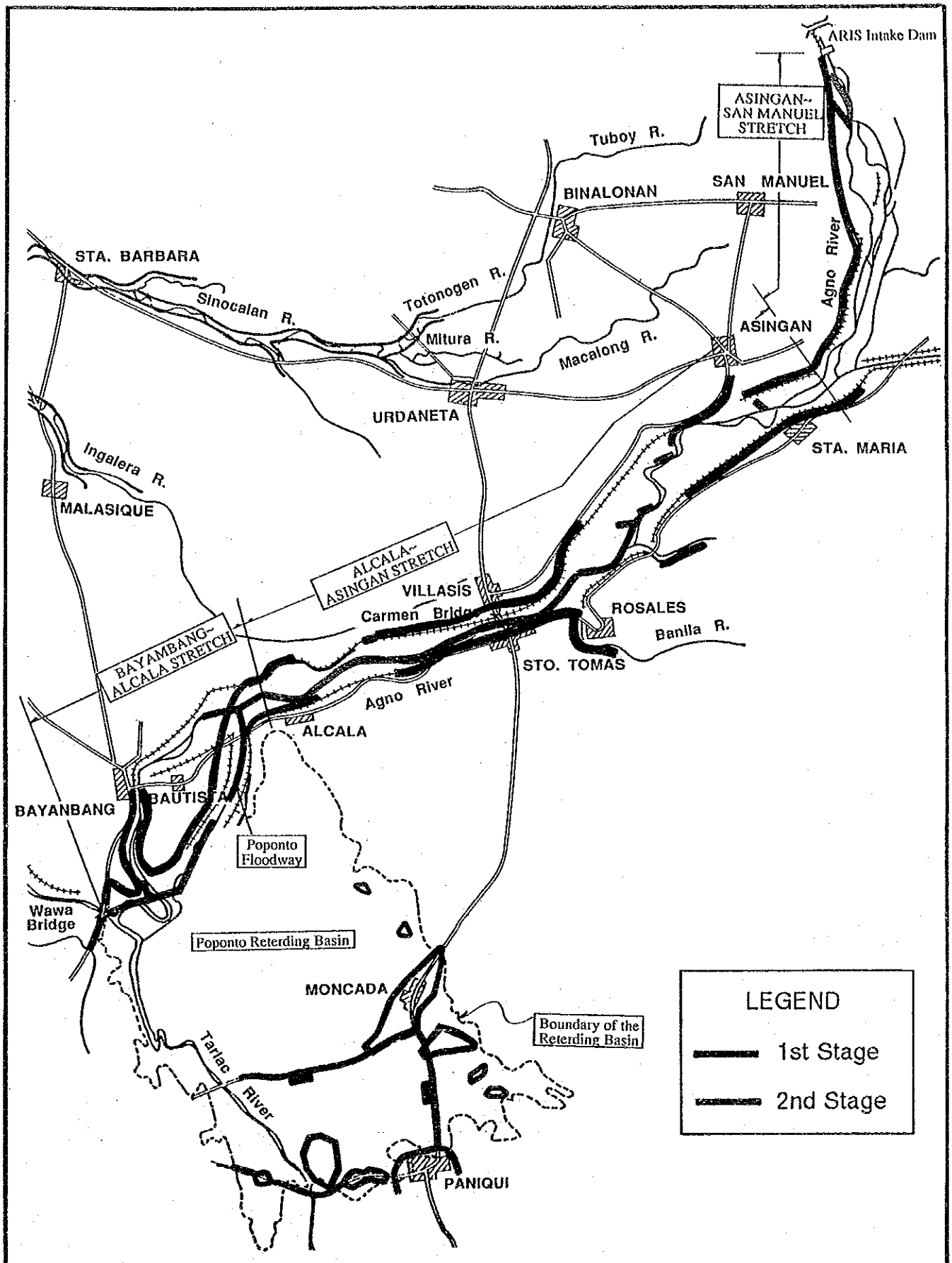


Fig. 9.1.2 SKEMATIC STAGE IMPLEMENTATION OF UPPER AGNO PROJECT

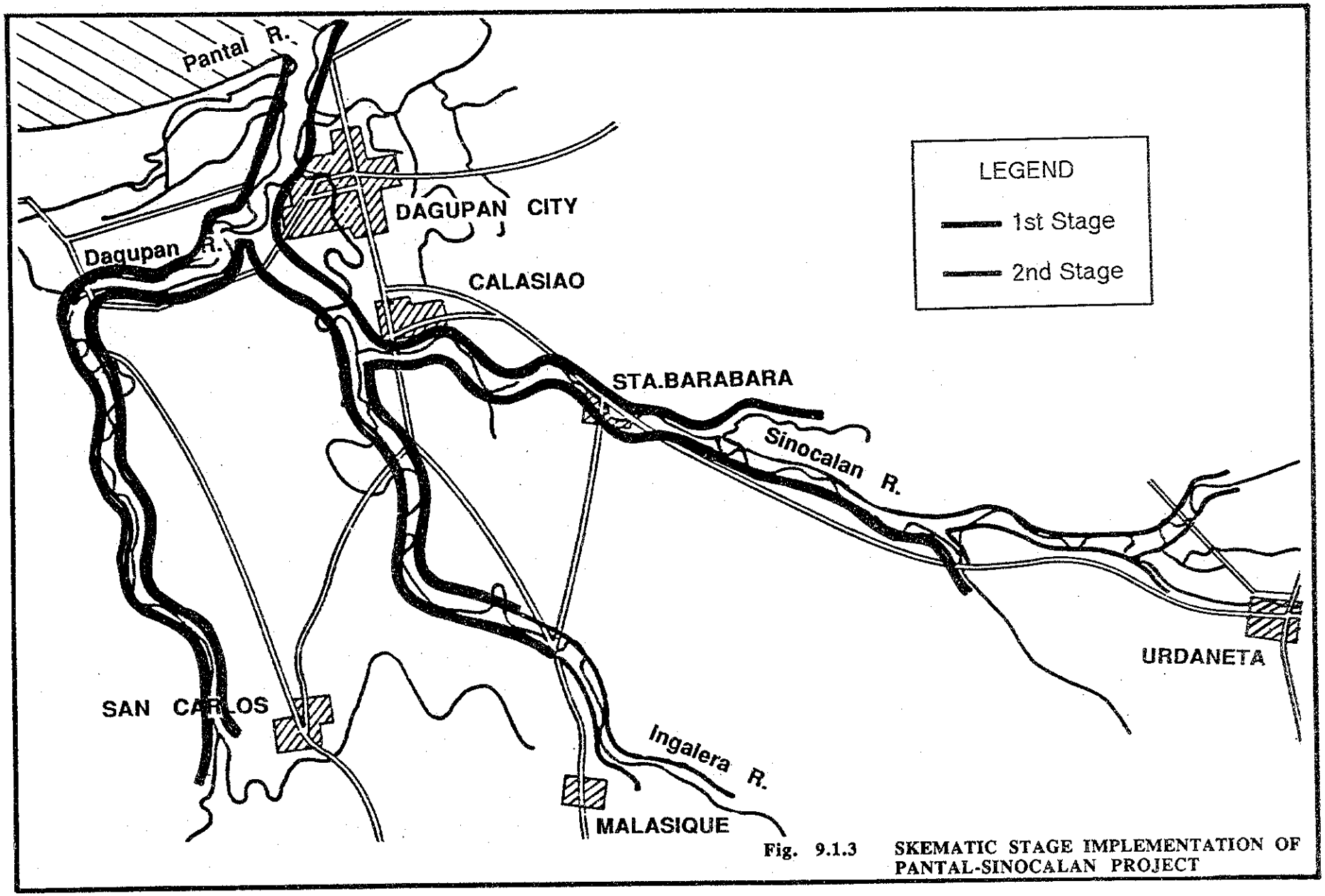


Fig. 9.1.3 SKEMATIC STAGE IMPLEMENTATION OF PANTAL-SINOCALAN PROJECT