Asian Urban Disaster Mitigation Program

Working Paper #5

Naga City Disaster Mitigation Plan

August 2001

Prepared by the

Philippines Cities
Disaster Mitigation Project

under the

Asian Urban Disaster Mitigation Program

adpc
Asian Disaster Preparedness Center
Bangkok, Thailand www.adpc.ait.ac.th

The **Philippines Cities Disaster Mitigation Project** was launched in January 1997 with the objective of reducing the vulnerability of two cities to natural hazards, beginning with mitigation of floods in Naga city and followed by multi-hazard mitigation in San Carlos. In addition to hazard mapping and mitigation planning, the project will emphasize land use planning, the formation of disaster management standards, and the training of professionals from urban areas. The cascade city component will encourage replication of lessons to other vulnerable cities in the Philippines.

This paper is published under the Asian Urban Disaster Mitigation Program for sharing knowledge and experiences from national demonstration projects on disaster mitigation in target countries of Asia. It is made available by the Asian Disaster Preparedness Center, Bangkok, Thailand, with minimal editing. The opinions expressed herein are those of the author and do not necessarily reflect the views of Asian Disaster Preparedness Center or the U.S. Agency for International Development. Publication of this paper was made possible through support provided by the Office of Foreign Disaster Assistance, United States Agency for International Development, under the terms of Cooperative Agreement No. 386-A-00-00-00068.

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It is with great pleasure that ADPC presents the working paper on Naga City Disaster Mitigation Plan prepared by the Philippines Cities Disaster Mitigation Project (PCDMP). The PCDMP is one of the national demonstration projects under the Asian Urban Disaster Mitigation Program (AUDMP). The AUDMP, which is currently being implemented in Bangladesh, Cambodia, Laos, India, Indonesia, Nepal, Philippines, Sri Lanka, and Thailand, has demonstrated successful methodologies and approaches in mitigating the impact of the natural disasters in the region. During implementation of the national demonstration projects by country partners, there has been continuous building of knowledge and experience emanating from the country projects. The national demonstration projects have produced wealth of knowledge in the form of hazard maps, reports, proceedings, review of policies, documentation of various events and activities, etc.

The purpose of making this paper available is to share the knowledge and experiences with those attempting to develop similar plans for disaster management in their respective cities.

The PCDMP is implemented by the Naga City Government and the Philippines Business for Social Progress (PBSP). The project has successfully demonstrated an approach for developing mitigation plan by identifying hazards and by analyzing and assessing risks. In addition to hazard mapping and mitigation planning, the project emphasizes on land use planning and formation of disaster management standards for redcing the impacts of disasters.

ADPC congratulates both the Naga City Government and the PBSP for successfully implementing the activities under the demonstration phase. ADPC appreciates the efforts made by the project in reducing the loss of lives and damage of properties from devastating disasters.

We hope that you will find this report useful and we look forward to receiving your comments.

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August 2001

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List of Acronyms

ADB	Asian Development Bank
AUDMP	Asian Urban Disaster Mitigation Program
BHAs	Barangay Health Aids
BIR	Bureau of Internal Revenue
BRBFCIDP	Bicol River Basin Flood Control and Irrigation Development Project
BUA	Built-Up Area
CARP	Comprehensive Agrarian Reform Program
CBD	Central Business District
CIPS	Community Information Planning System
CPDO	City Planning and Development Office
CSAT	Camarines School of Arts and Trade
DA	Department of Agriculture
DECS	Department of Education, Culture and Sports
DM	Disaster Management
DMMU	Disaster Mitigation Management Unit
DPWH	Department of Public Works and Highways
DSWD	Department of Social Welfare and Development
EDP	Electronic Data Processing
ENRO	Environmental and Natural Resources Office
EO	Executive Order
ERN	Emergency Rescue Naga
FEMA	Federal Emergency Management Authority
FHZ	Flood Hazard Zone
FIRR	Financial Internal Rate of Return
GIP	Government Internship Program
GIS	Geographic Information System
GOLD	Governance and Local Democracy
Ha	Hectares
HLURB	Housing and Land Use Regulatory Board
HR	High Risk
IEC	Information and Education Campaign
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
kph	kilometer per hour
LOC	League of Cities
LR	Low Risk
LUPZ	Land Use Plan and Zoning
MBN	Minimum Basic Needs
mm	millimeter
MNWD	Metro Naga Water District
MR	Medium Risk
MS	Multi Storey

MVA	Most Vulnerable Area
NCDCC	Naga City Disaster Coordinating Council
NCDM	Naga City Disaster Mitigation
NCDMC	Naga City Disaster Mitigation Council
NCDMEB	Naga City Disaster Mitigation Executive Board
NCDMP	Naga City Disaster Mitigation Project
NCDMPU	Naga City Disaster Mitigation Project Unit
NGOs	Non-Governmental Organizations
NIA	National Irrigation Administration
NPV	Net Present Value
NR	No Risk
NSO	National Statistics Office
OCD	Office of Civil Defense
OIDCI	Orient Integrated Development Consultants, Inc.
OJT	On-the-Job Training
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAR	Philippine Area of Responsibility
PBSP	Philippine Business for Social Progress
PD	Presidential Decree
PNP	Philippine National Police
PNR	Philippine National Railway
PREMIUM	Program for Essential Municipal Infrastructure Utilities Maintenance
PTB	Pulmonary Tuberculoses
SEC	Securities and Exchange Commission
SL	Split Level
S S	Single Storey
SURP	School of Urban and Regional Planning
TA	Technical Assistance
T S	Two Storey
UP	University of the Philippines
USAID	United States Agency for International Development

CHAPTER I

INTRODUCTION AND SCOPE OF THE STUDY

1.1 PROJECT BACKGROUND

The Naga City Disaster Mitigation Project (NCDMP) is under the umbrella program called Philippine Cities Disaster Mitigation Project being implemented by the League of Cities (LOC) and the Philippine Business for Social Progress (PBSP). The Project has financial support from the USAID through the Asian Urban Disaster Mitigation Program (AUDMP) implemented by the Asian Disaster Preparedness Center in Bangkok, Thailand.

The Project represents the LOC's efforts to build safer and more livable cities. The Project will help establish awareness on the need for disaster mitigation among cities and promote new standards at the national and city levels through information campaigns and demonstration projects, formal education courses, and policy reforms. A major concern of the Project will be to identify mitigating measures that will help the urban poor, while promoting the importance of awareness and city planning for all potential hazards. As the first Model City, the Naga City Project will focus on the need to mitigate disasters particularly cyclones and flooding. In general, the Project aims to develop Naga as a model City for mitigating cyclones and floods. The Project will help strengthen capacity of Naga City to develop and implement disaster mitigation programs and increase their awareness on disaster mitigation standards and practices.

1.2 SCOPE OF THE STUDY

The City Government, through its Naga City Disaster Mitigation Project Unit (NCDMPU) and with the assistance of the PBSP, has initiated a massive information and education campaign about the project, and in the process generate community participation in gathering information necessary for the formulation of a disaster mitigation plan. It was at this point that the Consultancy Services of the Orient Integrated Development Consultants, Inc. (OIDCI) was solicited by the PBSP to assist the City Government of Naga undertake the following:

a) Analyze current situation which involves an assessment of various development policies, plans and studies, and characterization of risk barangays and population groups;

b) Undertake hazard mapping and vulnerability assessment involving a review, updating/validation and analysis/correlation of available hydrological and river engineering studies and damage assessment data/reports, and hazard map preparation; and

c) Formulate Disaster Mitigation Plan.

1.3 EXISTING STUDIES AND DATA COLLECTION EFFORTS

1.3.1 Completed Studies in the Bicol River Basin Area

Many studies have been undertaken in the Bicol river basin to mitigate the perennial flooding occurring along the Bicol river course. The latest of this study is the Bicol River Basin Flood Control and Irrigation Development Project (BRBFCIDP), a Feasibility Study funded by the Asian Development Bank (ADB) and completed in August 1991. There are other previous studies that had been undertaken and these include the following:

a) Comprehensive Water Resources Development Study of 1976 by TAMS,

b) Quinali Integrated Development Area – a Feasibility Study by Asiatic Consultants, Inc.,

c) BRBFCIDP of 1983 prepared by the national government inter-agency group, and

d) Re-study of Mayon Volcano Sabo and Flood Control Project of 1983 by JICA.

The scope of the studies undertaken varies from specific areas to the whole basin. These reports are good sources of information for the Study. For Naga City, the detailed design study of the Naga City Storm Drainage System undertaken by F.F. Cruz contains river cross-section data that is useful in estimating the full-bank capacity of Naga River. The river cross-section data however are quite old and may be only fairly accurate due to some changes in the river channel.

The BRBFCIDP study is the latest and the most comprehensive in terms of data collected and the complexity of the mathematical modelling adopted. The study covers the whole Bicol river basin from Camalig to Cabusao covering a total drainage area of 3,120 sq. km. The study evaluated the frequency and extent of flooding and provides inundation maps for 1.25-, 5- and 25-year return periods. This information is useful in the current study since the main cause of flooding for most of Naga City is overbank discharge coming from the Bicol River. The BRBFCIDP study proposed many flood control measures to try to mitigate the flooding along the Bicol River. These proposed measures are mostly large flood control works which will probably take years to implement. They could, however, be implemented individually but the impact on the river will be far less substantial and effective. There was no detailed assessment of the flood problem of Naga City included in this study.

1.3.2 Completed Studies for Naga City Development

In addition to basin wide data, there are completed project studies with disaster mitigation components that are now being adopted by the City Government for implementation. These are:

a) Naga City River Watershed Strategic Management Plan, November 1997, a study conducted under the Governance and Local Democracy, (GOLD) project,

b) Detailed Design for the Proposed Naga City Storm Drainage System under the PREMIUM project, and

c) Comprehensive Water Resources Study for the Naga City's Water District.

1.3.3 Community Survey and Hazard Mapping

Beside the previous technical studies undertaken for the Bicol River, the NCDM Project Office initiated the gathering of additional data through a community-based survey. Sectoral representatives (i.e., youth, professional, women, etc) were invited to participate in the community survey. This special type of survey was undertaken to gather basic information on the social and economic background of the 27 barangays of Naga City and other information related to the occurrence of previous storms. Additional support information that have been processed by the project office include maps such as city map, topographic map, land use map, ground slope map, flood inundation maps and others that are stored in the Geographic Information System (GIS) installed at the Electronic Data Processing (EDP) Center of the city government.

On the basis of the community survey, data on the depth and duration of flooding were collected for four storms, namely: Typhoon Yoning (1988), Typhoon Monang (1993), Typhoon Rosing (1995) and Typhoon Sisang (1997). Typhoon Rosing produced the most rainfall while Typhoon Yoning registered the highest wind velocity. Flood inundation map was prepared by the Project Office using the average water level in each barangay and then classified the areas into 3 categories, namely: zero level, alarm level (1-2 feet), alert level (2.1-3.5 feet) and critical level (3.6 feet). The categories follow the one used by PAGASA.

1.3.4 Naga City GIS Data

An important aspect of the study is the GIS-assisted mapping and analysis of spatial data. The city government is already equipped with an ARC/INFO GIS package at its EDP Center. Maps that had been digitized include the following:

i. Naga City Base Map - featuring rivers and waterways, road network, topographic contours, barangay and zone boudaries,

ii. Land Use Map - Existing and proposed land use map,

iii. Flood Inundation Map - for four (4) selected storms and features the generalized water levels and barangay/zone boundaries, and

iv. Other thematic maps, such as slope, land capability, zoning, and 1996 Naga City detailed map at scale 1:4,000 m. showing building footprints, and other features.

1.3.5 Hydrometeorological Data

Hydrometeorological information are available in the PAGASA stations at Pili and Camaligan. The project office has collected the required data to the form specified by the Consultant, as follows:

- Annual maximum one day (24 hours) rainfall at Pili and Camaligan station;
- Annual maximum wind speed or by storm at Pili and Camaligan;
- Annual maximum water level and discharge at Camaligan;
- Typhoon tracts of relevant storm events affecting Naga City;
- Typhoon signal/max wind speed, with reference point at Naga City; and
- Wind speed threshold that will topple trees, uplift roofs and collapse lightly constructed houses.

1.3.6 Land Use and Ordinances

Existing and proposed land uses in the city are available for evaluation. In addition, existing policies and ordinances, including the zoning ordinance and building code, were made available for review and assessment. A cursory review of the available documents and maps, as well as those that the consultant understands to be in the process of being prepared or completed, seems to indicate that there are enough data (both in document form and in maps) for use in the analysis and planning activities of the project.

1.3.7 Socio-Economic Profile

The project office has compiled socio-economic data, flood damage data, and other information generated during the community surveys conducted by the project office. Based on the preliminary assessment of the available secondary information, data obtained are not at-all interrelated since each agency came up with figures related to their respective objectives (MBN surveys are for each barangay in general while stakeholders' profile done by the City is by zone). Since the MBN surveys are quite extensive and were only recently completed in 1996, this information serve as indicative measures of the socio-economic characteristics of households in the barangays directly affected by typhoon and flooding.

1.4 APPROACH AND METHODOLOGY FOR THE STUDY

1.4.1 The Naga City Disaster Mitigation Planning/Implementation Framework

In areas where natural hazard occurs, like the perennial typhoon and floods in Naga City, the major concern for the city to become safer and liveable is the safety and protection of some major sectors, such as the population, shelter, food/agriculture, lifeline facilities, and the lifeline infrastructure. The lifeline facilities are the communication, electricity, hospitals/clinics, airports, evacuation centers, warehouses, etc., while the lifeline infrastructures are roads leading to lifeline facilities, levees, drainage, etc. This became the basis for formulating the Naga City Disaster Mitigation Planning/Implementation Framework (*see Figure 1*).

The Framework shows that overtime, the reduction of the vulnerability of the identified major sectors from high to low, if not totally removed, would depend on how the mitigation strategies could be implemented by the combined efforts of concerned institutions involved in the disaster mitigation program implementation. Since typhoon and flooding are natural occurrences that could not be prevented from happening in Naga City, the institutionalization of some key elements in the Disaster Mitigation Program is a must to reduce the vulnerability

of the major sectors of the community at risk due to natural hazards. These elements are as follows:

a) Strengthening of organizational management support and linkages;

b) Enhancement of support services of weather forecasting, information and education dissemination, rescue and evacuation, relief operation, etc.;

c) Establishing regular collection of data during and after typhoon and floods, which could be systematically stored into a data bank. The same could be used in the continued studies on disaster mitigation which could identity and update mitigation strategies; and

d) Generation and/or optimizing resources in implementing proposed programs and projects.

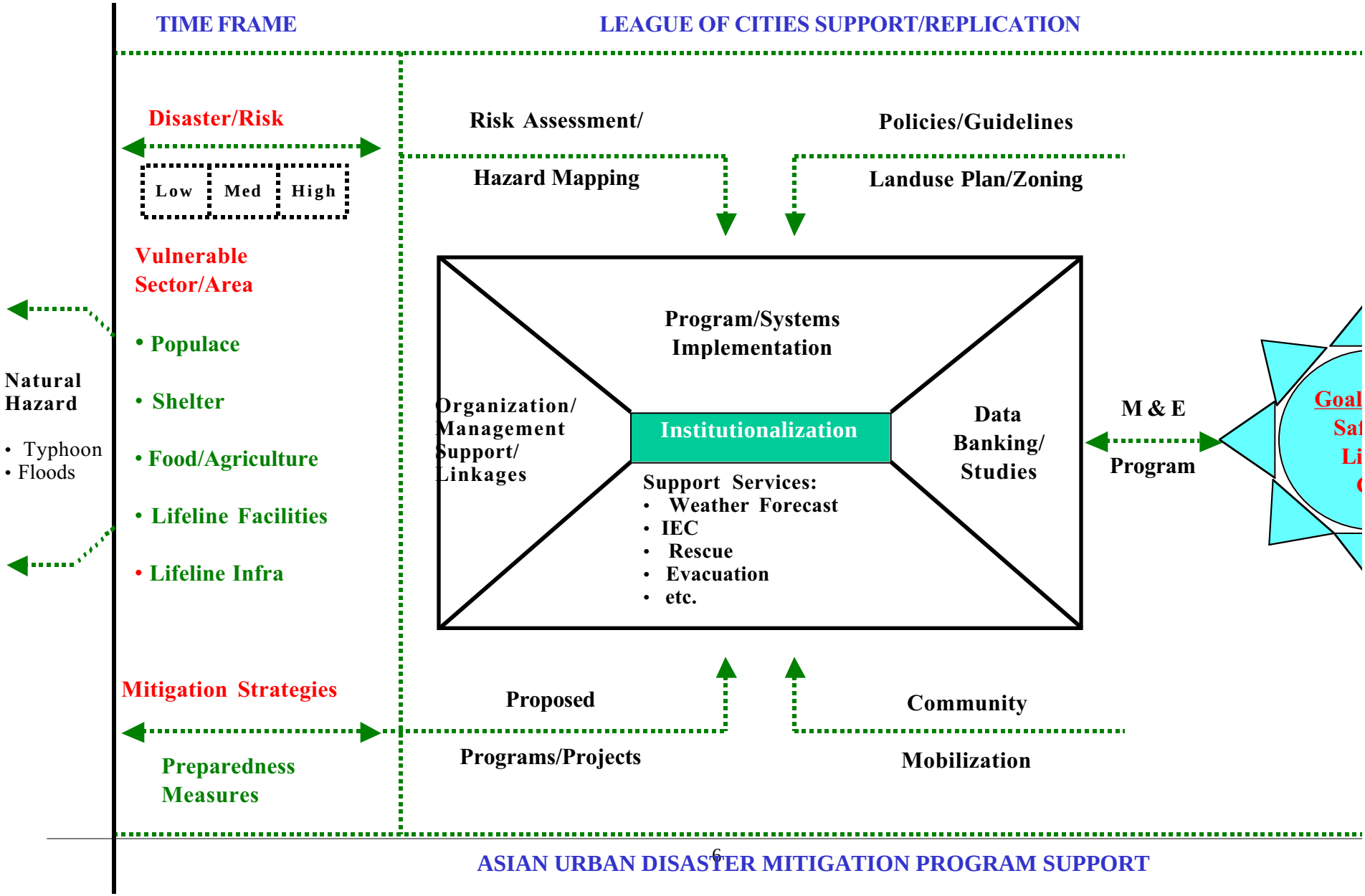
Once the above key elements become operational, the mitigation strategies could be further refined to continuously, reduce the vulnerability of the identified key sectors of the community. This could be realized through:

- Enhanced risk assessment and hazard mapping;
- Adoptable landuse and zoning plans supported with dynamic policies and ordinances;
- Updated programs and projects; and
- Strong community participation in planning and implementation of disaster mitigation programs.

1.4.2 Other Key Features of the Framework

A strong Monitoring and Evaluation program shall be established to assess the various contributions to the attainment of the goals/vision of the program. This would include the evaluation of the continuous risk assessment and hazard mapping, implementation of policies/guidelines and the land use plan and zoning, implementation of proposed programs and projects, and the community mobilization and participation. The other key elements that would contribute to the attainment of the program goals/vision are the support of the LOC and the AUDMP. Hopefully, this exercise could be replicated in other members of the LOC.

Figure 1. Naga City Disaster Mitigation Planning/Implementation Framework



1.5 PLANNING ORGANIZATION AND STRATEGIES

1.5.1 Participatory Approach

In terms of process, the conduct of the study adopted a participatory approach recognizing the primacy of what the stakeholders want and need. The political leadership, other concerned government agencies and private sector groups involved in disaster-related programs and more importantly, the local communities concerned were consulted, through series of consultation meetings and workshops, in all phases of the project study. They were able to provide the values and ideas from which the assessment, the disaster mitigation plan and consequent actions were appropriately developed. The purpose is to ensure greater acceptance, commitment and support to the plan and eventual sustainability of the planning efforts initiated under this project. This was done by working closely with the Naga City Mitigation Council, chaired by the City Mayor of Naga, and the organization of the Study Team, comprising the Counterpart Staff and the TA Team.

1.5.2 Use of Existing Data

The NCDMPU, as mentioned earlier, has undertaken community-based survey and hazard mapping. Through this process a lot of data were collected and stored in anticipation for this study. Given this situation, and considering the limited time and resources for collecting primary data, it was agreed to fully utilize the available data and other secondary information that are available in other agencies. Since most of the data were not compiled in proper forms and format for analytical purposes, a lot of effort was taken by the Study Team to restructure the available data. As needed, validation surveys through rapid appraisal and field assessments were undertaken to confirm and supplement existing data.

1.5.3 Working Arrangement

The Study Team composition, comprising of the Technical Counterpart Team from the City Government and the Technical Assistance Team, was designed to formulate a more adoptable Disaster Mitigation Plan. The arrangement was for the Technical Counterpart Team to facilitate access to all needed information, collection of additional data as required, and coordination with other units and institutions for their participation in the review and planning formulation through consultation meetings and workshops. In the process of their participation, the counterpart staff has undergone On-the-Job Training (OJT). On the other hand, the TA Team's main concern was to analyze and interpret the data for use in the planning process. These include the risk and vulnerability assessment, and the formulation the disaster mitigation plan based on the data interpretation and recommendations of all concerned sectors in Naga City.

The City Government has designated the office of the NCDMPU as the coordinating center of the Study Team, particularly in the collection and compilation of data and other administrative requirements. To facilitate the analysis portion of the study, the TA Team has undertaken the analysis and plan formulation in their respective offices, using the OIDCI's office as the main service center in the Manila operation of the study.

1.5.4 Technical Approach of the Study

Following the Naga City Disaster Mitigation Planning/Implementation Framework, the project study was divided into four (4) major phases as follows:

i. Risk Assessment and Hazard Mapping

ii. Vulnerability Assessment

iii. Mitigation Measures Strategy Formulation

iv. Disaster Mitigation Plan Formulation

CHAPTER 2

PROJECT SETTING

2.1 PROJECT LOCATION

Naga City is centrally located in the province of Camarines Sur and nestles at the foot of Mt. Isarog. It is about 377 kilometers south of Manila and about 100 kilometers north of Legaspi. Naga is placed on the Philippine Map between 13 to 14 degrees North Latitude and between 123 to 124 degrees East Longitude. It is bounded on the north by the municipalities of Canaman and Magarao, on the east by Mt. Isarog and the Municipality of Pili, the capital town of Camarines Sur, on the south by Milaor, and on the west by the Municipality of Camaligan (*Figure 2)*. These municipalities and Naga City comprise the Metro Naga Council.

Naga is classified as a first class city with 126,972 residents (*1995 census*) that expands to more than 180,000 during the day. It has 27 barangays on a land area of 7,748 hectares. About 54 percent of the land area is devoted to agriculture, 29 percent to residential and only 7.23 percent remains as forest parks and reserves.

Naga City is the door to the Bicol Region. When typhoons flood the city and inundate its main national highways, a major lifeline for commerce and delivery of services is shut down. As the catch basin of Region 5, flood waters from Mt. Mayon in Albay, Iriga of Rinconada area, and other areas rush towards the city on its way to San Miguel Bay. Naga City and a large portion of its nearby municipalities known as Metro Naga are situated within the flood plains of the Bicol River Basin. The Naga River which straddles the city is a tributary of the Bicol River that accumulates floodwaters largely from the provinces of Albay, Camarines Sur, and Camarines Norte, and conveys excess runoff into San Miquel Bay. The urban center of Naga City, comprising 17 barangays, lies between 1.00 to 5.00 meters above mean sea level. Sudden atmospheric and meteorological changes during typhoons makes it vulnerable to tide levels and storm surges from Naga River's confluence with the Bicol River up to its outlet at San Miguel Bay.

2.2 CLIMATE AND WEATHER

Naga falls within the Type II climate under the Modified Coronas Classification. This is characterized by a definite absence of dry season and a very pronounced maximum rainy period from November to January. The normal annual average rainfall for Pili, Camarines Sur (the recording station closest to Naga City) is 1,166 mm; and the normal annual average temperature is 27.1^{o}C.

Figure 3 shows the climate map of Pili, using Walter's Climate Diagram method. In this method, both rainfall and air temperature were used. In this climate map, the period during the year with a monthly rainfall more than 100 mm is shown (i.e., May to December). During this period, the soil is believed to be saturated, whereby any soil disturbing activities in the higher slope will greatly enhance soil erosion. As shown, the rainfall curve has always been higher than the temperature curve implying that there is no severe drought within Naga.

Figure 2. Location Map

This also indicates that under normal climatic conditions, there is sufficient moisture in the soil to support some upland crops during the period from January to May.

The highest average monthly rainfall is 323 mm (November) and the lowest average rainfall is 37 mm (April). The highest monthly temperature is 29°C (May and June), and the lowest monthly temperature is 25°C (January).

An average of 20 tropical cyclones of various strength pass through the Philippines' area of responsibility every year. The Bicol Region including Naga City is visited by an average of 5 typhoons annually. The region in fact falls within the typhoon belt.

2.3 EXISTING LAND USE: *WHYS AND WHERE FROMS*

Viewed from above, the land area of Naga City is formed like a ship with its bow facing east towards Mt. Isarog, and its stern sitting west just about the junction of the Bicol and Naga rivers. It is at this westernmost tip of Naga where its urban area is located. It is an old city by Philippine standards having been founded in 1578 by a conquistador (Pedro de Chavez), not yet two decades since the arrival in force of the Spanish colonizers.

<u>From Manila, the CBD (Central Business District) at Once</u>:

From Manila along the Pan Philippine Friendship Highway, one enters Naga City from the South, specifically from the direction of the town of Milaor. The approach to Naga City from Milaor is marked by the appearance of a string of a number of commercial structures along both sides of the Pan Philippine Highway. In between these structures are farmer huts whose households obviously tend to the rice lands beyond the warehouses, mills, buying stations and other commercial units along the highway. As one crosses the Bicol River, the rotunda indicates the entry to the City's built up area. Around are the unmistakable patterns of urbanization: contiguous residences interspersed with commercial activity. Driving farther, one is suddenly confronted with the city's urban core. On both sides of the road, commercial activities proceed oblivious of anyone's movement. Having crossed one river, the Bicol River, now one must cross another, the Naga River.

The Naga River is where the famous translacion fluvial parade of the region wide festival of Peñafrancia is held. Crossing this river, one becomes aware that the area is the entry to the central business district of the city. The CBD is concentrated in about a dozen and a half small blocks and one could walk briskly around it and inside in an hour and a half. Almost at its center are two parks and one multi-purpose covered stage facing an open court. One of these parks, called Rizal park, is acclaimed as the Hyde park of Bicol because of the freedom of activity within it as well as its popularity as a spontaneous debating court. Beyond these public parks, after a smattering of light commercial activities, one will discover the reason why the city likes to call itself the educational and religious center of the Bicol region.

2.3.1 Naga is Bicol's Center of Institutions and Traditions

Turning into one of the interior roads from the Northern end of the park, one runs into the gate of the University of Nueva Caceres. Backtracking then walking along the city's main artery, one can see a huge cathedral and the ancient walls of the oldest major seminary in the country. To the rear of the cathedral and the major seminary is the Jesuit run Ateneo de Naga, acclaimed as one of the region's best schools. Across the road from the cathedral is the high wall of the Catholic Archbishop's residence, which occupies practically an entire city block. Next to the Archbishop's residence is one of the oldest schools for young women in the entire Far East, the Colegio de Sta. Isabel. Along the street of the Colegio is the Camarines School of Arts and Trade (CSAT), one of the biggest public school of its kind in the country. Still farther but proximate to the CSAT is Naga College, a private college. As one walks on, he will get to the Shrine of the Virgin of Peñafrancia where, until recent times, the statue of Our Lady of Peñafrancia was lodged. These institutions are just a few of the many that give Naga City its character as a university town and religious center.

Like old cities established by the Spaniards, the urban core of Naga was established not only around the trading area, but more so around its Catholic cultural cluster which was the headquarters of Spanish missionaries proselytizing throughout Southern Luzon, including islands around it, in the 16th and 17th centuries. In fact, Naga at one time was the seat of the Holy See in the Philippines and was the center of the most extensive archdiocese, Nueva Caceres, which practically covered all territories South of Manila up to the San Bernardino Straight at one time.

Indeed the city is really known for the great festival of the Peñafrancia which finds the revered statue being brought out of its shrine northeast of the city, carried in a fluvial parade along the Naga river and transferred to the Naga Cathedral in the center of the city for the duration of the festival. At the end of the fiesta, the Lady of Peñafrancia is brought back to the shrine in the same manner as before. These features: the statue of the Virgin, the shrine, the river, the Cathedral are the historical and current composites of the memory of those who have known Naga. Subordinate only is the recollection that the city has the biggest public covered market in the country called "supermarket" by the locals. Curiously, it is Rizal Park, the Hyde Park of Bicol, that is also retained in the memory of visitors after the Peñafrancia.

2.3.2 Naga City Development: Roots and Land Use Pattern

The central business district of Naga in the sense of being the trading area of the city has apparently remained locationally unchanged since Spanish times. It has of course expanded northeast beyond its original area near the Naga River and occupied the sites of the original provincial government headquarters and the old provincial jail. It has also widened. Most of it lies within the Barangays of Dinaga and Igualdad, although it has spilled over to the Barangay of Sabang, in the triangular area carved by the Bicol and Naga rivers, and Abella, on both sides of the road artery all the way to the boundary of Camaligan. Thin strips of light commercial activities also appear from the bank of the Bicol River in Barangay Tabuco towards Milaor. Light to medium commercial activities also dots both sides of Peñafrancia Avenue from San Francisco up to the walls of the Archbishop's place. At this point, the

institutional cluster remains where it was established since the 17th century.

The historical pattern is the market area was by the river (in the 16th, 17th and 18th century, the Bicol River was the foremost transportation artery) near where the public "supermarket" is now and the religious cluster was some distance from it and directly on the topographic line delineating an elevation of 5 meters. In other words, the religious cluster was not only some distance from the hustle and bustle of worldly activities; it was also built in relatively higher ground. In between the place of commerce and the Cathedral, the government administrative cluster with its police headquarters and jail located itself as if to mediate between the affairs of the market and pronouncements from the pulpit.

It is, therefore, not surprising that to this day the center of Naga's built-up area is shared by a robust business district on one hand, and a conservative cluster of religious and educational institutions on the other. From this dual core, the city stretches out in five directions. To the north, from the Cathedral complex, the Ateneo and Colegio, it moves along Bagumbayan road among old houses until it approaches the boundary with the separate municipality of Canaman, whereupon residential subdivisions occupy the spaces on both sides of the road going beyond Naga. To the northeast, the built-up area hugs the Naga River almost up to its headwaters. Here can be found several new developments including the new Basilica of Peñafrancia. To the west, the central business district, having expanded and spilled over residential areas over the years, does business alongside the Bicol river town of Camaligan, which is already a contiguous part of a Metro-Naga conurbation. To the south, on the other side of the Bicol River, some new commercial establishments lining the highway up to the boundary of Milaor town pockmark the flood plain.

To the east, the CBD bursts out in the direction of the national road named Panganiban Drive until the road merges with the Pan Philippine highway as it proceeds towards the provincial capital town of Pili on the way to far away Albay. In this area, an urban strip development is in the making from the beginning of and all along Panganiban Drive then along the Pan Philippine highway up to the city boundary with Pili. Housing, many of them recent, and new light commercial establishments fill up interstices north of the Panganiban Drive. These merge with movements in the higher eastern portion of the city where developments in housing have started moving vigorously from the Dayangdang area going east into hitherto agricultural areas.

The urban area (*see Figure 3, Urban Land Use*) is concentric in orientation. Its built-up area occupies roughly ten percent of the City jurisdiction. Within this ten percent area, 58 percent of its 126,972 population (1995 Census) work, rest, pray, study, play, shop, and sleep. That is, until it floods.

2.4 GENERAL SOCIO-ECONOMIC FEATURES

Naga City is among the 3 major cities in the Bicol Region centrally located in the province of Camarines Sur. It is the smallest city in the region occupying an aggregate land area of 7,748 ha., about 1.5 percent of the entire province of Camarines Sur.

2.4.1 Demographic Pattern

Population in the city was placed at 126,972 persons in 1995 (*see Table 1*), the highest reported among the cities in the Bicol Region. This accounts for 18 percent of the total population in Camarines Sur and some 3 percent of the regional total. Relative to the national average (2.23 percent), annual population growth in the city is comparatively lower. Population grew by an

Table 1. POPULATION AND HOUSEHOLD BY BARANGAY (1995)

Barangay	Area (ha.)	Population	No. of Household
1. Abella	22.11	5,740	1,043
2. Bagumbayan Norte	23.32	1,952	425
3. Bagumbayan Sur	56.86	5,544	1,071
4. Balagtas	182.01	5,719	1,014
5. Calauag	49.77	6,707	1,209
6. Cararayan	972.28	5,469	1,024
7. Carolina	1,605.29	3,330	597
8. Concepcion Grande	306.37	7,598	1,432
9. Concepcion Pequeña	333.06	15,615	2,832
10. Dayangdang	29.57	5,216	936
11. Del Rosario	201.52	5,021	1,005
12. Dinaga	7.35	741	146
13. Igualdad Int.	9.86	2,620	519
14. Lerma	3.82	2,363	411
15. Liboton	25.31	3,269	659
16. Mabolo	105.26	5,751	972
17. Pacol	1,184.61	3,146	630
18. Panicuason	1,413.22	1,366	214
19. Peñafrancia	37.57	5,644	1,024
20. Sabang	41.06	6,179	1,080
21. San Felipe	518.25	3,977	809
22. San Francisco	10.54	1,483	318
23. San Isidro	229.81	1,698	306
24. Sta. Cruz	65.03	6,135	1,186
25. Tabuco	147.63	4,392	826
26. Tinago	34.46	3,721	738
27. Triangulo	132.06	6,576	1,206
Total	**7,748.00**	**126,972**	**23,632**

average of 1.94 percent annually from 1990-1995. This is more or less the same growth pattern registered by Camarines Sur and the region as a whole.

Average population density is 16 persons per ha.; the highest density registered relative to the other cities and the entire Bicol Region. By NSO definition, Naga is classified as entirely urban having a population density of at least 10 persons per hectare.

Of the total population, some 84 percent are concentrated in the poblacion while the rest are sparsely distributed in the outlying areas of the city. The urban population density of about 49 persons/ha. is three times higher than the city average indicating an overcrowding in the urban side of Naga. The rural areas of Naga however only registered an average population density of about 4 persons per hectare.

The increase in the city's population is 1.5 percent attributed to migrants from other areas. This shows that the city is an in-migration area.

2.4.2 Demographic Characteristics

The city's population is composed of some 23,632 families in 1995 with an average household size of 5.37. The female population is slightly higher than the male with a ratio of 105 females for every 100 male population. It has a relatively young populace with 67.2 percent under 30 years of age.

Ethnic composition of the population shows an intermixed community of Bicolanos and migrants mainly composed of Tagalogs. However, Bicolanos are still the dominant ethnic group comprising some 92 percent of the total population.

Naguenos are predominantly Roman Catholics, Naga being the seat of the Archdiocese of Caceres since the Spanish time. It is also the center of religious festivities in the Region with the annual feast of our Lady of Peñafrancia as the highlight of the biggest Marian devotion in the country, gathering the Bicolanos together in religious celebration.

Literacy rate is very high at 98 percent. The city serves as the center of education in Bicol with the preponderance of schools offering pre-school, elementary, secondary and tertiary education. There are 133 day care centers, 32 and 16 public and private schools offering elementary and secondary education, respectively, 7 vocational schools and 13 colleges and universities, 2 of which are government-run.

The leading causes of mortality and morbidity in the city are mostly diarrhea and respiratory-related illnesses (pneumonia, influenza, PTB). These are largely water-borne diseases, which are indicative of water quality and sanitation condition in the city. Health services and facilities are more than adequate to serve the city's population with a high bed to population ratio of 3.9 per 1,000 population and surpassing the health manpower standard of 1 doctor/dentist per 20,000 population (current ratio is 1:684 for physician and 1:1,294 for dentist).

Some 72 percent of the city's population own houses and the rest are either renting or squatting. Naga's urban poor population that is mostly squatters was estimated in 1997 to comprise some 5,000 families. This group is the target of the city government's resettlement program.

2.4.3 Labor Force and Family Income

The city's labor force (population 15 years and over) comprises some 68,771 persons or 60 percent of the entire population. Of the total labor force, about 57 percent are considered economically active. Unemployment rate is around 5.4 percent.

The average monthly income of families with a mean household size of 5 members is estimated at P3,532. Poverty threshold level in the region in 1995 based on income was estimated at P8,319 annually. Urban poverty incidence in the region is estimated at 39 percent of the urban population. This corresponds to about 40,000 people or 7,400 households of the city falling within the poverty line.

2.4.4 Economic Base

Naga remains primarily an agricultural city in terms of land use. Almost 55 percent of the entire land area of Naga is devoted to agriculture (see *Table 2* for land use allocation). The productive agricultural lands are concentrated in the upper barangays of the city. Major crops planted include rice, coconut, corn and sugarcane. In terms of hectarage, rice occupies the majority of arable lands. The city has also a thriving livestock industry where some 16 commercial livestock and poultry farms operate.

Table 2
Land Use Allocation, Naga City

LAND USE	TOTAL AREA (has.)	PERCENTAGE DISTRIBUTION
a) Residential	2,271.18	29.31
b) Commercial	321.60	4.15
c) Light Industrial	54.10	1.70
d) Agro-Industrial	140.10	1.81
e) Agricultural	4,256.91	54.94
f) Agricultural Nursery	4.29	0.06
g) Institutional	70.20	0.91
h) Parks/Plaza/Open Space	1.14	0.01
i) Forest Parks and Reserves	560.00	7.23
j) Cemetery	23.80	0.31
k) Dumpsite	3.48	0.04
l) Water Bodies	41.20	0.53
TOTAL	**7,748.00**	**100.00**

The contribution of the agricultural sector to the city's economy is, however, not established. This is presumed to be not that substantial compared to commerce and industry.

In terms of the service sector, Naga is considered as the undisputed center of trade and commerce in the province and in the region. It boasts of most of the large businesses from retailing to wholesaling, entertainment, and financing and other services. Records show that it has a total of 4,950 business establishments registering a growth rate of a little over 100 percent since 1987. Revenue contribution of the service sector amounted to some P70 million in 1997 from only about P30 million in 1994.

The main business center of the city however covers only about 30 hectares corresponding to about 16 commercial blocks. In view of the limited commercial space, land value in the CBD is skyrocketing with the recent selling price of an average of about P40,000 per sq. meter. A new CBD is being developed along the Panganiban Diversion Road area to address the congestion problem in the main CBD. Other interventions to disperse development away from the main CBD include development of idle lands such as those of the PNR lands along Panganiban Drive and development of satellite markets.

The industry sector of Naga is still at a nascent stage. This comprises of some 378 manufacturing industries, which are mostly cottage type. These include food processing, metal works, furniture, body building/auto shops, warehousing and storage concentrated mainly in Concepcion Pequeña, Concepcion Grande, Del Rosario, Abella and Mabolo.

The tourism sector, except for the Peñafrancia fiesta, is still to be developed to attract substantial share in the tourism market for both domestic and foreign tourists.

2.4.5 Basic Infrastructures and Utilities

The city's road infrastructures are already well developed exceeding the national standard road-area density ratio of 1 km per 100 ha. Other modes of transport available include boats to reach neighboring riverine towns, by train through PNR's southline railway and by air through the Naga airport.

The city's domestic water requirement is serviced by 4 waterworks systems, the largest of which is operated by the Metro Naga Water District (MNWD) with service area coverage extending to neighboring towns of Canaman, Pili, Camaligan and Magarao. Three smaller systems service the upper barangays of the city. The MNWD water sources include 2 springs in Pili and 7 deep wells located mostly in the low-lying areas of Naga, except that of San Felipe. Average daily production of MNWD is 20,110 cu.m. There is no data on the aggregate water demand of residential and commercial users in urban Naga to compare existing supply.

Solid waste management in the city is handled solely by the General Services Division of the city government. Garbage generated in 1997 was about 94 metric tons with reported collection efficiency of 80-85 percent. The garbage disposal area of Naga is a dumpsite which is already loaded. A new site is being negotiated to establish a sanitary landfill.

2.5 EXISTING FLOOD CONTROL STRUCTURES AND FACILITIES

2.5.1 Existing Drainage System

Most of the natural waterways and drainage creeks in the city have been silted or built-over with structures blocking the natural flow of flood waters. The absence of any natural drainageways subject the low-lying areas to prolong flooding even during moderate rainfall.

A storm drainage master plan has been prepared for the city in 1981. This was not however evaluated because the plan was destroyed during one of the major floods that inundated the City Engineer's Office. In the absence of such master plan and corresponding updating, drainage improvement becomes difficult especially considering the rapid changes in the land use of the city.

Based on available maps and rapid field assessment undertaken by the study team, the poor condition and inadequacy of existing drainage system have been found to further exacerbate flooding in the city. While drainage facilities are constructed, localized flooding continues to be a major problem. In the general layout of the existing waterways, most of the storm run-off is directly discharged towards Naga River which is the nearest main waterway. Under normal condition when the water level is low, the street run-off is drained into the river. When the water level rises, the floodwater reverses direction, enters the open outfall, flows into the drains and eventually spreads floodwater into the streets. As Naga River overflows its banks, the floodwater travels above ground and follows the ground gradient which is away from the river and into the natural depressions located in Bgys. Triangulo, Abella and Igualdad. Failure to consider the backflow effect causes more flooding. In addition, the construction of street drainage facilities have been found to be unsystematic and inconsistent with the capacity requirement. Moreover, poor maintenance of the existing drainage system also contributes to the occurrence of localized flooding. *Figure 6* shows the areas, mostly near the low riverbank, that are prone to flooding.

2.5.2 Naga Tidal Structure

A tidal gate structure that also serves as a bridge has been constructed along Naga River (connecting Tabuco and Sabang) near the confluence with Bicol River. One of the purposes of the tidal gate structure is to control the flow of Naga River during the annual Peñafrancia fluvial parade. The structure has 8 bays with a two 4.0 x 1.0-meter gates each. The facility seems to have no clear guidelines on gate operation. The structure is not equipped with any manual or mechanical lifting mechanism except for a standby crane. The construction of the facility could affect the flow capacity of the river especially with very small clear gate opening. During flood flows, these bridges usually accumulate debris which provide damming effects, causing the increase of flood levels upstream which aggravate the inundation of the low lying areas near the river banks.

2.5.3 Camaligan Flood Forecasting Station

PAGASA has established a flood-forecasting network for the whole Bicol river basin. Rainfall and river stage data are collected by telemetry system that send the data to the Flood Forecasting Center in Manila. Part of this hydrometeorological telemetry system is the Camaligan Station that observes in real-time the river stage and rainfall depth. The Camaligan station also receives the weather and domestic bulletin prepared in Manila for dissemination to the local radio and TV stations, while the flood bulletin is prepared in the Camaligan Station. The equipment of the station are quite old including the computer system. There is no real flood forecasting being undertaken but more of monitoring since no prediction is made on the occurrence of the flood level.

2.5.4 Typhoon 99 Website

A special website was created and maintained by Michael Padua, an amateur meteorologist in Naga City, that features current information on storms and typhoons occurring in the Philippine Area of Responsibility (PAR). The website address is http://geocities.com/capecanaveral/6825. The weather data and satellite images are compiled from international weather offices of the United States and Hawaii, Japan, Philippines and other countries. Beside the current weather forecast, the website also contains data on past storms that includes the typhoon tracks, storm warning or category, maximum 1 min. sustained wind speed, lowest atmospheric pressure and rainfall depth. There are also links to other websites that have similar information and interest. Another interesting website is the Federal Emergency Management Authority (FEMA) whose address is http://www.fema.gov. FEMA has data and information on the effects of significant storms on building and infrastructures.

2.6 EXISTING DISASTER MITIGATION ORGANIZATION AND MANAGEMENT STRUCTURE

2.6.1 Existing Special Bodies on Disaster Mitigation Implementation

There are three (3) major special bodies involved in disaster mitigation management operating in Naga City. The City Mayor chairs all these special bodies and the main features and functions are shown in *Table 3* and summarized as follows:

i. Naga City Disaster Coordinating Council (NCDCC) - Organized under PD 1556, it is part of the network of the National Disaster Coordinating Council Chaired by the Secretary of Defense. The Council is being supported by the Office of Civil Defense (OCD). The Council is, however, perceived as a body for disaster rescue operation and post disaster assistance operation only. No regular activities have been undertaken for disaster mitigation.

Table 3

Other Special Bodies – On Disaster Mitigation

Title	Chairman	Member	Meetings	Function Feature
1. Disaster Coordinating Council under PD 1566	Mayor	• PNP Station Commander as Vice Chairman & Action Officer • Organic City Officials • National Officials assigned to the City • NGOs	As required	• Pre-disaster planning, community disaster preparedness, disaster control action for rescue, evacuation relief and rehabilitation
2. Emergency Rescue Naga • Board of Trustee	Dr. R. Ursua/ City Mayor as Co-Chairman	• Mr. D. Claro, Sec • Mr. F. Cu, Treasurer • Ms. J. Crescini, PIO • Mr. D. Dy, Business Mgr. • Dr. M. Jamito, Jr.	As required	• Chief Operations Officer of ERN • Technical & Communications Group Chairman • Training of Paramedics • Medical Assistance Group Chairman • And other Cooperating Associations, Hospitals, College & Universities, PNP & Fire Bureau, and Volunteer Groups
3. Naga City Disaster Mitigation Council: Mayor, EO	Mayor	• Selected Organic City Officials • Sangguniang Member Representatives • NGOs • Selected National Agencies (OCD, DECS) • PNP • Fire Bureau	As required	• Presence of Project Office • Implement Disaster Mitigation Program in Coordination with AUDMP and PBSP

ii. Emergency Rescue Naga (ERN) - Organized by the City Government of Naga in May 1991, ERN is composed of governmental and non-governmental civic oriented professional and non-professional volunteers designed to provide efficient quick response to different types of emergencies/disasters needing medical services in Naga City. The City Government has committed the facilities of the Naga City Hospital as the operating center of the ERN, subsequently designating its Chief of Hospital as the Chief Operations Officer. An adhoc Board of Trustees was organized in the early part of its operation. The Board was quite inactive for sometime while the ERN continued its operation with the full support of the City Government and the Volunteer Groups. Due to its effectiveness in promoting volunteer rescue operations, the active volunteer members have recently organized the Emergency Rescue Naga (ERN) Foundation, Inc. After electing the first set of Board of Directors and Officers, they are now moving to formally register the Foundation with the Securities and Exchange Commission. The main thrust of the foundation is to provide an effective and efficient response and to establish measures at the earliest possible time to minimize damages to lives and properties during and after disasters. It shall coordinate, monitor, initiate, support preventive measures, consolidate damage assessment, and propose policies that will

facilitate smooth and effective operation of the City Government in the event of natural and man-made disasters.

iii. Naga City Disaster Mitigation Council (NCDMC) - Organized as the Naga City Disaster Management Team under Executive Order No.98-005 signed by the City Mayor on June 02, 1998. The Team was organized primarily to coordinate with the AUDMP-LOC-PBSP in the implementation of the Disaster Mitigation Program. Through series of meetings, the Team has evolved into what is known today as the Naga City Disaster Mitigation Council. No formal document was issued for this evolution. According to some key officers, this change was based on the popular decision of the membership, which has increased from 15 to 29. The council in collaboration with the PBSP has organized the planning workshop last July 16-17, 1998 as its first major effort, since the inception of the Project in November 1996, in pursuing vigorously the project activities. The output of the planning workshop became the basis for the activities of the Project Office in the community orientation cum socio-economic survey, and flood hazard mapping.

2.6.2 Naga City Disaster Mitigation Project Unit (NCDPMU)

An Adhoc unit organized by the City Government under the Office of the City Mayor as its counterpart to PBSP's effort in implementing the decision of the NCDMC. The unit is acting as the coordinating center in the implementation of the Disaster Mitigation Program. The Unit is headed by a designated Project Officer from the Office of the City Mayor, and manned by six (6) Government Internship Program (GIP) Trainees, and Youth/student Volunteers. A local consultant was hired by the City to augment the technical capability of the project staff. An office space was also provided. In addition, the EDP unit, with GIS capability, was committed to provide all digitized maps of the project. On the part of the PBSP, a full time Project Coordinator was assigned to work closely with the project staff. The project office is being managed jointly by the Project Officer and the Project Coordinator. However, the absence of a formal agreement between the PBSP and the City Government on the counterparting arrangement has set some misunderstanding in the administrative and financial operations of the project office.

2.7 EXISTING DISASTER MITIGATION MEASURES

Most of the programs on disaster mitigation measures presented by Line Agencies during the June 7-8 Workshop were on disaster preparedness, rescue operation and post disaster relief assistance operations. The agencies who are directly involved in these operations are the Office of Civil Defense; Social Welfare and Development Office; Department of Education, Culture and Sports; Philippine National Police; and the Naga City Fire Station.

2.7.1 Naga City Disaster Mitigation Program

The City Government has adopted several programs to reduce the vulnerability of Naga City from flooding and typhoon hazard. These major programs are as follows:

i. Drainage Improvement Program

The drainage improvement program has been a continuing activity of the City Engineers Office in an attempt to reduce flooding duration in the area. In the early part of 1981, a storm drainage master plan was prepared under the Program for Essential Municipal Infrastructure Utilities Maintenance (PREMIUM), a World Bank Assisted Program. The whole study was lost during one of the major floods that inundated the office of the City Engineer. Given the current situation, without any guide for drainage development, the construction of drainage facilities are not systematically implemented. Much worst is that the capacities of the drainage facilities to evacuate flood waters are not quantified.

ii. Adoption of the Naga City River Watershed Strategic Management Plan

This program includes the following components: river park development, relocation of squatters, easement recovery and development, revetments, and restoration and maintenance of vegetative cover. The City Government has started the easement recovery and development program in some portion of the Naga River. This has, however, spawned some problems that include the occupation of the easement area by squatters.

iii. The La Niña Task Force

In anticipation to the occurrence of La Niña, the City Government has organized a La Niña Task Force, with the City Health Office taking the lead. There are 17 barangays out of the 27 barangays that are identified as flood-prone areas (*see Table 6*). A massive information campaign in coordination with the Barangay Councils was undertaken. A Plan of evacuation was formulated with the concerned barangays. Evacuation centers were also identified for each flood prone barangay, as shown in *Table 4*. The plan was put to test during typhoon Loleng in 1998. Although the evacuation centers allocation per barangay was not totally followed, the plan facilitated the evacuation of about 16,093 persons in various evacuation centers within and outside their respective barangays (see *Table 5*). It was observed that the evacuees preferred to evacuate on safe buildings within their barangays, or near their residence. This preference is quite understandable. First, they can easily transfer with less risk due to strong wind, and secondly, proximity of the evacuation center to their residence give them some confidence and security that their houses will not be ransacked by thieves since they can oversee their area at any point of time.

iv. Private Initiative.

The common practice of some residents in Naga, for those who can afford the cost of land filling, is to elevate their buildings above the recorded flood levels. This has, however, created pockets of low lying areas without drainage, making their situation worse than before.

Table 4: Recommended Evacuation Centers Under La Niña Program
Naga City

Barangay	Evacuation Centers
1. Abella	Jade Bldg., Bichara Complex, High Rise Building within the Barangay, PNB, Grand Special Plaza, and Naga Central School II
2. Lalauag	Calauag Elementary School, and Barangay Hall of Calauag
3. Dayandang	Cararogan Elementary School, and High Rise Building within Barangay
4. Dinaga	High Rise Building within Barangay, and Naga City Public Market
5. Igualdad	Naga City Public Market
6. Lerma	Camarines Sur National High School, and High School Building within Barangay
7. Liboton	Barangay Hall of Liboton
8. Mabolo	Concepcion Grande Elementary Schools, and Del Rosario Elementary School
9. Peñafrancia	Camarines Sur National High School, Bicol College of Arts and Trades, Naga College Foundation, Romero Building
10. Sabang	Cararagan High School
11. San Francisco	High Rise Building within Barangay, and San Francisco Church
12. Sta. Cruz	Carolina Elementary School
13. Tabuco	High Rise Building within Barangay, and Local Elementary School
14. Tinago	Mariners Polytechnic Colleges, and Villa Grande Elementary School
15. Triangulo	Concepcion Pequeña High School, and Naga City Science High School
16. Balatos	Mac Mariano Elementary School, and Basilica Hall
17. San Felipe	Maramba Elementary School

Table 5: Evacuation Operations
Typhoon Loleng, 1998

Barangay	Evacuation Centers	# of Persons Evacuated
1. Sabang	Santa Rafaela Center, Cararayon High School, Naga City Supermarket, Naga City Civic Center, Minor Seminary, LCC, and Abella Ice Plant	702
2. San Francisco	DMG Commercial Bldg., Old BIR Bldg., and Carbonel Apartment	413
3. Dayangdang	Naga City Gymnasium, Naga City Youth Center, Valiente Institution, Private Residences, and Barangay Hall	543
4. San Felipe	Barangay Hall	19
5. Calauag	Calauag Elementary School, Barangay Hall	341
6. Concepcion Requens	Concepcion Requeña National High School, Barangay Hall, San Roque Chapel, Maja Seminary, Day Care Center, Camp Headquarters, and Private Residences	720
7. Liboton	Barangay Hall of Liboton	95
8. Tinago	Mariners Polytechnic Colleges Foundation, and Mac Mariano Building	1,218
9. Peñafrancia	CSNHS, BCAT, and Naga College Foundation	622
10. Bagumbayan Norte	United Methodist Church	216
11. Dinaga	Vic theater, Alvarez Bldg., Ramos Theather, Naga City Public Market, and Private Residences	152
12. Tabuco	High Rise Bldgs., and Private Residences	4,194
13. Lerma	CSNHS, Mormons Bldg., CCDI, and Private Residences	936
14. Abella	Naga Ice Plant, Barangay Chapel, Lucky Fortune Hotel, Bensia Warehouse, and Private Residence	1,756
15.Concepcion Grande	Six Evacuation Centers within Barangay	930
16. Triangulo	Naga City Science High School, Mormons Bldg., ACDP/DWAR, and PNR	1,331
17. Igualdad	Bethel Temple Church, Naga City Supermarket, and Private Residences	1,905
TOTAL		**16,093**

Figure 3: Naga City Urban Land Use Map

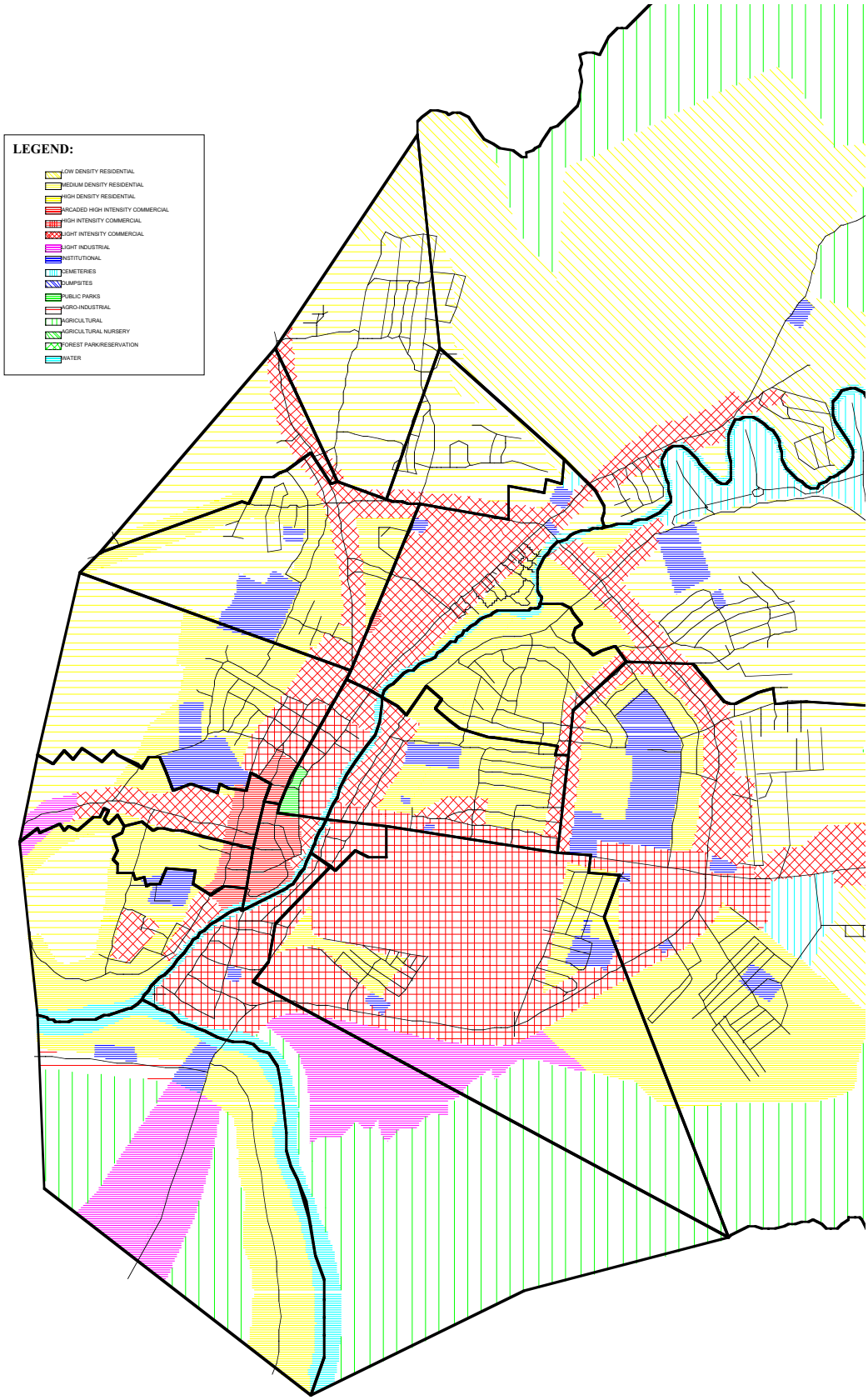


Figure 4.

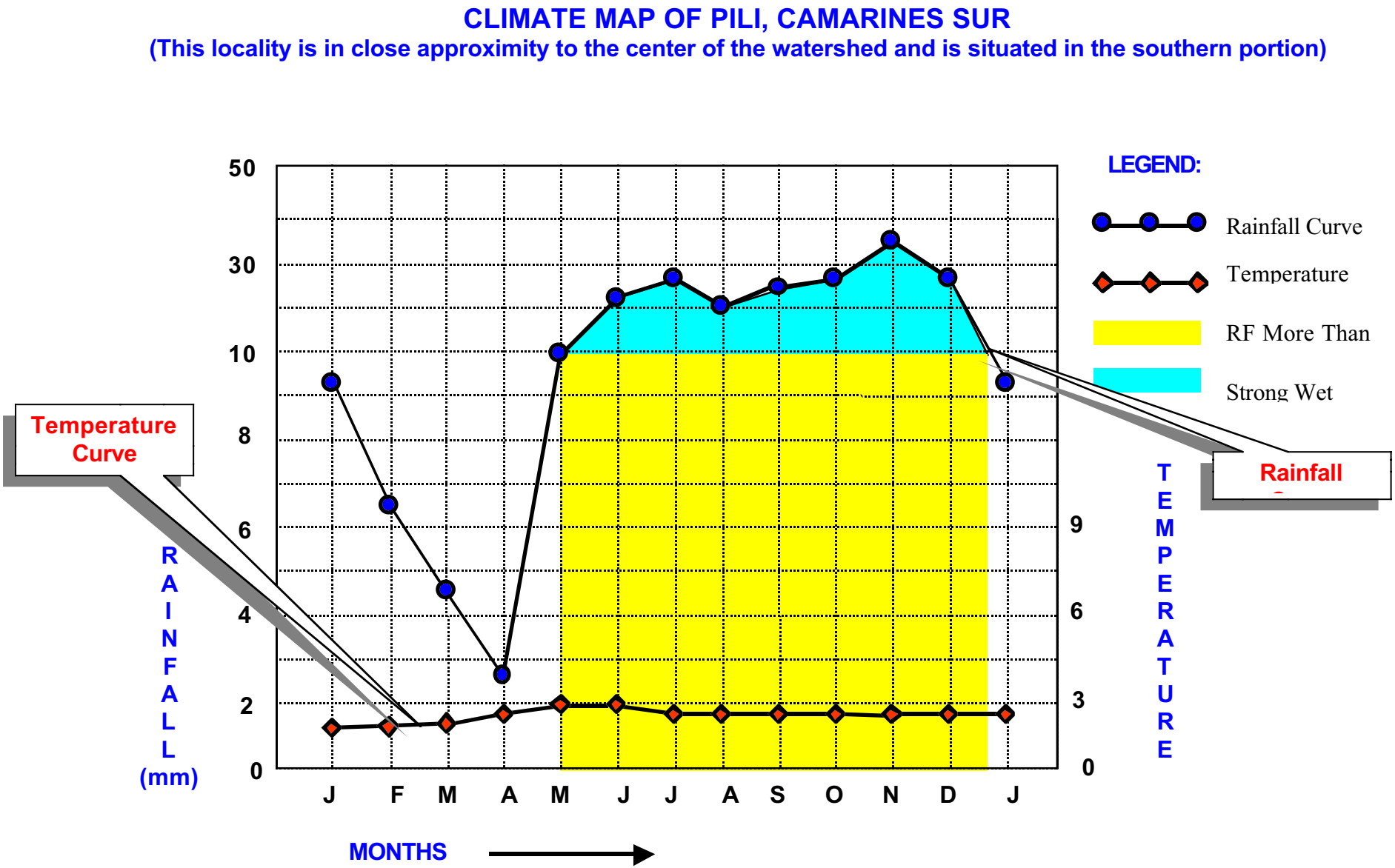

CLIMATE MAP OF PILI, CAMARINES SUR
(This locality is in close approximity to the center of the watershed and is situated in the southern portion)
LEGEND:
Rainfall Curve
Temperature
RF More Than
Strong Wet
Temperature Curve
Rainfall
RAINFALL (mm)
TEMPERATURE
50
30
10
8
6
4
2
0
9
6
3
0
J F M A M J J A S O N D J
MONTHS

Figure 5. A Glimpse of Naga City

Figure 6. Flood Prone Areas

Table 6: Land Use Allocation By Barangay

Barangay Barangay	Total Land Area (ha)	LANDUSE AREA (Ha.)						
		Residential	Institutional	Commercial	Industrial	Public Parks	Agricultural	River
Abella	22.11	8.10		14.01				
Bagumbayan Norte	23.32	19.15		4.17				
Bagumbayan Sur	56.86	38.40	8.49	9.97				
Calauag	49.77	49.38		0.39				
Dayangdang	29.57	26.13		2.41				1.03
Dinaga	7.35			6.36				0.99
Igualdad Int.	9.86	8.30		1.56				
Lerma	3.82			3.74				0.08
Liboton	25.31	23.10		2.21				
Mabolo	105.26	33.63	0.97		17.02		43.19	10.45
Peñafrancia	37.57	5.59	1.30	28.96				1.72
Sabang	41.06	33.45		5.07				2.54
San Francisco	10.54			8.60		0.98		0.96
Sta. Cruz	65.03	47.46	8.11	9.46				
Tabuco	147.63	0.19		19.99	22.73		93.04	11.68
Tinago	34.46	16.35	3.15	14.41				0.55
Triangulo	132.06	37.45		68.08			26.53	
SUB-TOTAL	**801.58**	**346.68**	**22.02**	**199.39**	**39.75**	**0.98**	**162.76**	**30.00**
Balatas	182.01	106.04	21.66	9.64			36.54	8.13
Cararayan	972.28	216.27			62.46		692.58	0.97
Carolina	1,605.29	157.96					1,447.33	
Concepcion Grande	306.37	155.38	33.42	43.18			74.39	
Concepcion Pequeña	333.06	275.92	3.12	26.41			27.61	
Del Rosario	201.52	67.10	2.50	8.38	61.74		61.80	
Pacol	1,184.61	263.00					921.61	
Panicuason	1,413.22	40.28				516.60	856.34	
San Felipe	518.25	235.71	0.59	7.79			270.5	3.66
San Isidro	229.81	50.28					179.53	
SUB-TOTAL	**6,946.42**	**1,567.94**	**61.29**	**95.40**	**124.20**	**516.60**	**4,568.23**	**12.76**
GRAND TOTAL	**7,748.00**	**1,914.62**	**83.31**	**294.79**	**163.95**	**517.58**	**4,730.99**	**42.76**

CHAPTER 3

HAZARD IDENTIFICATION AND ASSESSMENT

3.1 FLOODING AND TYPHOON HAZARD OCCURRENCE

3.1.1 Methodology for Hazard Identification and Mapping

A hazard map classifies the affected areas based on the magnitude of the hazard and the potential physical damage inflicted on the area. It defines the physical extent of the areas at risk. Hazard assessment is carried out for different probabilities of occurrence or return periods. In this study, the hazard assessment was done for a 5, 10 and 20 year return period covering hazards attributed to flooding and storm winds.

3.1.2 Flood Hazard Mapping

In the preparation of the flood hazard map, the magnitude of flooding was assessed using the depth of flooding or inundation while the physical damage was assessed using the land use function. These two parameters were integrated and classified into the flood hazard map.

The steps involved in preparing the flood hazard maps are as follows:

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i. Undertake a maximum one-day probability analyses and determine the equivalent return period of the four storms.

ii. Prepare the flood inundation map using the flood depths at each zone and adjust the depths using the topographic map.

iii. Classify the inundated areas according to the range of flooding depth (low, moderate and high).

iv. Prepare a land use map and classify the area according to its main functions (residential, commercial, industrial, agricultural and others).

v. Prepare the flood hazard map by integrating the flood inundation map and land use map, and classifying the area according to its probable risk (low, moderate and high).

3.1.2.1 Flood Inundation Map

Data available includes the community survey on the depth and duration of flooding of four significant storms, namely Typhoon Yoning (1988), Typhoon Monang (1993), Typhoon Rosing (1995) and Typhoon Sisang (1987). It is said that Typhoon Rosing had produced the most rainfall while Typhoon Yoning had the highest wind velocity.

The Project Office prepared the flood inundation map of the four significant storms. However, they used the average water level in each barangay rather than the actual observed depth in preparing the inundation map and had classified the flooded areas into 3 categories, namely: zero level, alarm level (1-2 feet), alert level (2.1-3.5 feet) and critical level (3.6 feet). The categories which follow the one used by PAGASA is probably more appropriate for flood warning where the water level moves between zero to a maximum level. In contrast, a hazard or inundation map represents a single maximum value.

Before using the storm data, it is necessary to first establish their equivalent return periods. Data on maximum one-day rainfall is available for the four storms. A probability analysis was performed on the yearly maximum one-day rainfall of Camaligan station using the Gumbel probability analyses. The following are the values for the selected return periods.

Return Period, year	Maximum One Day Rainfall, mm
5	223
10	300
20	400

The observed storm rainfall was compared to the observed rainfall for the four storms to obtain the storm recurrence interval or probable return period. The resulting equivalent return periods of the observed storms are as follows:

Observed Storm	Max. One Day Rainfall, mm	Equivalent Return Period, year
1987 Typhoon Sisang	132	1.8
1988 Typhoon Yoning	185	3.5
1993 Typhoon Monang	292	10
1995 Typhoon Rosing	393	20

The inundation maps of the four storms were prepared using the flood depth data on the zone and compared with the contour elevation for consistency. Some adjustments were made

when the water levels on adjacent zones are significantly higher or lower and in instances, when the water level does not conform to the flood return period. The flooded area was classified into the following flood depth categories:

i. Low Flooding - less than 0.5 meter,

ii. Moderate Flooding - 0.51 to 1.0 meter, and

iii. Severe Flooding - greater than 1.0 meter.

These ranges of flooding were selected based on the potential physical damage that the flood could inflict. Low flooding means that there will be minor damages, which will mostly involve general cleaning. Moderate flooding means that damages will be limited to some home furnishing, minor repair of houses and voluntary evacuation of some families. Severe flooding means that there will be significant damages to houses and evacuation of residents might be necessary.

Two storms have a return period equivalent to a 10-year and a 20-year magnitude. The inundation maps of these two storms were adopted for the 10-year and 20-year return period. For the 5-year return period, the flood inundation map was prepared by interpolating the flood depths of the observed storm with the 3.5-year and 10-year return period using the extreme value probability and compared with the contour elevation for consistency. The flooding of the four typhoons documented by the Project Office has the following equivalent return period:

i. Typhoon Sisang (1987) - 1.8-year return period, *see Figure 7*,

ii. Typhoon Yoning (1988) - 3.5-year return period, *see Figure 8*,

iii. Typhoon Monang (1993) - 10-year return period, *see Figure 9*, and

iv Typhoon Rosing (1995) - 20-year return period, *see Figure 10*.

3.1.2.2 Land Use Map

The city government had recently approved the city's land use that allocates the different areas into different functions. The new land use map generally follows the present land use and categorizes the areas into the following main classification: agricultural, residential, commercial, industrial, institutional and parks/reservations. In terms of potential physical damage, the residential, commercial and industrial areas would be the most vulnerable while the parks, reservation and agricultural areas would be the least vulnerable.

3.1.2.3 Flood Hazard Map

The flood inundation and land use maps were integrated to obtain the flood hazard map with the area exposed to flooding classified according to the level of risk. The flood hazard was classified into the following categories:

Low Risk Area - Flood levels below 0.5 meters and all types of land use.

Moderate Risk - Flood depths of between 0.5 to 1 meter and classified as residential, Area commercial and industrial.

High Risk Area - Flood depths greater than 1 meter and classified as residential, commercial and industrial

Using the above parameters and superimposing the flood inundation map over the land use map, the **flood hazard maps** were formulated on different flood inundation as follows:

i. Flood Hazard Map for 5-Year Return Period,

ii. Flood Hazard Map for 10-Year Return Period, and

iii. Flood Hazard Map for 20-Year Return Period.

3.1.3 Wind Hazard Mapping

The assessment of the wind hazard was found to be more challenging compared to flood hazard due to the lack of information on the wind distribution during typhoon and the unpredictable response of the buildings to random wind gust. In obtaining the wind hazard maps, the maximum wind gust was used in measuring the magnitude of the wind hazard while the relative density of high-risk building was used in gauging the potential physical damage to the standing structures. The steps involve in deriving the wind hazard map are as follows:

i. Undertake probability analyses to determine the probable wind gust speed for 2-year, 5-year, 10-year and 20-year return period;

ii. Prepare a topographic map (*see Figure 17*) and determine the wind correction factor for difference in elevation of each contour line;

iii. Prepare the wind intensity map by applying the probable wind gust speed to the correction factor and draw the wind speed isoline using the topographic contour as guide;

iv. Classify the area in the wind speed map into moderate, gale, and typhoon strength;

v. Determine the density of high-risk buildings to wind damage against the total number of buildings in the barangay using the community survey data;

vi. Prepare the high-risk building density map (*see Figure 11*) using the percentage of high-risk building density of each barangay and classify the area according to low, moderate and high density; and

vii. Prepare the wind hazard map by integrating the wind speed map and the building density map, and classify the area into low, moderate and high-risk areas.

3.1.3.1 Wind Speed Map

Wind observations are only available from the synoptic station at Legaspi City in Albay province, which is located about 50-km southeast of Naga City. The wind data available includes average monthly and daily wind speed and direction, and maximum daily wind gust. Alternative sources of wind data are from observed storms such as typhoon tracts and recorded maximum center winds. It will probably take a long time however to compile, extract and interpolate the wind speed from the storm data. The maximum wind gust data of Legaspi City was taken to be a reasonable representative of the wind event at Naga City considering its proximity, terrain and exposure. This adopted in the analyses.

A probability analysis of the annual maximum wind speed or gust was performed using the Gumbel probability analyses to estimate the 5-, 10-, and 20-year wind speed. The results of the probability analyses are as follows:

Return Period in Years	Maximum Wind Gust in kph
2	93
5	124
10	149
20	179

Generally, it has been observed that the higher elevations have greater wind velocity. According to meteorological studies, the relationship of wind speed and elevation can be expressed by the following equation:

$$V = Z^{K}$$

where: V - Wind Speed
Z - Elevation
K - Constant (normally equal to 0.2)

Using this equation, the computed wind speed was redistributed based on the difference in elevations between high ground and the standard observed elevation of 10 meters. A 10 percent reduction was also applied for reduced exposure of the higher slopes of the Naga

watershed. The wind isoline of the wind speed map was drawn following the topographic contour. The areas in the wind speed map were then classified according to the following wind range: strong wind (less than 60 kph), gale wind (between 60 to 100 kph) and typhoon wind (greater than 100 kph). This wind range is identical to the values used in the storm warning issued by PAGASA (e.g., public storm signal no. 1, public storm signal no. 2 and public storm signal no. 3).

3.1.3.2 High-Risk Building Density Map

The potential physical damage of the wind hazard was evaluated using the results of the community survey and hazard mapping that was conducted to determine the building levels and building resistance. Although the height of the building is considered to be important in assessing the potential wind damage, only the building resistance was used in preparing the high risk building density map since it is not possible to distinguish between the building height and type of material used on the building from the survey results.

The building resistance survey data categorized the building into different level of risk as follows:

- High Risk - made of bamboo and sawali wall with nipa shingles,
- Medium Risk - semi-concrete building with GI roofing,
- Low Risk - concrete frame and walls with GI roofing, and
- No Risk - all concrete building.

In preparing the building density map (*Figure 11*), the percentage of the high-risk buildings to the total number of buildings serves as the indicator of the potential physical damage that a strong gust could make. The relative number of high-risk buildings was a good indication of the land use, population density and income level. Areas with high values could mean that the area is generally residential and has a low average income level. Likewise, an area with low values could be associated with a commercial district or a high-income group.

The high-risk building density map was subjectively categorized into low-density (less than 20 percent), moderate density (over 20 to 50 percent) and high density (greater than 50 percent). These values were perceived to be reasonable to represent the range of potential damage due to strong winds. The higher the value, the more likely that more houses will sustain significant damages.

3.1.3.3 Wind Hazard Map

The wind hazard map was prepared by combining the wind speed map and the high-risk building density map. The probable affected area was then classified according to the following categories:

- Low Risk Area - Moderate wind (less than 60 kph) and high density of high-risk

buildings.

- Medium Risk - Gale wind (between 60 to 100 kph) and moderate to area high density of high-risk buildings.
- High Risk Area - Typhoon wind (greater than 100 kph) and low to high density of high-risk buildings.

The selection of the range used in categorizing the risk was based on the description of the potential damage associated with a certain wind speed given in the Beauport Wind Scale and PAGASA Public Storm Warning. For wind speed of 30 to 60 kph, the potential damages include loss of palay crops, banana plants and small fruit trees. At 60 to 100 kph, coconut trees and big trees will be defoliated or uprooted and lightly built houses could collapse or unroofed. Wind speed greater than 100 kph will destroy large number of trees and agricultural crops, topple many utility poles, damage communication facilities, damage many lightly built houses and unroofed medium-built houses.

As a result of the above analysis, the wind hazard maps were prepared based on 2-year, 5-year, 10-year and 20-year return periods which are shown in *Figures 12, 13, 14 and 15*, respectively.

3.1.4 Limitation of Data and Results of the Analysis

Risk and probability analyses are important components in the planning stage to mitigate any potential hazard. It allows the authorities to allocate resources effectively based on a selected level of risk. However, it must be emphasized that probability and actual occurrence of the hazard are not the same and except for a post-event evaluation, it is not possible to use the hazard probability of occurrence in the operational stage of any disaster management.

The methodologies used in identifying the flood and wind hazards were formulated to effectively use the available data, information gathered during the field visit and other secondary information obtained from technical publications and reports. The data on the depth of inundation caused by the four storm events were crucial in the preparation of the flood inundation maps. Some of the flood depths obtained are not however consistent with the surrounding observations and ground elevations, and had to be disregarded. Overall, the data was adequate to give a good approximation of the level of inundation. The maximum one-day rainfall data taken from Camaligan station was very useful in establishing the equivalent return period of the four storms. Later, if sufficient data can be obtained on the annual maximum flood levels at Camaligan station, another probability analysis can be performed to determine the equivalent return period using the flood levels. It is expected that different return period values will result from this second analysis. The use of either the rainfall or water level is considered acceptable since both are principal elements of the flooding process, although many other factors could affect the occurrence of flooding including the contribution of the Bicol river basin and the local inflow of Naga River.

The application of the proposed land use map may not give a true assessment of the present condition in terms of the potential flood hazard. However, the proposed land use map generally follows the present condition except for some areas designated as industrial zones.

Some areas have also been designated as residential or commercial areas although these are presently open areas and unoccupied. These differences with the present condition are considered minimal and still acceptable for the land use map to be used in the hazard study. There are probably some advantages in using the proposed land use map as it highlights those areas that are destined for development as high-risk areas and therefore require some re-evaluation on the part of investors.

3.1.4.1 Flooding Hazard

Flooding in Naga City is always associated with the occurrence of typhoons. When there is a typhoon flooding is expected in the flood-prone area. At the same time, the flood-prone areas are likewise subjected to wind hazard due to typhoons. The flood problem of Naga City may appear to be small relative to the total area of the city (about 10% of the total land area of Naga City). However, if we look at where the main economic and human resources are located, then the impact of flooding becomes very significant. For all the return periods analyzed, flooding is widespread and disastrous. It has been noted that many new commercial developments had been set-up in high-risk areas including the construction of the new diversion road. The main highways are vital links especially during disaster and therefore should be carefully planned and protected. The various levels of inundation by return period and the extent of flooding are shown in *Table 8*.

The flood prone area of Naga City is quite extensive as shown in Figure 1. A review of the inundation map of the most recent storms shows that most of the flooded areas are in the vicinity of Bicol and Naga rivers on the western side of Naga City. The depth of flooding varies from less than a meter to over 2 meters with duration of less than 3 hours to a few days.

Barangays Liboton, Calauag, Bagumbayan Sur and Bagumbayan Norte experience less than a meter of flooding due to discontinuous and inadequate drainage system. Natural waterways/existing creeks in these areas were observed as shallow, silted and clogged with grasses and debris. The city center had been subjected to flooding and many commercial establishments have resorted to landfilling their properties. These landfilling activities have created pockets of low ground that are regularly flooded even during moderate thunderstorms. Barangays Mabolo, Tabuco, Triangulo, Sabang, Igualdad, and Abella commonly experience severe and prolong flooding due to their proximity to Bicol River, tidal influence and the low riverbank.

These areas are in the priority list to be evacuated whenever there is a storm. The new diversion highway (traversing Tabuco and Triangulo) to Legaspi has been raised but is not completely protected from flooding. This road is a vital access route during flood disaster. The new road had also encouraged the conversion of the nearby paddy field that is prone to flooding to commercial and residential areas. Other Barangays near the city urban centers that were identified as flood prone areas are Barangays Dinaga, Lerma, Tinago, Dayangdang, Peñafrancia, and San Francisco. The flooding in these barangays is more influenced by the overbanking of Naga River floodwaters. The areas near the low riverbank should also be part of the priority list for evacuation.

3.1.4.2 Wind Hazard

Wind hazard is quite different to flood, as the latter is more physical, stable and lasting. Strong wind accompanyinga typhoon varies in time, location and exposure. Wind occurrence is also more difficult to evaluate and predict. Storm winds come in short burst or gust and change direction frequently. Wind observations are taken from a few synoptic stations representing a small sample thus, leaving many areas with no data at all. The effects of the storm winds also vary. Strong wind could pass through an area and not all of the houses of the same material will be affected to the same degree. The wind could be deflected and dispersed by sloping ground, tall trees and buildings.

The maximum wind gust speed was used in measuring the magnitude of the storm winds. A probability analysis was performed to determine the probable wind gust speeds. The wind speed maps for the 5-year, 10-year and 20-year return period show that the whole city will have a maximum wind gust greater than 100 kph. Another wind speed map was prepared for a 2-year return period to illustrate the effects of lower wind speed.

The high wind speed shown in the maps is alarming but does not mean that all the houses will be destroyed and crops damaged. A wind gust is only a short bust of strong wind and it takes a prolonged and consistent strike to unroof a house. The wind effect on the houses and other standing structures will not be the same throughout and other factors affect the wind flow and intensity. The maximum wind gust seems not to be an effective measure of the hazard's magnitude as it takes many wind gusts to have an impact. The maximum wind run for 1 hour or more could be a better alternative but this type of data is not available and difficult to obtain. A relationship between the maximum wind gust and the maximum one hour wind run could be prepared and applied but again it will probably require a lot of time and effort to prepare such an equation. In the meantime, the maximum wind gust is the best parameter to use in the hazard study and considering further that the maximum wind gust is only a small sample of the wind values in the surrounding area and throughout the day, then many wind gust of the same or even stronger magnitude could have occurred and had not been recorded.

The physical damages attributed to storm winds were measured using the density of high-risk building in a barangay. It is a good parameter to measure the threshold of potential damage. A moderate wind will damage crops but will have only a minimal effect on a lightly built house. With gale wind, the same type of houses will be severely damaged or destroyed while a typhoon wind could partially damage even stronger built houses.

The wind hazard map was prepared by integrating the wind speed map and the high-risk building density map and categorizing the level of risk. Looking at the wind hazard maps, it may seem strange that the agricultural areas are categorized as high hazard map although in the flood hazard map it is classified as low hazard. The reason for the difference is that in flooding the number of houses affected is important while in the wind hazard mapping the strength of houses is the principal consideration. *Table 9* (Settlement and Housing Data) shows that about 24% of houses or 7,270 out of 29,208 houses, are at high risk due to wind hazards at various return periods.

3.2 LAND USE AND FLOODING

3.2.1 Flood Hazard: Natural Propensity

The Naga Proximity Map (*see Figure 16*) illustrates the fact that Naga is located in the floodplain of Camarines Sur province. Moreover, it has been often asserted that the city's urban area was part of San Miguel Bay itself thousands of years ago. The Topographic Map (*see Figure 17*) clearly shows that the urban core of Naga is in the lowest lying end of the city's land area. All of the built up area of the city is within the 0 to less than 5-meter elevation. The fact is a major part of presently urbanized Naga is naturally prone to flooding. It is asserted, however, that historically the city did not experience floods as frequently, as deeply and as long as in recent times.

Official studies point to a combination of factors on top of its natural propensity to flooding as the reason for more extensive flooding. These are: the denudation of the Mt. Isarog watershed, flooding problems upstream of the Bicol river all the way to Albay province, the current incapacity of the Naga river to efficiently absorb storm rainwaters and the serious siltation of the San Miguel estuary. This combination of problems obviously cannot be addressed piecemeal and until these are addressed comprehensively and systemically, flooding will continue to be a seasonal part of present Naga cityscape.

When it floods, particularly a 5-year return period magnitude and higher, the southern part of the built up area including the city's urban core suffers severely. Commerce stands still. Transportation from North to South is cut and transportation terminals do not operate. Recreational and shopping activities in and around the central business district cease. Schools and offices are naturally closed. Hospitals in the flood zone become isolated.

Moreover, historical data on flooding seem to indicate a progressively increasing level and coverage of flooding. Based on this experience, new construction invariably involves land filling such that buildings are now elevated several meters above street level. Such recent practices in turn tend to induce new patterns of flooding in proximate areas. For instance, the higher areas of Bagumbayan Norte and Sur and Peñafrancia are now inundated when up to 1987 they were not. The Dinaga area is also now more severely flooded than before.

3.2.2 Flood Hazards: Human Faults

Previous studies already point to certain old unhealthy practices and recent developments that exacerbate Naga's flooding problems. Certain practices have been identified to be simply harmful to the common good, and these practices were mandated to be brought to a halt. However, enforcement has been unsustained and hence ineffective. Moreover, certain private and public actions have independently and/or in combination led to sub-patterns of land uses that have unwittingly brought more harm than good to the general welfare. In certain cases, these developments served to mitigate the flooding problem in a particular area but adversely affected communities in other areas.

One of the most environmentally sensitive ecosystems is rivers and streams. In these cases, it

is imperative to assert an open strip of land on each side of the river or stream to maintain the integrity of the system. These strips of land called stream environmental zones have a width that is determined by ground investigation based on soil type and how surface water filters into the ground, the types and amount of vegetative cover and how it stabilizes the soils, the slope of the land within the zone and how significant it is for retaining sediment from reaching the streams. The intent is to preserve the natural environmental qualities and functions of the land to purify water before it reaches the stream.

In the case of Naga, an environment zone in the Bicol and Naga river systems was determined to be at least three meters in width. This policy of maintaining a three-meter buffer zone along the riverbanks was also seen as a way of preventing solid wastes and sewage to be thrown into the river, which result in clogging and heavier sedimentation. The policy was approved by the city and ordered enforced but with little success to this day due to resistance by homeowners along the riverbanks and outright squatters.

The age old practice of squatting on riverbanks and sensitive stream areas have continued despite a focused effort to rid the Naga and Bicol rivers of squatters. The same situation has dogged programs prohibiting waste disposal into the river systems. These are clearly problems of enforcement will rather than law and policy.

The rise of flooding levels and increase in duration in the Dinaga area has been attributed to the flood compounding effect of the flaw in drainage design of the "Panganiban Ugrading and Beautification Project" which saw the construction of duplexes and rowhouses for light commercial use on the PNR right of way strip in the Southern side of Panganiban Drive. The old alignment of the drainage system, which had rainwater flowing through culverts across Panganiban and the railroad tracks, allowed floodwaters to drain southwards towards the Bicol River. The filling-in of the culverts redirected flood water run-off along Panganiban Drive itself (i.e., the road became the drainage vehicle and thus becomes an artificial creek during typhoon season) towards the Naga river which because of undercapacity ends up throwing back the waters over its banks particularly onto the Dinaga side of the river.

A more recent development that was the offshoot of a policy, was the decision to promote a commercial growth area in the Triangulo and Tabuco districts. The growth area, estimated at about 275 hectares, is centered on the development of the erstwhile agricultural and open marsh area at the center of Barangay Triangulo.

3.2.2.1 The CBD II

A large stadium built on landfilling that raised the structure at least three meters from the original ground level is already nearing completion. Moreover, an expansive bus terminal complex has been practically completed within the same location and is awaiting finishing touches and occupancy. East of the bus terminal complex, concrete roads mark an area where further construction is soon due. The development approved and supported by the City is dubbed the Central Business District II (CBD II) project and is designed to become exactly that - a new central business district on the other side of the Naga river somewhat perpendicular to the original CBD.

Part of the area of CBD II, although privately owned, had naturally functioned before as a flood retention basin for Naga floodwaters. Even today, one can watch children take a swim in the natural depression that turns into a "swimming pool" after the rains. There is a real need to investigate the characteristics of the CBD II project site to determine without doubt whether its conversion into high intensity commercial use will not generate undesirable effects elsewhere. Already, proximate communities are complaining of severe flooding where before flooding was marginal. Another has complained of longer duration flooding and increased depths. It should be noted that allocation of the natural hydrology is always bound to create prolonged of flooding either within or adjacent to the affected area.

The predicted pattern usually involves undesirable effects in the ground water table also. It is in the nature of natural water catchment basins to serve as an aquifer to recharge the underground water table. The planned CBD II area might be integral to the sustainability of fresh water aquifers in Naga and the wholesale conversion of this 279-hectare area might negatively impact on such sustainability. At this time, the basic source of water supply of many areas in Naga is ground water and the aforesaid scenario deserves looking into and addressing.

Additionally, the compacting and building over of this former marshland will increase the velocity of water run-off. Since the CBD II will obviously be raised, water that historically accumulates in the Triangulo basin will fan out probably east and West. If this happens flooding could compound the Concepcion corridor in the East and exacerbate flooding in the original CBD. Otherwise, flooding will spread out of CBD II and transfer elsewhere within the urban area.

The CBD II project exemplifies a policy development that has made a fundamental impact of Naga's land use pattern and threatens to bring increased flooding. The 1978 Naga Land Use Plan, wittingly or unwittingly, preserved the natural depressions as floodwater catchment and drainage areas when they were delineated agricultural (green) areas and formed them into a rough band encircling the CBD and high-density residential areas of the city. This band, which included the present CBD II area, acted as a buffer for potential floodwaters rushing down from higher ground and continued to be natural retention areas.

While these areas were privately owned, they remained compatibly agricultural in use due to the high investment costs of alternative uses i.e. commercial or residential subdivisions. The high cost of filling and construction plus history of floods were not only disincentives for property owners to build, they were also unattractive to real estate buyers. Hence, these spaces remained open and green and agricultural in use and remained as such because as agricultural lands within an urban setting, they were not essential for urban access and hence were not systematically integrated into the urban circulation network. Another crucial factor was the government's failure to provide effective flood mitigation measures in those areas. In fact, they were apparently recognized as natural water catchment areas and city drainage systems were oriented to empty into them. Incentives to develop these marsh areas were unheard of.

Thus, these green areas remained open interstices within the urban spread of Naga City both

by market neglect and by 1978 urban land use policy. But benign neglect in the market does not continue indefinitely. The real estate boom in Naga in the late 80s forced owners of large landholdings to review the utility of their lands versus potential income if these were converted to urban uses. Costs were still high, flooding had not gone away but the new element was the override of the 1978 land use plan and its corresponding zoning.

Where before the government did not pay attention to the open interstices, in the early 1990's, the city promoted real estate-led development and effectively induced realty development in the green areas and vacant spaces. The 1978 Land use Plan was pronounced to be no longer in effect and zoning liberalization effectively proceeded and land use on the green buffer zones were reclassified as residential or commercial.

3.2.3 Review of Naga Land Use Plan

Land capability involves a judgement of land for its highest and best value. For some time, it was thought that the market value for land would be the best objective criterion for its best use based of course on the principle of economic efficiency. Historical experience, however, has illustrated that a judgement of a particular location's land use based on economic efficiency alone (i.e., without a bold understanding of the land's natural processes), usually leads to tragic social costs. In the specific case of Naga City, which is located on a flood plain, is at the junction of two major rivers, and is naturally vulnerable to flooding. It is critical that land use planning takes primary consideration of the flooding hazard and the natural processes of the land and the water bodies within the city's land uses.

3.2.3.1 The 1978 Land Use Plan

In looking into the present Land Use Plan, it would be fruitful to first examine its predecessor, the 1978 Land Use Plan (*see Figure 19*). The records of the planning process involved in Naga's 1978 Land Use Plan have reportedly been lost to the scourge of termites. However, it is obvious that the 1978 planners were conscious of the flooding problem. In the 1978 Comprehensive Zoning Ordinance, a category of "flood zone" had been provided. The ring of agricultural (green) areas that was mandated around the built-up area of the city included spaces that had long acted as natural water catchment areas. It could be argued that the 1978 planners did not mean to restrict the urban area's expansion but sought to help divert flooding from the urban core to natural floodwater catchment areas, around the city. The wide green bands (agricultural use) delineated in the East was to serve as a buffer to mitigate the threat of flooding due to heavy water run-off from Naga's higher ground. The fact that these spaces were still actively utilized as agricultural areas or were idle marshland made the land use delineation convenient and non-contentious at that time.

The population of Naga in 1977 was about 83,400 with a density of 10.75 per hectare across the entire land area. Urban center population was estimated at about 58,000. Assuming its growth rate at that time of about 1.5 percent per annum, it was projecting a population of about 63,400 in 1983 and about 68,300 people in 1988. Considering these indicators, the 1978 Land Use Plan, for the timeframe that it was planned for, addressed the projected needs of Naga's urban area. It had allowed sufficient space for expansion for both population change

and increase in economic activities based on the current growth rate at that time. Prudently, it mandated the retention of agriculture in the upper Eastern reaches and the development of forest cover in Naga's Mt. Isarog watershed area.

However, by 1980 it became obvious that a previous estimate of the population growth was grossly inaccurate. In that year, the population of the urban area had grown to 63,181, which was already equal to the projected urban population in 1983. Density in the urban area in just about three years had increased to about 79 from 72 persons per hectare. The increase in Naga's population and urban activities was simply running way ahead of the projections. This should have been a good time to review the Plan and make adjustments for the higher growth rates than what was anticipated.

3.2.3.2 Context of the Present Land Use Plan

As noted by present city planners, the 1978 Plan has been "already outpaced by rapid urbanization." They further observed that by 1995, "the scope of urbanization has so widely expanded that new types of urban functions and commercial activities ... alien to (1978) zoning regulations have sprouted. Determining the right zoning for such activities has become a problem." The last cited statement underlined the approach to the formulation of Naga's new land use plan.

Urban Function:

All parts of the urban area are easily accessible. Indeed, the urban road system is highly articulated resulting in a circulation system that gives easy access to all residents. There are 155.9 kilometers of road (*see Figure 20*) which is over the standard of 1 kilometer per 100 hectares, public intra-city transportation is well served by motorcycle cabs called "trimobiles" (71%), jeepneys (12%), buses (1%), of average daily traffic. Private modes of transport account for other transport within the city. Inter-regional travel is also efficiently provided by bus (15 bus companies), car rental and train on land, by plane on two air transport firms, and motorized banca by river. These firms needed support facilities and thus terminals started proliferating. Of the seventeen formal bus terminals, at least 10 are in the Flood Hazard Zone (FHZ).

Every part of the city is locationally accessible to a lifeline facility. Its medical personnel and facilities ratio are higher than standard. Bed to population ratio is 3.8 per 1,000 (national standard is 1:1,000). There is one doctor per 684 persons and one dentist per 1,294 (the national ratio is one doctor and one dentist: 20,000). However, at least half of the hospitals are in the flood hazard zone and only one (St. John hospital) is isolated during floods. Up to one third of all day care centers are in the flood zone.

The growth of business establishments in Naga for the last ten years is unprecedented. Several shopping centers, malls, "satellite" markets have mushroomed. Similarly, hotels and banks also increased or expanded. In Naga, there are 74 educational institutions. However, the majority or most of these are located in the FHZ.

Population and Density:

Population density per hectare was 92 at its urban core in 1995 (most dense ten percent of the urban area) which compares to Manila's 123 per hectare. A glance at *Table 7* (Percent Changes in Population) underlines the recent shifts in land uses and their impact on population movements. Conversion from residential dwellings in the Abella area to business establishments has resulted in negative population growths. New housing in the Calauag and Cararayan area has resulted in great increases in density. But perhaps the most dramatic increase in density and number of households is in Barangay Del Rosario towards Pili. Here, between 1990 and 1995, the annual growth rate was 35 %. Nevertheless, in terms of absolute density, the communities within the CBD and urban core are still the densest.

3.2.3.3 Present Land Use and Zoning Objectives

The present Land Use Plan and Zoning (LUPZ) for Naga City (Figure 21) was crafted in 1996 specifically with the following objectives:

a. To maximize the city's potentials for urban growth by opening up new areas for urban use without prejudice to the policy of the government to preserve prime agricultural lands and promote sustainable ecological balance;

b. To further strengthen the city's role as the regional center of commerce, trade, services, education, religion and culture;

c. To further enhance the functional character of the Central Business District (CBD) by continually undertaking redevelopment and urban renewal programs;

d. To designate new areas as growth centers by integrating functional areas into a comprehensive whole by establishing a more coherent relationship among places of residence, work, recreation, shopping, and education;

e. To strengthen the character or identity of each functional area by eliciting private initiatives; and

f. To improve accessibility, transport and road network system.

3.2.3.4 Urban Development Strategy

The strategy for pursuing these development objectives has been described as a "compact urban development strategy" which seeks to maximize the utilization of urban services within the built up area, sustain the "vitality of its present central business district", and minimize "dead" lands within the urban area of Naga. That is to say that it was decided to consolidate urbanization within the built up area by inducing the development of all vacant and green spaces within it and simply enhance existing urban services for the intensifying activities within the CBD and the added requirements ensuing from the aforesaid decision. The intention was to complete the concentric development pattern within the historical urban

area.

This strategy rationalized previous initiatives involving the commercial strip development along the PNR right of way along Panganiban Drive, the "satellite market" program which allowed the establishment and provided incentives for private markets within the present urban area, and, lastly, the decision to develop a new central business district called CBD II in the Triangulo-Tabuco area straddled by the Naga Diversion road.

In addition, the Approved Land Use Map (*see Figure 21*), made it also clear that the planners anticipated and legitimized strip development along the Pacol portion of the San Felipe-Carolina road to the junction with the San Isidro-Carolina road, strip development along the middle portion of the Cararayan road, and corridor development from the Magsaysay crossing all the way to the boundary of Pili along Panganiban Drive and the national highway. It also promotes a San Isidro "agro-industrial zone" on the southeastern side of Naga's land area.

3.2.3.5 Design Oversight in the Particular Context of Flooding Hazard.

From the perspective, however, of the flooding hazard, it cannot but be observed that certain oversights in the design of the present Land Use Plan might have occurred. Its strategy of explicitly converting into commercial and residential zones the agricultural and open spaces within the built up area delineated by the 1978 Plan as green areas fails, to give due regard to the flood mitigation functions of these lands. The deliberate development of the Triangulo and Tabuco areas into high intensity commercial zone, i.e., a new central business district, did not take cognizance of the probable vulnerability of these and outlying areas to flooding and therefore the possible risk of economic and social losses. Discussions on the current plans and an ocular inspection of the CBD II area did not reveal a drainage system designed for at least a five year return period flood level and provisions for staving-off the spread of flood waters to outlying areas.

Obviously the current Land Use Plan follows the principle that built-up areas should be located where urban density and full urban services already exists. However, it needs to consider that conservation areas such as open space systems that contain beneficial natural processes may pierce developed areas. Moreover, the urban transition areas should NOT be located in hazardous zones, or in highly vulnerable natural systems, or land needed for catchment area for waters. That the flood prone area that is the current site of CBD II was not subjected to hydrological studies first may indicate an oversight in planning.

Furthermore, the other "dead" lands anticipated to be converted to medium density residential areas within the urban area on its western side are within the zonal valuations that are very expensive for the middle class Naga family and even more prohibitive for lower income groups. These areas close to Camaligan may also not appeal to would-be homeowners as they are in severe flood hazard zones and development costs could, therefore, be higher than average. On the other hand, high rise buildings that could make development investments more viable are technically at risk since the liquefaction factor in the area prohibits high rise buildings or allows them at very high costs of construction.

Planners have themselves observed that "the biggest limiting factor to Naga's sustained leadership in trade and commerce is its saturated CBD where availability of space has become scarce and whose land value has naturally skyrocketed. This made doing business in Naga relatively costlier compared to neighboring towns and cities."

It is also noted that despite the inclusion of the "Panganiban Upgrading and Beautification Project" within the overall framework of the Plan, there seems to be no provisions for rationalizing the spontaneous growth along the larger Panganiban - Del Rosario corridor. No provisions for flooding effects of compacting and heightened activities and densities on present drainage systems along the corridor have been indicated. This is true also of the planned Pacol-Carolina and Cararayan strips, although being light residential, the urgency for these strips is lesser.

Ironically, estimates of current demands and the housing backlog for the year 2000 places the hectarage required for residential use at about 1,129* hectares or roughly 135 hectares more than the 994 hectares provided for under the current Land Use Plan. Assuming that the estimates are on the high side, the best case scenario indicates that the current Plan's provision for housing needs will meet only short term requirements (1-2 years) considering the high population growth, heavy in-migration to the city and housing demand for the urban poor.

* Current residential housing occupy about 850 hectares; backlog projected by year 2000 is about 7,000 units; current pressure from urban poor communities is estimated at 5,000 families; dwelling units to hectare standard is mid-point for R2 residential zone category.

Figure 7: Typhoon Sisang

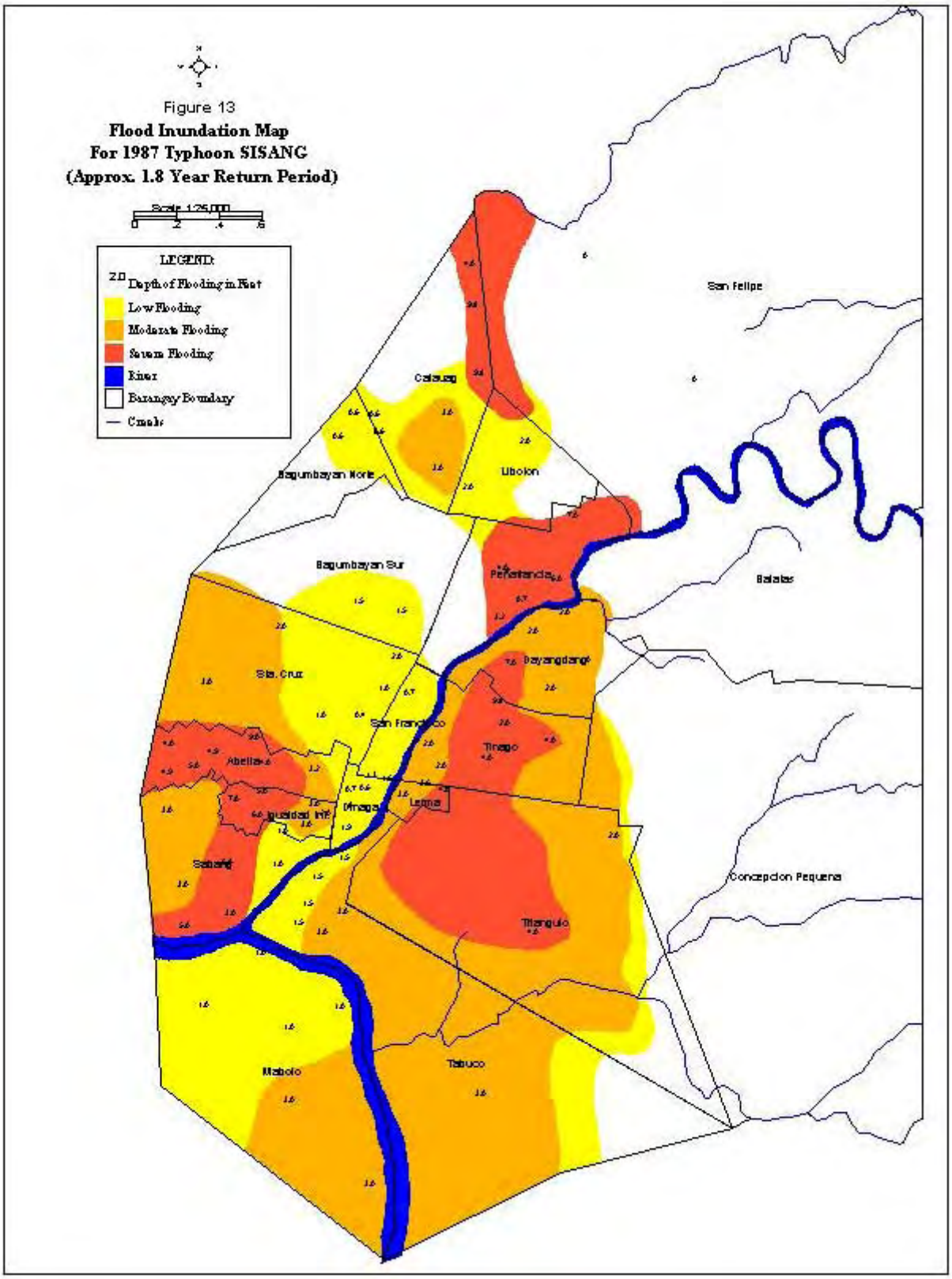


Figure 8: Typhoon Yoning

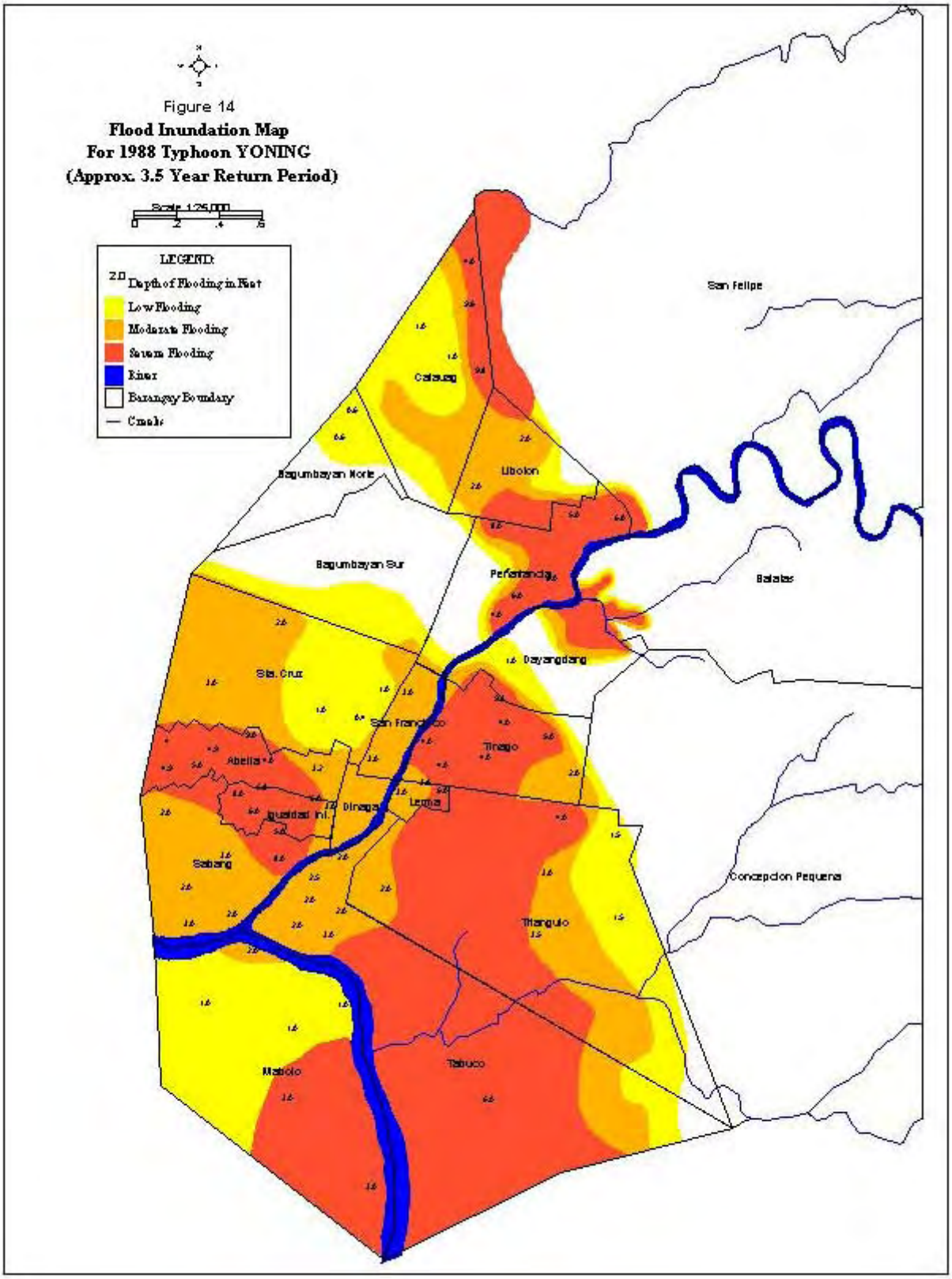


Figure 9: Typhoon Monang

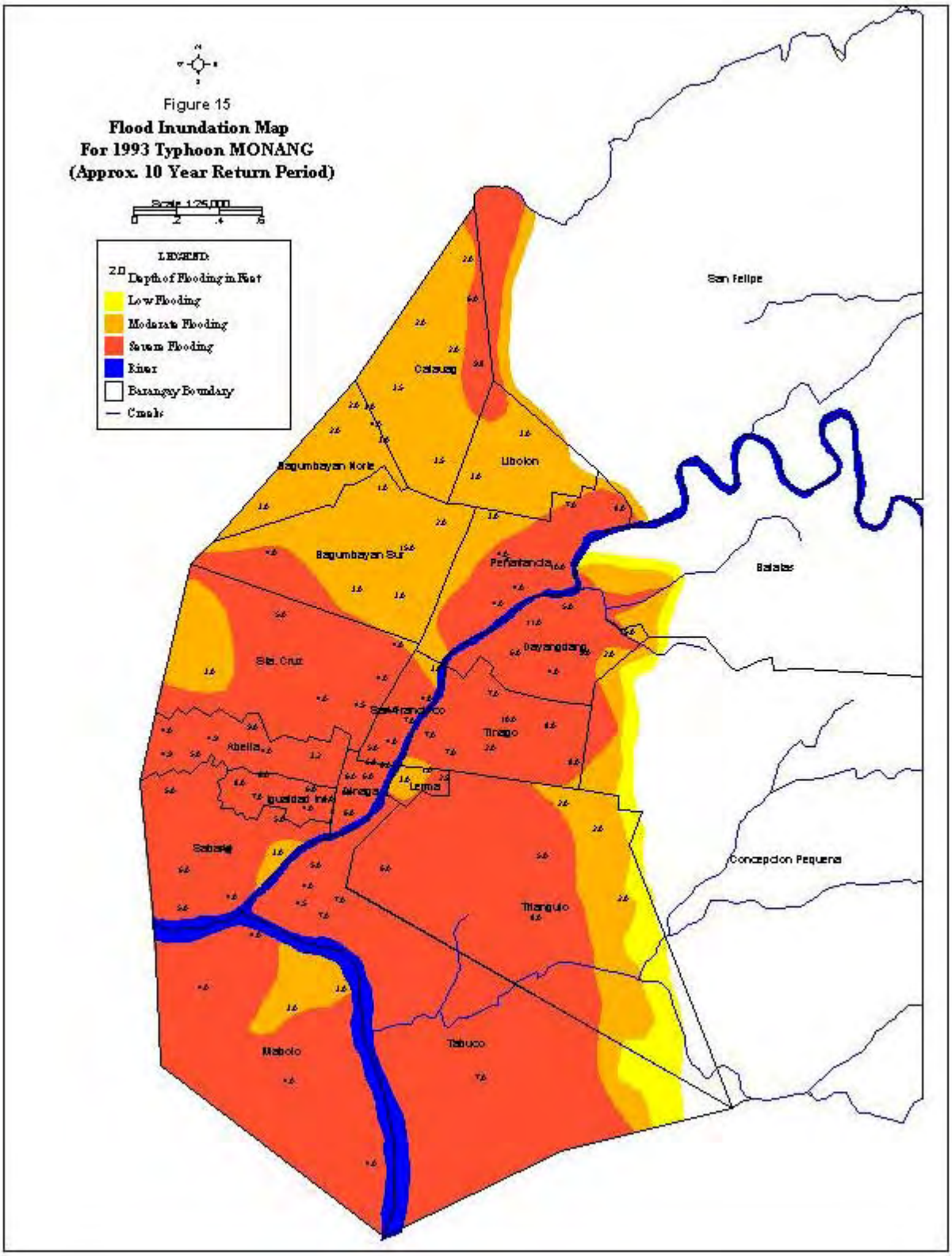


Figure 10: Typhoon Rosing

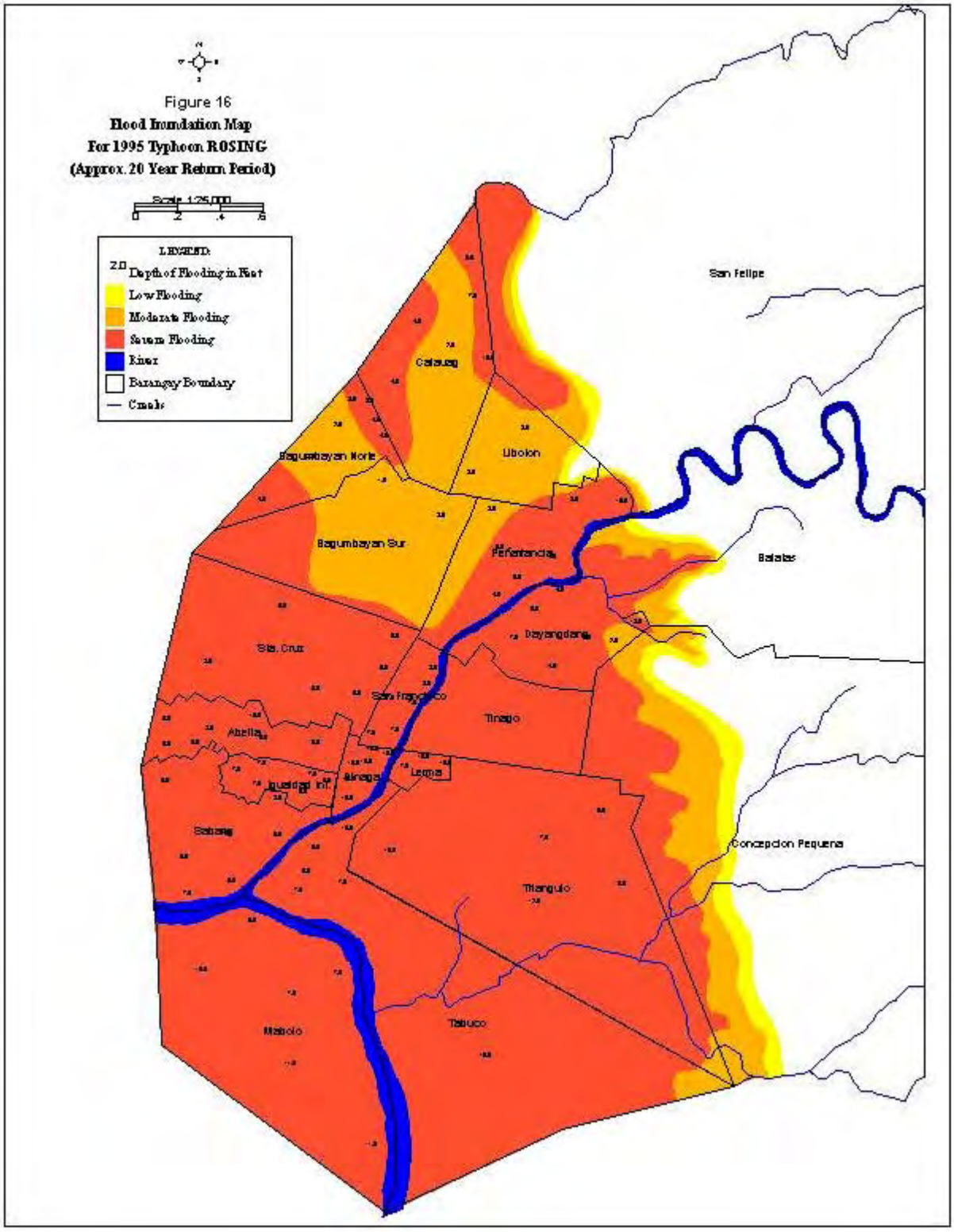


Table 7: Naga Population, Area, and % Change in Population, Density, Households

Barangay Name	1995 Population	Area in Hectares	Population % Change	Density % Change	HH % Change
1. Abella	5,740	22.11	-10	-9	-7
2. Bagumbayan Norte	1,952	23.32	-7	-6	13
3. Bagumbayan Sur	5,544	56.86	1	2	5
4. Calauag	6,707	49.77	33	34	40
5. Dayangdang	5,216	29.57	12	12	15
6. Dinaga	741	7.35	-16	-17	-15
7. Igualdad	2,620	9.86	14	25	20
8. Lerma	2,363	3.82	6	6	4
9. Liboton	3,269	25.31	21	21	31
10. Mabolo	5,751	105.26	11	12	18
11. Peñafrancia	5,644	37.57	-2	-2	0.4
12. Sabang	6,179	41.06	11	10	0.1
13. San Francisco	1,483	10.54	-9	-9	3
14. Sta. Cruz	6,135	65.03	-7	-7	2
15. Tabuco	4,392	147.63	-4	3	-3
16. Tinago	3,721	34.46	-23	-23	-14
17. Triangulo	6,576	132.06	7	2	10
18. Balatas	5,719	182.01	12	11	14
19. Cararayan	5,469	972.28	57	50	66
20. Carolina	3,330	1,605.29	3	0	6
21. Concepcion Grande	7,598	306.37	25	25	28
22. Concepcion Pequena	15,615	333.06	21	21	22
23. Del Rosario	5,021	201.52	175	177	195
24. Pacol	3,146	1,184.61	-1	0	10
25. Panicuason	1,366	1,413.21	11	0	-4
26. San Felipe	3,977	518.26	-18	-22	-1
27. San Isidro	1,698	229.81	27	33	29
TOTAL	**126,972**	**7,748.00**			

Figure 11: Naga City: High Risk Building Density Map

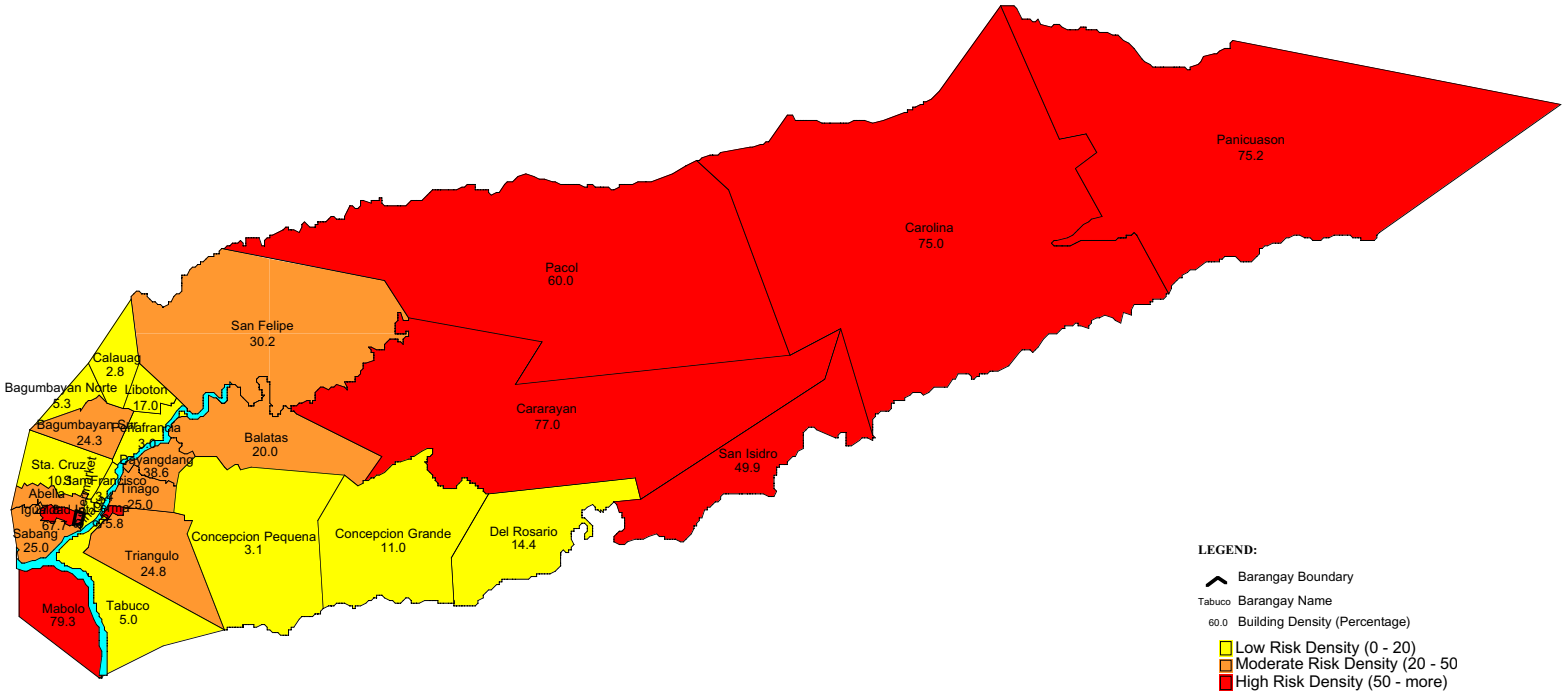


Figure 12: Naga City: Typhoon Wind Hazard Map (For 2 Year Return Peiord)

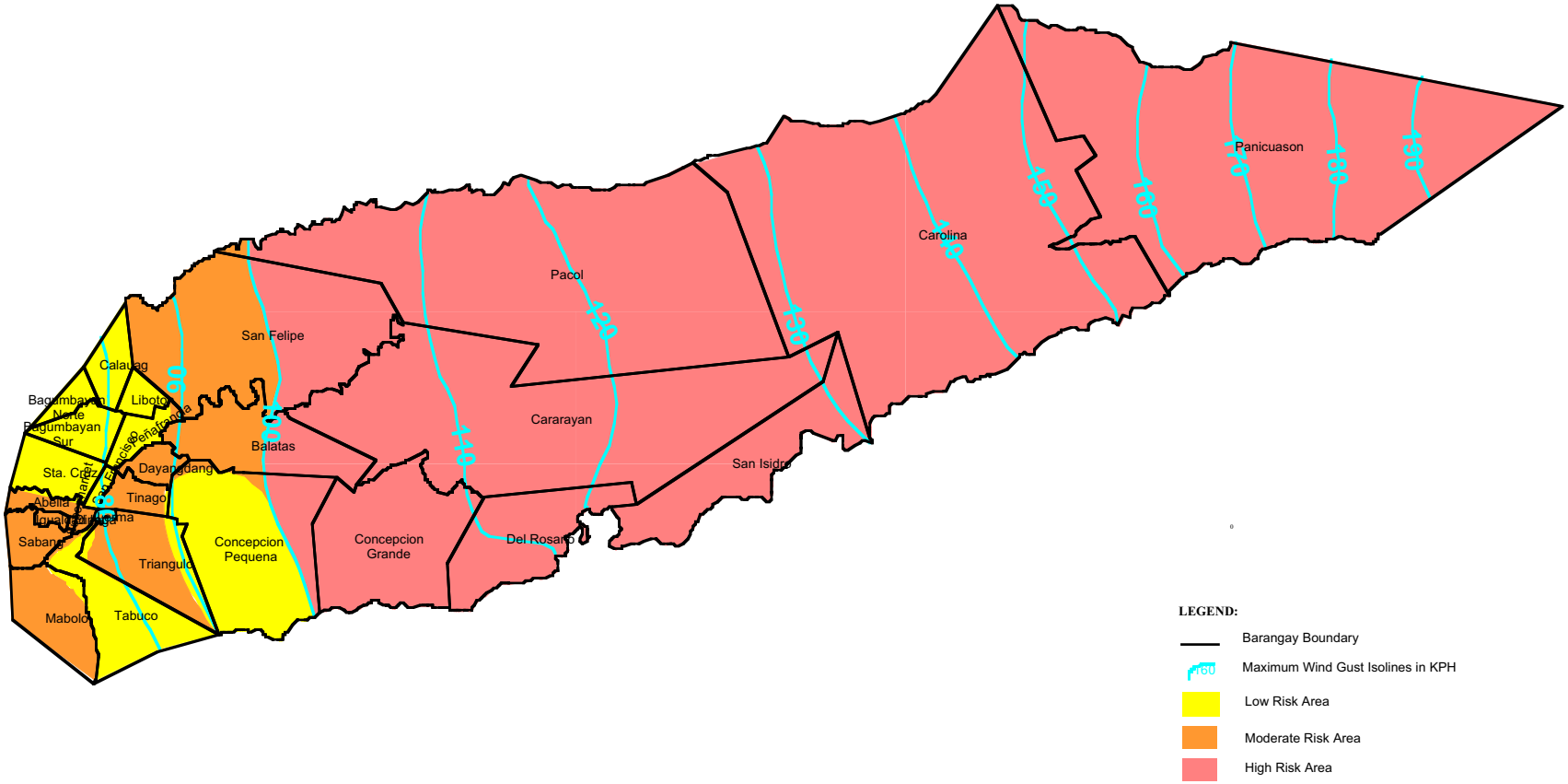


Figure 13: Naga City: Typhoon Wind Hazard Map (For 5 Year Return Paeriod)

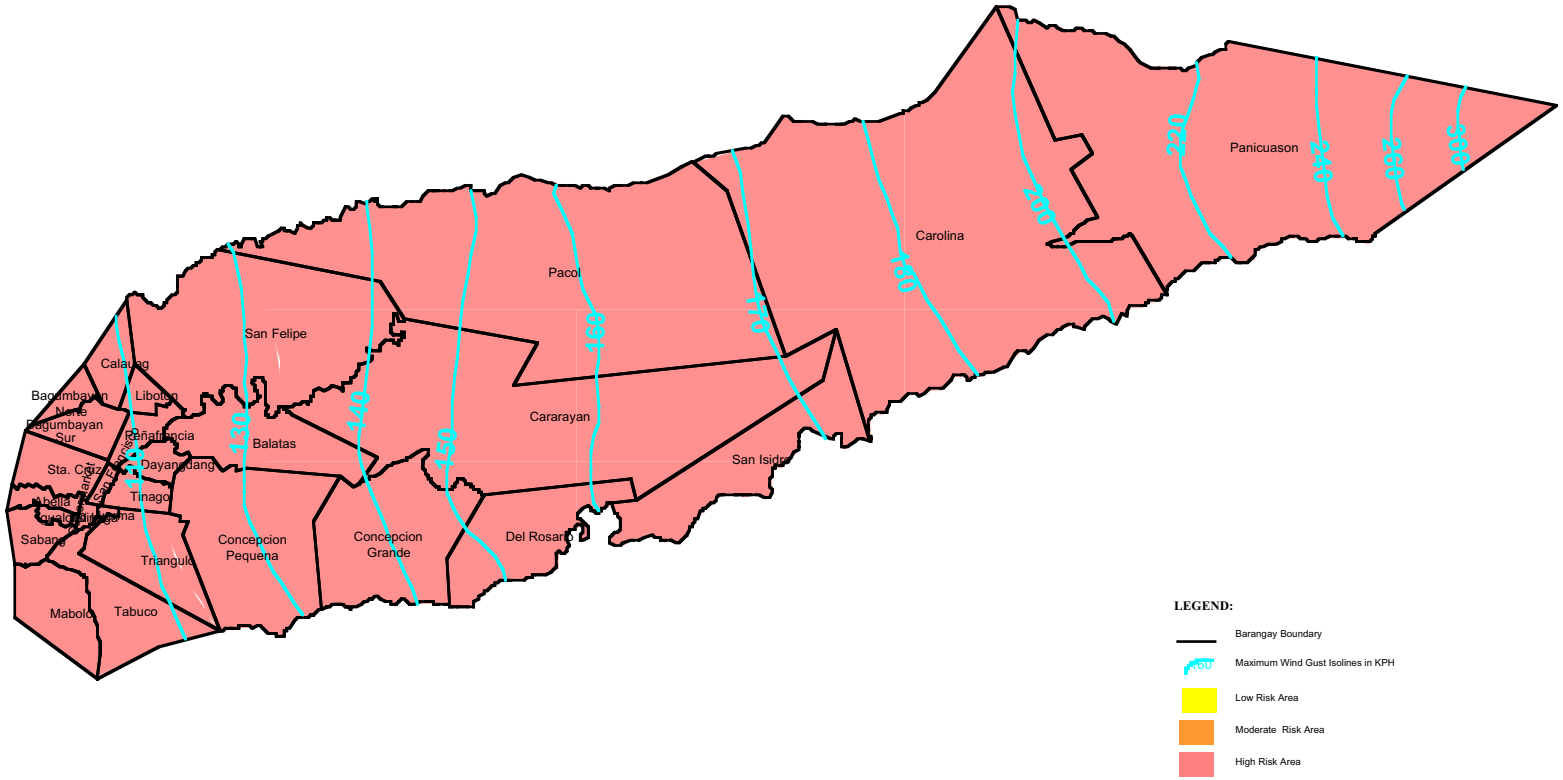


Figure 14: Naga City – Typhoon Wind Hazard Map (For 10 Year Return Period)

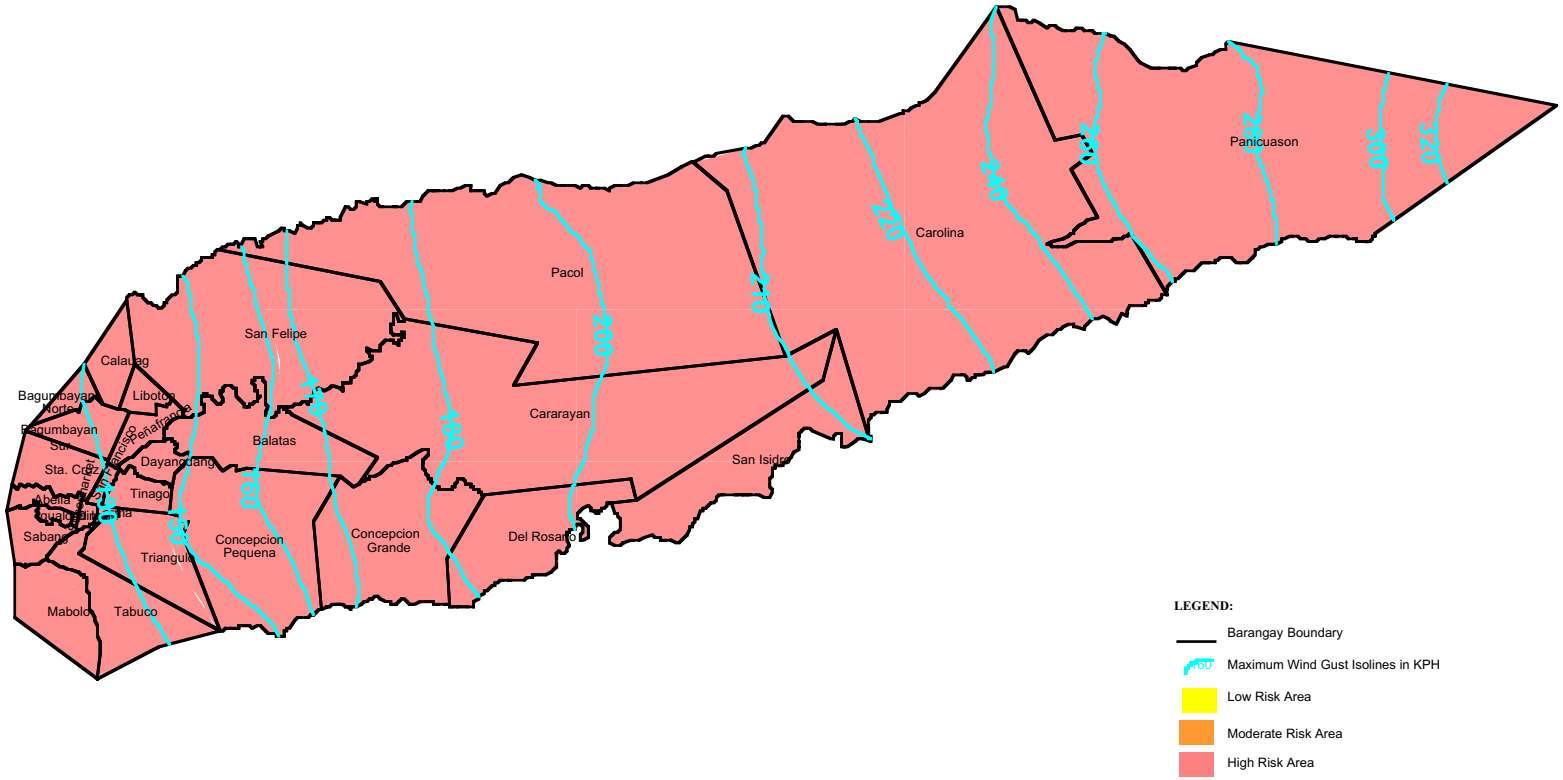


Figure 15: Naga City – Typhoon Wind Hazard Map (For 20 Year Return Period)

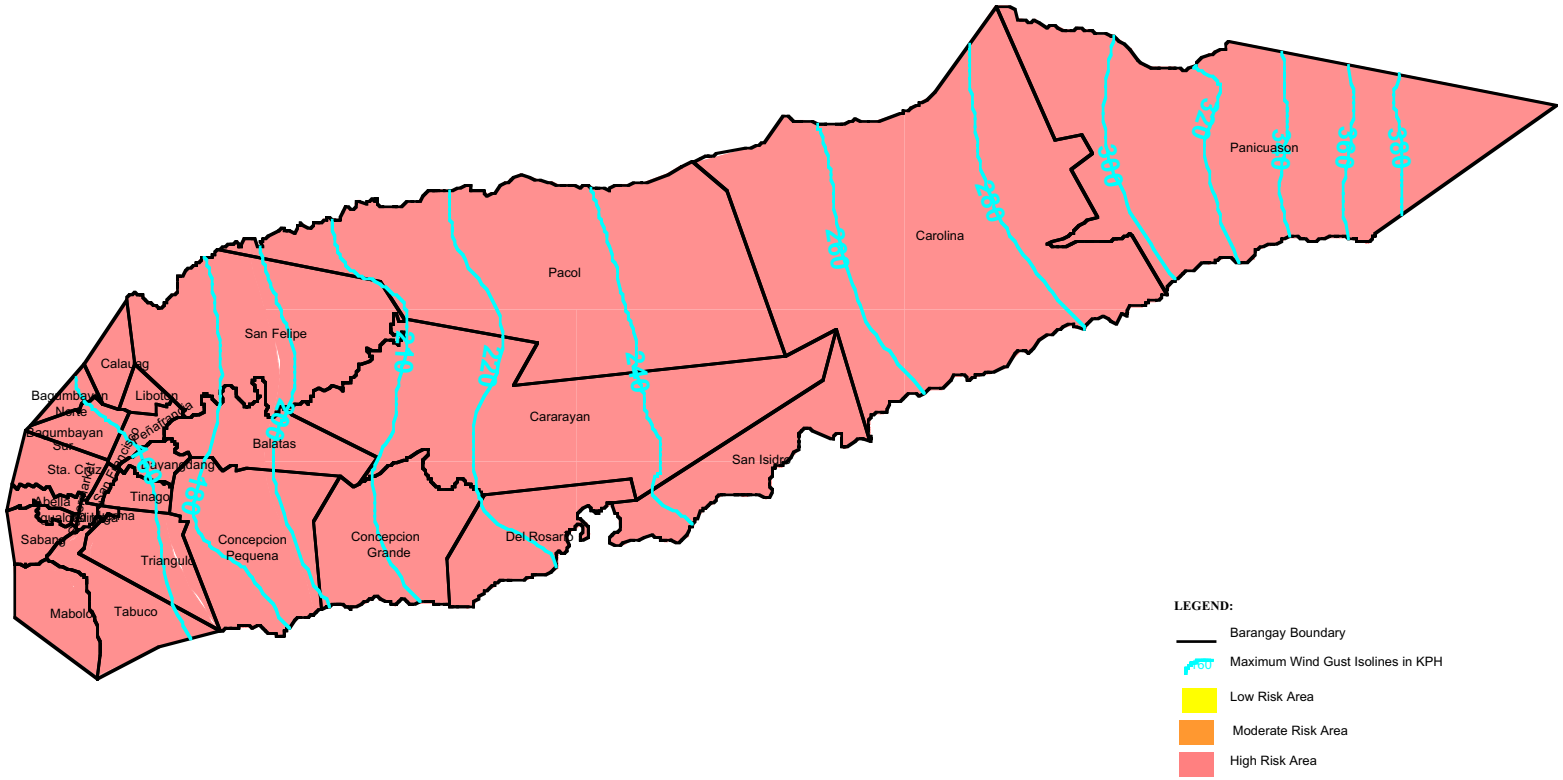


Table 8: Area at Risk of Flood Hazard

Table 9 – Settlement and Housing Data

Figure 16: Naga City Proximity Map

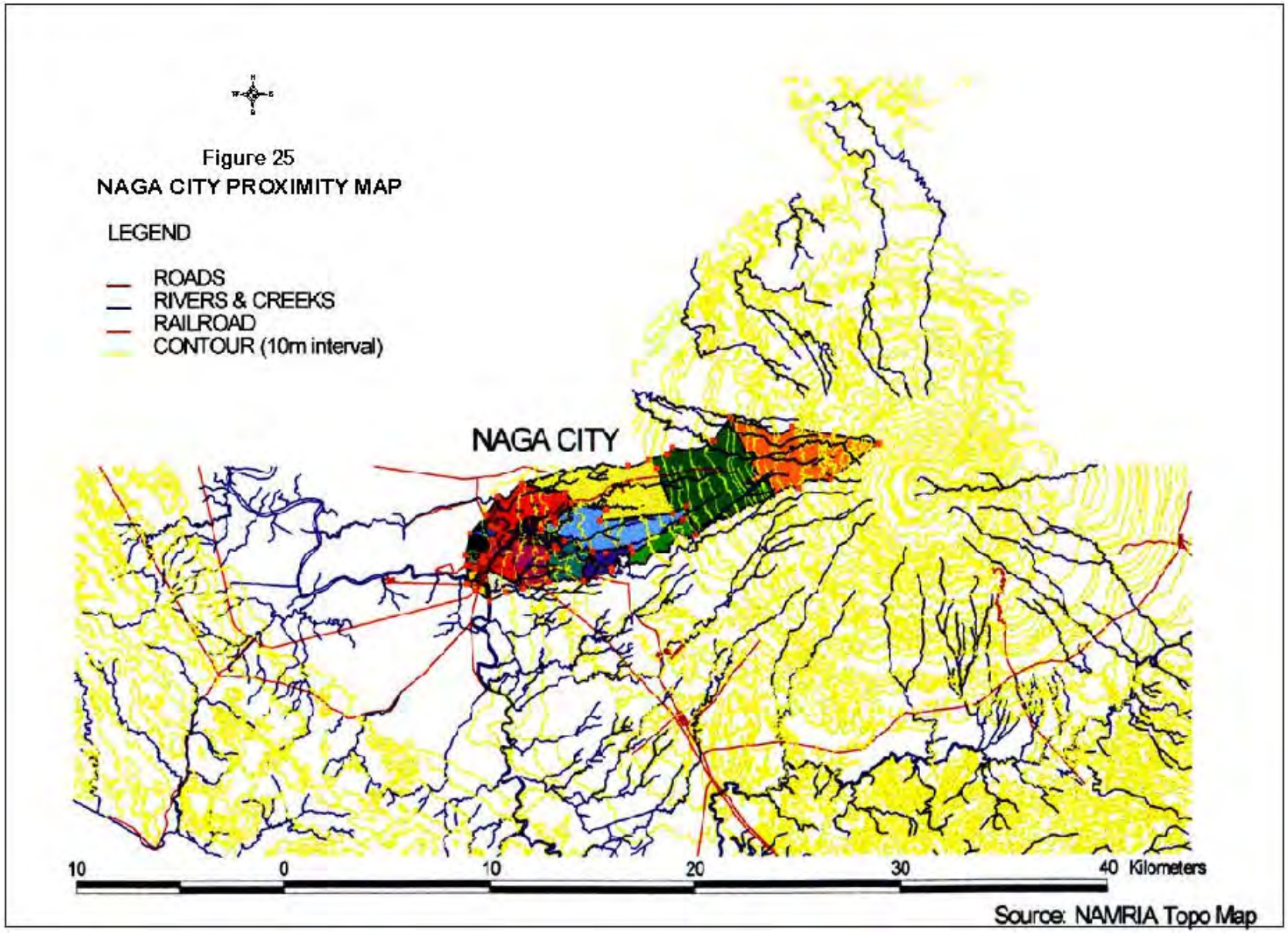


Figure 17: Naga City - Topographic Map

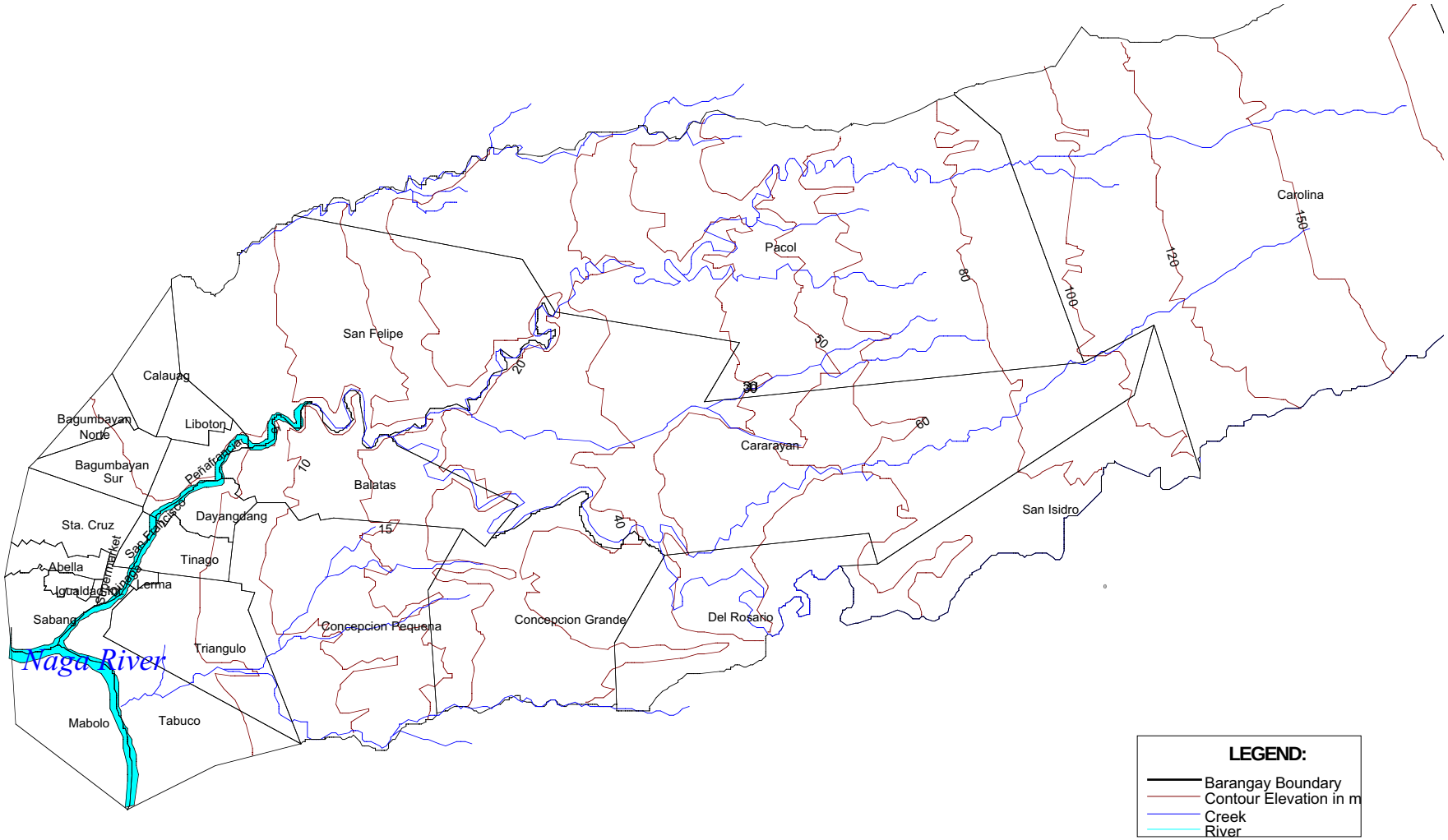


Figure 18: Reclassification Map of Naga City

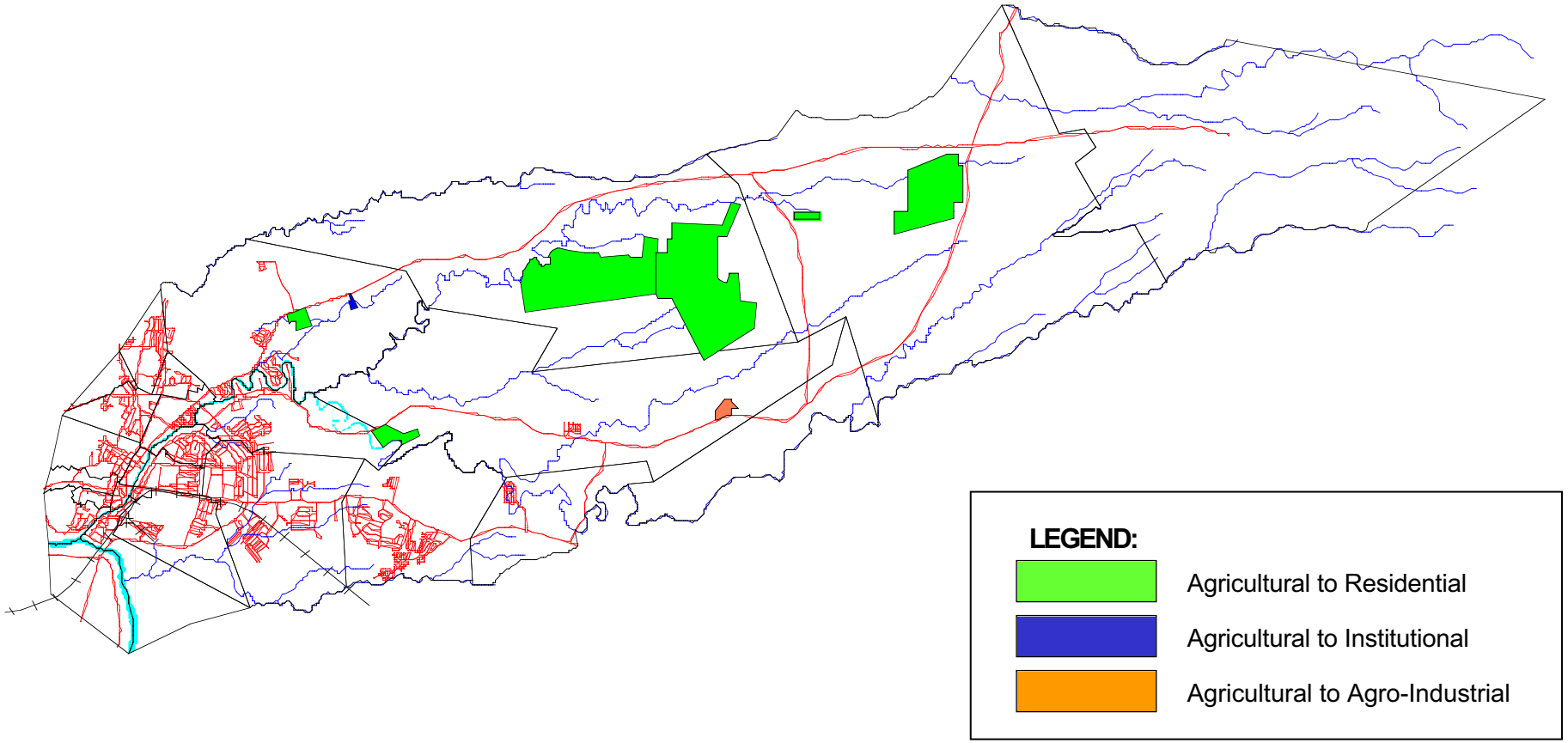


Figure 19: 1978 Land Use Plan

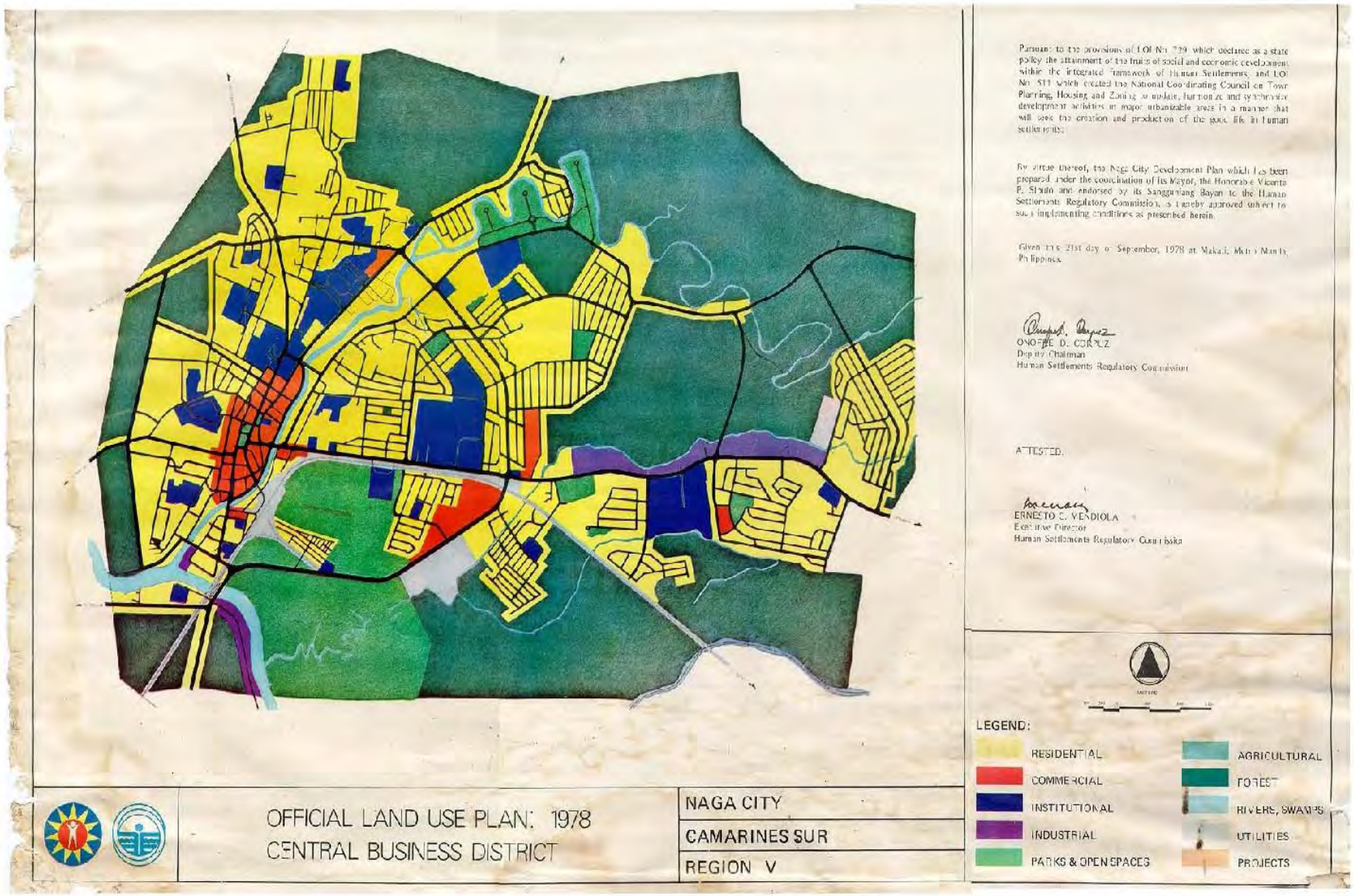


Figure 20: Naga City - Road and Railroad Networks

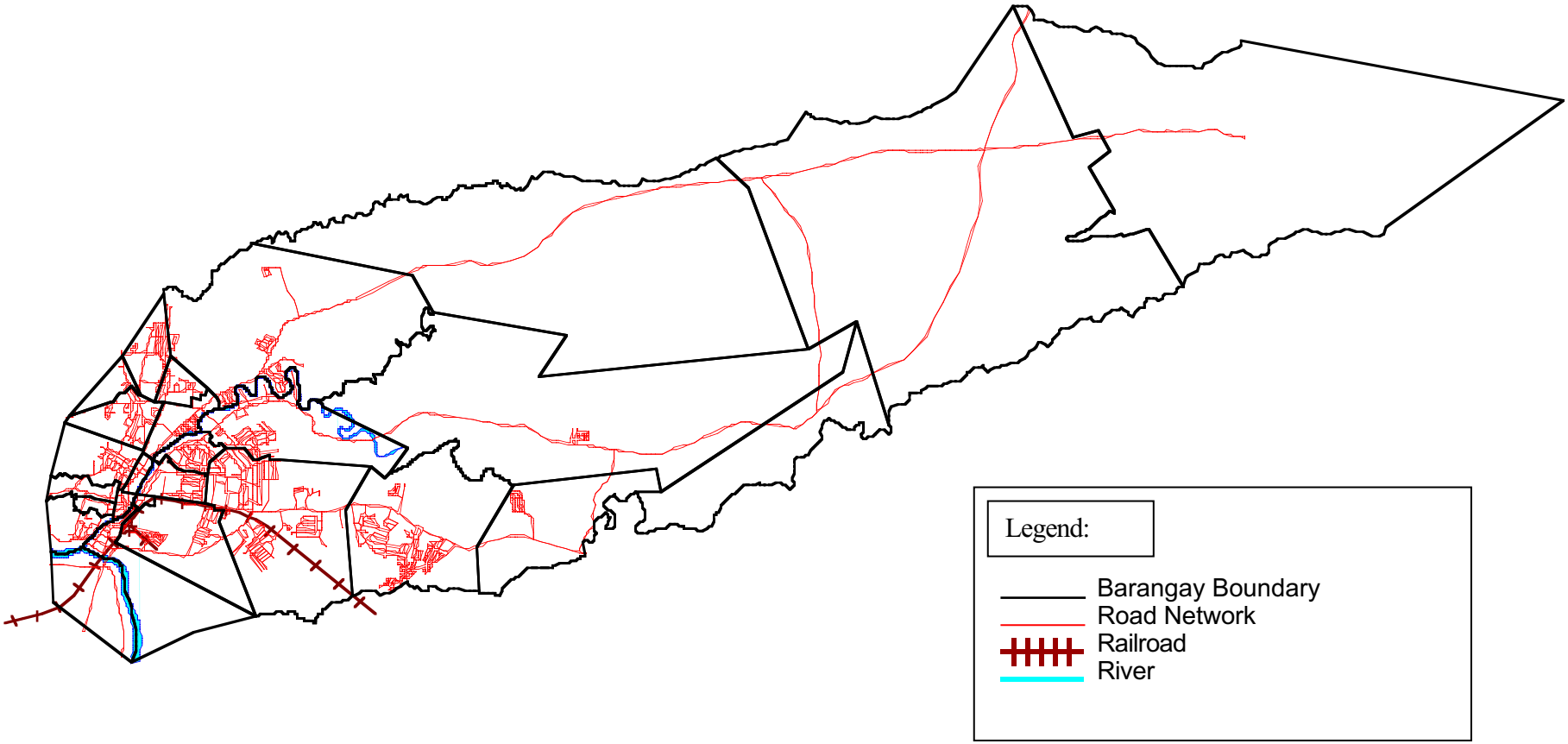
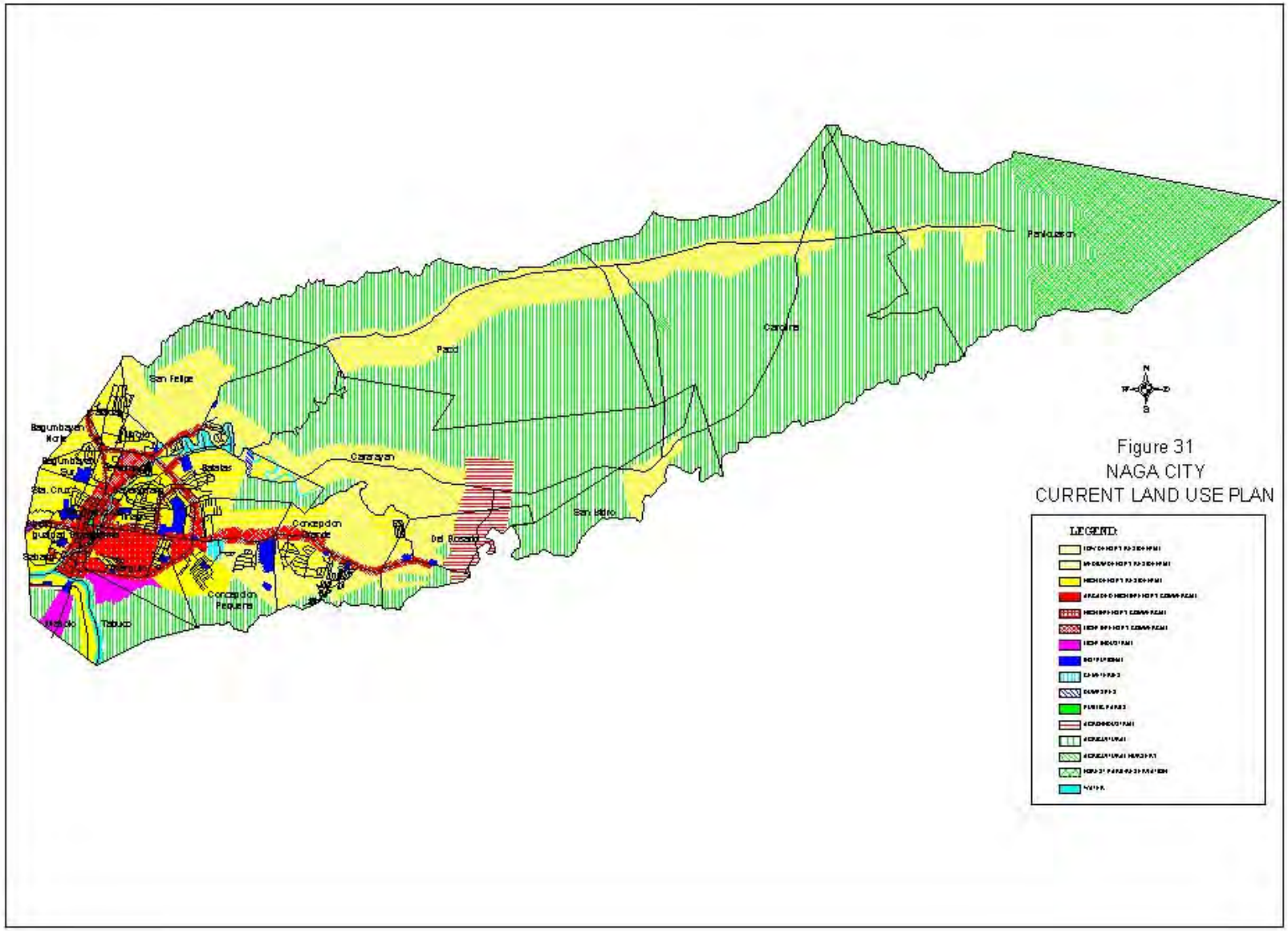


Figure 21: Naga City Land Use Map



CHAPTER 4

RISK ASSESSMENT

4.1 CONSEQUENCE ANALYSES

The frequency of typhoons visiting Naga and their magnitude at different return periods pose varying degrees of flooding and wind hazards to the city. The risks and consequences of flooding can be of such magnitude as to threaten public health and safety as well as disrupt the overall socioeconomic environment of the city. Depending on the type of risk and vulnerabilities of the socioeconomic sectors at risk, a disaster by situation can either be avoided, reduced to an acceptable level or further aggravated.

4.1.1 Risk Characterization

Societal risks associated with flooding and wind hazards involve primarily public health and safety as well as economic losses from various livelihood enterprises.

4.1.1.1 Risk to Public Health and Safety

Risks to public health and safety include mainly the following:

- fatality or death due to drowning, extreme injuries (e.g., from typhoon debris and electrocution), hypothermia and disease complications arising from long exposure to flood waters;

- morbidity cases from injuries (wounds) and illnesses related to wind and flood-water exposure, such as colds and other respiratory diseases;

- indirect effects on environmental health from contamination of water sources and exposure to polluted waters, liquid effluents and solid wastes carried by flood waters; and

- damage to housing and personal properties and consequent dislocation of families.

The number of fatalities is the penultimate indicator of the gravity of the risk to public safety. Death of individuals is an irreplaceable loss to society, especially among children and productive members of the community, who could have otherwise contributed substantially to the social and economic well being of their community had they lived their full productive lives. In addition, death has unquantifiable social and economic consequences to surviving families who have to suffer from the loss of a loved one.

Morbidity cases, depending on the type of illness/injury and recovery period, represent a temporary loss of opportunity and income to productive individuals and at the same time a cost to families who have to carry the burden of providing for the medical needs of sick family members.

Environmental health problems associated with flooding, while in most cases not immediately discernible, can often be recurrent and chronic and affect a larger segment of the population exposed. The pain and cost of continuous treatment and work disruption could amount to some significant income and opportunity losses over an indefinite period of time.

The damages to residential dwellings are often related to cases of morbidity and mortality. The type of construction materials and location of housing units may predispose a family to flooding and wind risks. Damage to housing and personal properties represents losses of investment that might prove difficult to recover or rehabilitate for the marginal sector of society. Moreover, the effects of dislocation of families affected for a certain period of time can create uncertainties and sometimes lead to social problems.

The health and safety of the population is not only a concern of individual families affected but the local and national government as well. The city government and local agencies carry the responsibility for ensuring the safety of affected communities by mobilizing the city's resources to evacuate families within danger zones and attend to casualties. Moreover, they have to provide for food assistance and other needs of evacuees/other affected members of the community. Government resources spent for ensuring the safety of its populace in typhoon events could reach some significant amount, which could otherwise be channeled to more productive endeavors and other pressing needs of the city government.

4.1.1.2 Economic Risks

The economic risks to wind and flooding hazards involve losses in investment, production and income from the following economic activities:

- occupational losses to daily wage earners of those occupations interrupted by flooding, such as those in the transport industry (e.g., tricycle, jeepney and bus drivers), factory workers and ambulant vendors.

- business losses from damage to goods and income foregone from disruption of business operation (e.g., due to closure and power interruption), and

- agricultural losses from crop damage, loss of investment and income.

4.1.1.3 Physical Risk

In addition, risks to lifeline infrastructures and facilities could include damages to critical facilities and infrastructures, such as roads/bridges, water, power and health facilities, which are themselves crucial to disaster management (e.g., evacuation and relief operation) as well as daily socioeconomic activities (livelihood and business maintenance). The cost of damage to lifeline infrastructures and facilities involves repair/rehabilitation, social and economic losses from lack of access and/or disruption of operation. For instance, damage to power lines will affect operation of the business and social sectors largely dependent on the use of electricity (e.g., food business, hospitals). Severe damage to roads will render many areas unpassable causing access problems and affecting the flow of goods and mobility of people.

4.1.2 Consequence Analysis

Consequence analysis involves the quantification of probable impacts/effects or damages caused by flooding and wind hazards during typhoon events that regularly visit Naga City. In as much as these hazardous events are naturally occurring, their predictive magnitudes at different return periods vis-a-vis anthropogenic interventions in areas naturally-prone to such hazards determine the extent of socioeconomic effects. This analysis however is constrained by very limited data on flood damages at various flood magnitudes. The only basis for the analysis is the flood damage survey undertaken by DSWD and the Office of the City Mayor during the 1998 Typhoon Loleng which more or less corresponds to a 10-year flood return period. Probable estimates for other flood magnitudes are difficult to quantify in the absence of any historical data. Nevertheless, the limited data is analyzed to illustrate the magnitude of impacts and consequent social and economic losses to the city as a means of generating awareness and broad support to avert and/or reduce to the minimum disaster conditions.

Table 10 summarizes the result of the damage assessment survey during Typhoon Loleng in 1998 as far as population affected, casualties and housing damage are concerned. Additional damage estimates were also assumed or inferred from other available information.

4.1.2.1 Mortality and Morbidity Cases

On a flood magnitude equivalent to a 10-year return period with a typhoon wind of greater than 100 kph as represented by Typhoon Loleng, the entire Naga reported a total death of 10 persons, 8 of which happened in the flood-prone barangays and 2 in the upper barangays prone to wind hazard. Reported causes of death include drowning, hypothermia, cardiac arrest and fetal death.

Morbidity cases reported involved 14 persons who suffered various types of injuries. The casualties were mostly (12) from the flood-prone areas. There were no data generated on other cases of illnesses/morbidity after the flood event from exposure to flood waters and in relation to ensuing environmental sanitation condition in the area. Considering the pollution level of river water inundating residential areas, uncollected garbage and possible contamination of well water sources, the likelihood of incidence of water-borne diseases is high. In fact, diarrhea and respiratory diseases are the most common causes of morbidity and to some extent mortality in the city.

In the absence of the profile of casualties reported including age, occupation, number of days sick, medication cost and others, it is difficult to quantify the opportunity losses from mortality and morbidity cases. It is also safe to assume that there were many unreported cases especially on those who got sick as a result of the flood event. In the overall, the consequences to public health and safety at this magnitude of flooding could be very substantial to warrant serious attention.

4.1.2.2 Damage to Housing/Properties

Some 8,634 housing units have been damaged by Typhoon Loleng, 16 percent of which

incurred total damage while 84 percent was partially damaged. Housing/property damage in the flood-prone barangays accounted for 407 units totally damaged and 2,793 units partially damaged. In the upper barangays of Naga there were more houses damaged primarily due to strong typhoon winds: 984 totally damaged and 5,434 partially damaged.

Losses in property investments were estimated at an aggregate of P29,450,000 for the entire Naga. The flood-prone barangays accounted for the bulk of the damage amounting to some P20.05 million. Some P9.4 million property damages were registered in the upper barangays.

4.1.2.3 Cost of Government Assistance for Relief Operation

Government resources (City Government, DSWD, OCD, etc.) channeled to relief operation and assistance to affected families covered/served some 81,000 persons incurring an estimated cost outlay of P654,206. Sixty eight percent of government assistance was provided to the flood-prone barangays and the rest to the upper barangays. This cost does not include the compensation of government personnel who have been mobilized for several days to render relief assistance. Considering personnel and equipment cost, the resources spent could easily amount to over a million pesos.

4.1.2.4 Occupational and Business Losses.

Workers involved in occupations sensitive to flooding/wind hazards loss daily earnings of about P180 per day. With a rough estimate of about 2,000 workers involved in these occupations, income equivalent to some P360,000 is lost in a day. Assuming a 2-day work disruption in any flood event, income foregone is about P720,000.

Based on the 1998 data on commercial/industrial establishments in the entire Naga the business sector generates an aggregate of some P7 billion revenues annually. Assuming businesses operate for an average of 300 days per year, the aggregate income losses on businesses in the flood-prone barangays at a 10-year flood was roughly estimated at P10.5 million per day. Assuming a 3-day closure, income losses could amount to around P31.5 million. If a one-day disruption in the rest of Naga is further considered from wind risk, the daily business losses for the entire city could reach some P 44.6 million a day. This represents a rather conservative estimate considering that the data was based on consolidated BIR reported annual sales by business establishments.

4.1.2.5 Agricultural Losses

Damage and income losses from agricultural crops, essentially from strong typhoon winds, amounted to some P39.6 million in 1998. The upper barangays of Naga where majority of the productive agricultural areas are located were the most hardly hit.

4.1.2.6 Damage to Infrastructures and Utilities

Damage to key public infrastructures (such as roads and bridges, school buildings, government facilities and drainage) was estimated at P18.8 million during Typhoon Loleng.

Of this, some P13 million or 69 percent was reported by the flood-prone barangays. This figure does not include damage to public utilities, such as power and water supply, private academic institutions and medical facilities, among others.

4.1.3 Overall Damage Assessment and Frequency Analysis

The overall quantifiable losses from flooding/wind risk of a 10-year return period magnitude, as typified by Typhoon Loleng, is summarized in *Table 11*. The aggregate losses quantified were estimated at P133 million. This could reach as high as P140 million if health-related opportunity losses were inputted as well as other occupational and infrastructure losses not earlier included/estimated.

In order to roughly illustrate probable socioeconomic effects at different flood/wind magnitudes, the 1998 data was used to proportionately estimate population affected and casualties while damage/losses were extrapolated linearly based on the extent of inundated areas with severe flooding.

The probable population affected and health-related effects are illustrated in *Table 12*.

Table 12: Probable Population Affected and Casualties by Flood Magnitude

Return Period	Population Affected	Mortality (No.)	Morbidity (No.)
1.8-Year Return Period	22,543	3	4
3.5-Year Return Period	45,502	6	8
5-Year Return Period	54,151	7	9
10-Year Return Period	**80,807**	**10**	**14**
20-Year Return Period	99,118	12	17

Flood/wind damage and probable consequent losses were estimated including the probability of occurrence in a year (frequency) and estimated cost at different magnitudes. This is shown in *Table 13*.

Table 13: Probable Economic Losses by Flood/Wind Magnitude

Return Period	High Risk Area (Ha)	Reported/Est Losses (Pm)	Adjusted Losses (Pm)	Frequency (%)
1.8-Year RP	150.52	37.13	39.06	56%
3.5-Year RP	303.81	74.95	78.83	29%
5-Year RP	361.56	89.20	93.82	20%
10-Year RP	**539.54**	**133.10**	**140.00**	**10%**
20-Year RP	661.80	163.27	171.72	5%

4.2 VULNERABILITY AND RISK ANALYSIS

Vulnerability assessment was undertaken primarily within the physical and socioeconomic context. The spatial distribution and characterization of population and settlements as well as economic activities across hazardous areas in relation to the degree of flooding/wind risks determine the vulnerable groups/sectors within Naga.

4.2.1 Area and Spatial Distribution of Barangays

Naga City is composed of 27 barangays encompassing an aggregate land area of some 7,748 ha. and with a total population of 126,972 in 1995.

Seventeen (17) out of 27 barangays of the city are located in the flood plains. However, they occupy only some 10% of the total land area of the city (802 ha) as against the remaining 10 barangays with a combined area of 6,946 hectares. The 17 barangays are naturally flood-prone in view of their nearly level elevation and their proximity to the Bicol River and Naga River that become inundated during typhoon events. Barangays that are affected by the Bicol River include Mabolo, Tabuco, Triangulo, Sabang, Igualdad and Abella. Directly located along the river are the barangays of Mabolo, Tabuco and Sabang. On the other hand, those that are directly traversed/affected by the Naga River are the barangays of Dinaga, Lerma, Tinago, Dayangdang, Peñafrancia and San Francisco.

The 17 barangays comprise today the heart and center of business and commerce of the city. The existing Central Business District (CBD-I) which is composed of the barangays of Abella, Dinaga, Igualdad, Sabang and San Francisco occupy an aggregate area of 91 ha. or about 11% of the flood-prone barangays. The proposed CBD expansion area (CBD-II) includes the barangays of Triangulo and Tabuco. These barangays, which have a combined area of 280 ha., are likewise located in the flood-prone areas. They occupy a much larger area of about 35% of the 17 barangays.

The 10 barangays outside of the flood plain, on the other hand, are located in higher elevation. This renders them relatively protected from flooding but more susceptible to wind hazard. Barangays located in higher areas are mostly agricultural areas that are still relatively sparsely populated.

4.2.2 Population Trend, Density and Spatial Distribution

Population and growth patterns in the city generally indicate increasing trend and movement of population within the city. Over the last 15 years (1980-1995), the city's population grew at an average annual rate of 2.27%. It was noted however that average annual growth rate was faster from 1980-1990 at 2.43% annually compared to the period from 1990-1995 which slowed down to 1.94% per year (*see Table 14*).

The spatial distributions of population across the different barangays indicate that majority of the population then and now are concentrated in the flood plains. In 1995, 58% of the population inhabit the flood-prone areas which only corresponds to 10% of the total area of

the city.

However, population movement within the city had been noted during the last 15 years. The percentage of population occupying the flood-prone areas had decreased from 70% in 1980, 62% in 1990 to 58% in 1995. Negative growth rates have been registered in 1995 by 8 barangays in the flood-prone areas, such as Abella, Bagumbayan Norte, Dinaga, San Francisco and Tinago. On the other hand, Calauag (6.59%) and Liboton (4.11%) registered very significant annual population growth. Moreover, the pattern showed a tremendous shift in population distribution to barangays located in higher areas. From 1980-1990, annual population growth in these barangays reached an average of *5.71%* and *4.48%* from 1990-1995. Highly significant increases in population have been reported, particularly in Concepcion and Del Rosario (going towards Pili) and towards Cararayan and San Isidro. The movement of population away from the CBD areas may be largely attributed to the growing commercialization of the area. Converting residential areas to commercial uses makes sense from an economic standpoint. Moreover, subdivision development has flourished and became fashionable, attracting many households to relocate in new subdivisions. To some extent probably, flooding may also be a factor for relocating residential dwellings to higher areas.

Density wise, the flood-prone barangays already exhibit overcrowding with an average population density of 92 persons per ha. in 1995 as against the rest of Naga which registered only an average of 8 persons per ha. and the city average of 16 persons per ha. for the same period. Areas in the flood plains with overwhelmingly high population density include Lerma (619 P/ha), Igualdad (266P/ha) and Abella (260 P/ha). Dayangdang, Peñafrancia, Sabang and San Francisco likewise registered high population densities. Only Tabuco followed by Triangulo, Mabolo and Bagumbayan Norte have densities lower than the average of the 17 barangays. In the rest of Naga, the highest registered density was only 47 persons/hectare. This covers the barangay of Concepcion Pequena. In the existing CBD, average population density registered a high of 184 persons per ha. compared to the CBD expansion area that posted only 39 persons/ha. Using the average annual growth rate of population from 1990-1995 of 1.94%, the population today in Naga is projected to reach some 137,127 persons comprising of about 26,000 households (*see Table 15*).

4.2.3 Population at Risk

4.2.3.1 Flooding Hazard

The city's population directly exposed to flooding risks are generally those that inhabit the 17 flood-prone barangays. The level of risk to the population is associated with their spatial distribution in the barangays affected. For purposes of identifying the magnitude of the risk across population centers, density factors were matched against identified high-risk residential areas by flood return period. Projected 1999 population data was used to illustrate and define spatially the highly at risk population.

Table 16 shows the residential areas and population exposed to high risk due to flood inundation at different return periods. This is summarized in *Table 17*.

Table 17: Estimated Population At Risk in Residential Zones by Flood Return Period

Flood Return Period	High Risk Res Area (Ha)	% to Total Res Area	Est Population At High Risk (1999)	Est Population at Medium/High Risk (1999)
1.8-Year Return Period	30.29	23%	10,248	25,339
3.5-Year Return Period	87.88	25%	12,425	26,403
5-Year Return Period	121.48	35%	16,891	29,619
10-Year Return Period	191.51	55%	25,581	42,235
20-Year Return Period	259.42	75%	32,238	43,023

Based on the city's land use plan and zoning, 43% or some 347 ha. comprise the residential zone within the flood-prone barangays. On a 1.8-year flood return period that has a 56% probability of occurring every year, some 263 ha. or 76% of the residential areas are affected at varying degrees of flooding. The high-risk areas which are inundated by floodwaters with a depth of 3.5 feet and above affects about 23% or some 60 ha. of the residential zone. Based on the 1999 projected population, at this flood magnitude, an estimated population of about 10,248 or 1,900 households will already be affected. Combining the medium risk (with flood levels of 2 feet to 3.5 feet) with the high-risk areas, some 189 ha. will be affected with an aggregate population at risk increasing to about 25,000 persons or 4,700 families. Populations that are highly at risk are those located in barangays Sabang, Tinago, Calauag, Abella, Igualdad and Triangulo.

A 3.5-year flood with 29% annual probability of occurrence will increase the flooded residential areas to around 275 ha. Population at high risk is estimated at 12,425 comprising of some 2,300 families. Including medium risk areas, the population at risk can reach some 26,000 or about 5,000 families. Most of the households affected are concentrated in the barangays of Igualdad, Abella, Tinago, Mabolo, Sabang, Dayangdang and Calauag.

On a 5-year flood return period with a 20% annual probability of occurrence, the areas affected dramatically increases to almost 99% (342 ha.) of the residential zone. While a relatively significant portion of the affected areas are still classified within the low risk zone, areas at high risk account for 121 ha which is about 36% of the residential zone in flood-prone barangays. The population at high-risk accounts for about 17,000 comprising some 3,000 families. Further incorporating the medium risk areas, the exposed population reaches almost 30,000 equivalent to some 5,500 families. Households in the barangays of Sabang, Igualdad, Abella, Sta. Cruz, Tinago, Dayangdang, Calauag and Mabolo are the most

vulnerable.

On a 10-year to 20-year flood return periods with 10% and 5% probability of annual occurrence, respectively, the areal extent of flooding risk will reach almost a hundred percent of the residential zone. Correspondingly, the high-risk residential areas can shoot up to 192 ha. (10-year RP) and 259 ha. (20-year RP). Almost 100% of the barangays are at high risk, including residential areas. The population at high-risk range from 26,000 to 32,000 corresponding to about 4,700 to 6,000 families. Including medium risk areas, the population affected by a 10-year flood will comprise some 42,000 persons or about 7,800 families. On a 20-year flood, the combined medium and high-risk areas can affect some 43,000 persons or almost 8,000 households. Hardly hit areas are the same as those in the 5-year return flood.

Regardless of the magnitude of flooding, it is the population in the barangays of **Sabang, Igualdad, Abella, Sta Cruz, Dayangdang, Calauag, Tinago, Mabolo and Triangulo** that are prominently at risk. These barangays ironically are mostly within the existing CBD.

Based on the reported average flooding duration by return-period in all flood-prone barangays, the number of days flooded ranges from an average of 7 days on 1.8-year return flood to 13 days on a 20-year return flood. Population exposed to very highly significant risk of long exposure to flood waters are those residing in Triangulo where flooding can last up to a one month on any flood return period. Igualdad, Abella, Calauag, Mabolo, Tabuco also reported longer flooding duration of more or less one week.

The above analysis does not cover households or settlements found along commercial zones which are also highly at risk. The likelihood therefore that more people are exposed to significant risk is still high especially if they live on single detached dwelling units constructed with light materials.

4.2.3.2 Wind Hazard

Risks due to strong typhoon winds affect primarily the population whose residential dwellings are made of light materials. The settlement and housing data of Naga showed that of some 29,000 residential buildings in the city, 25% is considered highly at risk. These residential units are home to about 40,000 persons or 7,400 families. In addition, about 24% of houses are considered as medium risk buildings with some 38,000 persons or 7,000 resident families (*see Table 18*).

The flood-prone barangays have more residential dwellings classified as high risk compared to the upper barangays. This is in view of the concentration of residential zones in urban Naga. In the flood-prone barangays, about 4,000 houses are in greater risk from wind hazard as against some 3,000 units in the upper barangays. Medium risk buildings account for an estimated 4,000 units in the low lying areas and almost 3,000 units in the upper areas. Based on the number of residential buildings classified as high risk, the following barangays have the most number of population highly at risk:

- Mabolo - San Felipe - Igualdad - Triangulo

- Cararayan - Dayangdang - Carolina

On a 2-year return period with 50% probability of occurring every year, storm winds poses already significant risk to the upper barangays of the city. The low-lying areas are exposed from low to moderate risk. On a 5-year to 20-year return period, the whole area and population of Naga become highly susceptible to wind risks posed by strong storm winds.

4.2.4 Social Vulnerability

While the city's populations at risk have been generally identified based on spatial location, their vulnerability to risks associated with flooding and wind hazard is contingent on several factors. Sectors or groups of people become vulnerable on account of their demographic setting, socioeconomic status and characteristics including their perceptions and attitudes towards flooding/wind risks.

4.2.4.1 Vulnerable Sector : Urban and Rural Poor.

In any disaster situation, it is always the marginal sector of society that is most vulnerable because they have relatively little means to prepare and protect themselves for such eventuality. In fact, most poor people are not alarmed by flooding/wind hazards and would rather concentrate their efforts on day-to-day economic endeavors to provide for their basic needs.

In the context of Naga, the marginal groups comprising the urban poor communities of the city are considered as the most highly vulnerable sector to flooding and wind risks. With limited economic resources, urban poor households are typically characterized as follows:

- Do not own residential lots and either squatting on open lands or renting small rooms/ houses in crowded areas.

- They tend to settle or occupy areas, which are relatively proximate to the center of economic activities, regardless of site flooding condition, where they are accessible to their livelihood.

- Housing units are typically made of light materials and poorly constructed (e.g., shanties, makeshift houses) which are often highly susceptible to wind and flooding damage.

- Subsistence to low income level families with one or two family members working.

While the rural poor population of Naga located in upper barangays are relatively safe from flooding hazards, they are more exposed to wind risks. Their dwelling units are mostly not resistant to strong winds. Moreover, their location in higher elevation within relatively sparsely populated open areas/fields and/or wooded areas pre-dispose them to wind risks.

Records at the Urban Poor Affairs Office indicate that there are about 10,528 urban and rural poor households registered as potential socialized housing beneficiaries in 1995. Of this 55% or some 6,000 families are located in the flood-prone barangays and the rest are from the upper barangays. The distribution of urban poor settlements in the city are largely concentrated in the CBD areas which experience in many cases severe flooding. These include the following barangays with the estimated number of urban poor families:

Triangulo	-	734 families
Sabang	-	568 families
Abella	-	557 families
Calauag	-	549 families
Tabuco	-	389 families
Igualdad	-	332 families

Within these high risk population, the most vulnerable to flooding risk among the urban poor sector are those residing in the following:

- along or adjacent to the Bicol River and Naga River,
- pockets of settlement areas built within or interspersed with commercial areas, and
- resettlement sites in low-lying areas.

Settlements/Communities Along or Adjacent to the Bicol River and Naga River

About 30 ha. of river area traverse 9 barangays of the flood plain. These include Tabuco, Mabolo and Sabang along the Bicol River and Dinaga, Lerma, Tinago, Dayangdang, Peñafrancia and San Francisco along the Naga River. During typhoon events, these rivers overflow and inundate areas beyond those barangays along the rivers. The Bicol River particularly affects the adjacent areas of Igualdad, Abella and Triangulo.

The Strategic Watershed Management Plan of Naga City has identified about 500 households whose settlements or houses are located in the river easements. Majority of families residing along the rivers lives in shanties or dwelling units made of light materials which are often times poorly constructed. They are therefore most vulnerable to casualty from both flooding and wind hazards. During typhoon Loleng in 1998, 2 people from Mabolo and Triangulo died of drowning while 5 fatalities from Tabuco, Sabang and Mabolo suffered from hypothermia/cardiac arrest. Twelve (12) persons were also reported to have suffered various types of injuries in Tabuco, Sabang and Mabolo.

Reported damages to residential houses (total and partial damage) were also significant, especially in Sabang, Triangulo, Calauag and Mabolo. Many families were evacuated from these areas by DSWD with the largest number of evacuees residing in Triangulo.

Pockets of Urban Poor Settlements Within and Around Commercial/Developed Areas

Commercial establishments in the flood prone barangays have increased tremendously over the years replacing what used to be dominantly residential areas. Many families who have converted their residential lots to commercial uses have moved to other locations in the city leaving behind squatter families and new migrants to occupy pockets of small open areas along commercial zones. The practice of land filling of new commercial and/or industrial establishments and even some residential buildings to raise the ground level (approximating the flood height) has shifted flood waters and/or increased flooding on low-lying areas surrounding them. Squatters or indigent families who cannot afford land filling of their settlements often occupy these sites. While multi-storey commercial/industrial buildings provide some kind of buffer which relatively protect them from wind hazard, floodwaters tend to concentrate in these areas exposing the urban poor to greater risk. These vulnerable communities are highly evident in areas along Igualdad, Abella and Sabang.

Resettlement Areas

Naga has embarked on a massive resettlement program for urban poor communities of the city. This program primarily provides on-site and off-site resettlement areas to qualified urban poor applicants. To date, a total of some 91 ha. of land had been acquired by the city for distribution to urban poor families. It was noted however that out of 33 resettlement sites, more than half (19 sites) are located along flood-prone areas. Eight of these earlier resettlements are sited in high-risk areas experiencing severe flooding such as those in Igualdad, Abella, Sabang, Calauag, Triangulo and Tabuco. Since most resettled urban poor households in these areas cannot afford to fill and build houses resistant to wind and flooding, they remain vulnerable to risks. Benefits from the program is somehow negated by such condition and by the fact that the city has to provide resources once again to the same sector every flood event for evacuating them to safer grounds and caring for their needs.

The overall reported casualty and damage mostly to urban poor households in the flood-prone areas during typhoon Loleng include some 52,000 persons affected, 8 persons dead, 12 persons injured and some 3,200 houses totally and partially damaged. Property damage was estimated at P20 million. Likewise, government spent some P444,000 in various forms of assistance to affected families.

Rural Poor Households in Upper Barangays

In the upper barangays of Naga, the most vulnerable population is similarly the poor families whose houses are made mostly of very light materials and are found largely in sparsely populated and open areas. Highly at risk are the poor families located in the barangays of Cararayan, Carolina, San Felipe, Pacol and Balatas. Two wind-related deaths have been reported in Cararayan during Typhoon Loleng as well as 2 injured in Pacol. Population affected by strong storm winds accounted for some 28,000 households with some 5,000 houses either totally or partially damaged. The most number of houses damaged were reported by the barangay of Pacol followed by Concepcion Pequeña, Cararayan and Carolina. Total reported property damage amounted to around P9 million. In addition, cost of government assistance to affected families in these areas amounted to about P153,000.

4.2.4.2 Vulnerable Population Group: Elderly, Children /Infants

Among population group comprising the urban/rural poor sector, those vulnerable to casualties are mainly the elderly and infants/children. Children with ages under 1 to 14 comprise some 38% of the city's population in 1995. They are more susceptible to injuries and sickness from exposure to strong winds and floodwaters. Cases of respiratory and water-borne related illnesses are often high after a typhoon event, especially among pre-schoolers and grade school children exposed to the bad weather and floodwaters. Cases of infant deaths also occur. Moreover, children hit by flying debris (due to strong winds) also suffer injuries.

The elderlies (age group 60 and over) accounting for 5% of the total city population are also predisposed to risks, especially those suffering from existing illness or those that are already generally very old and weak. Death cases during Typhoon Loleng were mostly elderlies who have either drowned or suffered hypothermia and eventually death by cardiac arrest.

Other vulnerable groups are the mentally and physically handicapped in the high-risk areas who will need assistance to be evacuated to high grounds. Women, especially pregnant mothers, are likewise vulnerable to flood water exposure because of their condition. One case of fetal death has been reported during Typhoon Loleng due to premature delivery.

4.2.5 Economic Vulnerability

The impact of flooding and wind risks on the economy comes in the form of direct and indirect damages and income losses affecting the following vulnerable groups:

- daily wage earners of occupations that are sensitive to interruptions imposed by flooding, such as those of the transport industry,
- business sector (commercial and industrial), and
- agricultural sector.

Direct losses affect owners of enterprises (business and farms) whose investments may suffer damages or losses including income foregone from interruption in operation. This also includes income losses of workforce, either temporarily or permanently, who are engaged in vulnerable occupations. Indirect losses applies generally to retailers and relevant economic sectors whose operation and income are dependent or tied-up to the supply and operation of big business establishments such as those in the food business.

4.2.5.1 Vulnerable Occupation

During flooding events, the most vulnerable groups to income losses are the daily wage earners who generate income and/or get paid on a day-to-day work. These comprise mostly of the workforce in the transport industry, such as tricycle, jeepney and bus drivers; factory/sales workers and agricultural labor. In the flood-prone areas of Naga, it is the tricycle and jeepney drivers who are mostly affected because they can no longer operate in many areas which are already flooded. Factory and/or sales workers on the other hand suffer losses

from work stoppage of their factories/businesses or have access problems to work sites. Losses in daily income or wages of equivalent to an average of about P180/day is already substantial to families mainly dependent on such sources for their daily subsistence. Moreover, if work interruption occurs for several days, it could at the worst result in starvation of poor families.

4.2.5.2 Vulnerable Businesses

As earlier indicated, the center of trade and commerce in Naga is located along the flood-prone zone, most of which are located in identified high-risk areas. A summary profile of high-risk areas, number of establishment and estimated annual gross sales by barangay is shown in *Table 19*.

The combined commercial and industrial zone area constitutes some 30% of the total area of the flood-prone barangays with the biggest commercial/industrial lands found in Triangulo, Tabuco, Peñafrancia, Mabolo, Tinago and Abella. Densitywise, the number of establishments per hectare is highest in Igualdad (494 establishments/ha) which hosts around 771 establishments including those located in the Naga City Public Market. This is followed by Calauag with 73 establishments per ha., Dinaga (50 est/ha), Sta Cruz (33 est/ha.), Lerma (28 est/ha) and San Francisco (19 est/ha). The least number of establishments relative to the area can be found in Triangulo, Mabolo, Tinago and Bagumbayan Sur.

The existing CBD occupies only about 15% of total commercial lands in the flood plains. However, 59% of total establishments are found in CBD-I with 89% of total gross sales coming from this area. On the other hand, the proposed CBD-II is more than twice the area of CBD-I. Business establishments however are still comparatively few with a total of 156 firms generating an aggregate revenue of only P31.2 M as against P2.8 B in CBD-I.

In terms of gross sales, Igualdad posted the highest revenue in 1998 followed by Dinaga, Sta Cruz, Abella and Sabang. Many small establishments which are largely into general merchandise retail can be found in Igualdad (Public Market), Calauag, Dinaga and Liboton. Large commercial establishments are found mainly in Igualdad, Abella, Lerma and San Francisco.

About 75 ha. of the commercial zone in the flood-prone barangays or 31% suffer from severe flooding on a 1.8-year flood return period. The areas severely inundated increase with the magnitude of flood reaching 91% of the total commercial zone on a 20-year flood return period. A significant portion of the commercial zones of barangays Abella, Triangulo, Peñafrancia, Tinago, Sabang and Lerma are almost always flooded, regardless of flood return period. It should be noted however that severe flooding is more pronounced in the CBDs with almost 100% of the commercial zone of these barangays at high risk especially on a 10 to 20-year flood return period.

Most business establishments in the city have learned to cope with flooding risks. New commercial buildings have been elevated and many have also been renovated to raise the ground floor level. As such, damage to goods as a direct consequence of flooding is often

minimal.

Damage to perishable items is attributed more often to power failure due to power line damage because of the typhoon. The impact on business is more attributed to disruption in operation because of flooding/wind risks.

4.2.5.3 Vulnerable Agriculture Areas

Naga City is still predominantly agricultural in terms of land use. Around 55% or some 4,300 ha. of the entire lands of Naga is classified as agricultural areas. Only 4% of this is found in the flood-prone barangays and these are either idle or utilized for subsistence-type of agriculture. Remaining agricultural lands in the flood-prone barangays are found in Mabolo, Tabuco and Triangulo.

Majority or 96% of the agricultural lands are found in the upper barangays of the city. These are mostly cultivated to rice, corn, sugar and a mix of agroforestry uses. The more productive and extensive agricultural areas which are highly at risk from strong winds are those found in Pacol, Carolina, Panicuason and San Felipe.

In the recent Typhoon Loleng, agricultural losses, largely from wind damage, amounted to about P39.6 million for the entire Naga. Almost 100% of the damage were reported by the upper barangays. The highly at risk barangays suffered the greatest damage/losses.

4.2.6 Perception of Risk

Flooding and wind hazards are a regular occurrence in Naga. People have generally adjusted and accepted them as a fact of life in the city. The proliferation of settlements and business establishments along flood-prone areas gives an indication that flooding is not really perceived as a serious problem and much more a risk to reckon with. Even the local government does not seem to accord priority concern to flooding hazard, judging by its existing and planned development thrusts.

People in the city have come to live with this situation and learned to cope with flooding hazards. Coping mechanisms of affected sectors/groups vary by socioeconomic status. Measures to alleviate or prevent the occurrence of casualties and losses are largely taken individually in accordance with ones financial capability. Relocation is often not resorted to as a means of avoiding the problem. Instead, business establishments and relatively well-off residents generally construct new buildings and/or remodeled old ones by raising the ground level (by land fill) to conform with the flood level. While this relatively protect their premises/properties from floodwaters, it is at the disadvantage of unfilled areas where flooding is further aggravated. This situation affects mostly the poor population settled within and around developed areas. The coping mechanism for the urban poor communities is either to build houses on stilts or just simply live with the situation when it occurs. There are in fact some communities whose dwelling units are almost always under water.

From 1980 up to the present there are indications of a significant number of families

relocating their residences out of flood-prone areas. This is largely attributed however to the conversion of many residential areas to commercial uses because of the increasing real property values of these lands. Economic gain is apparently the overriding concern for converting residential areas to commercial zones. For instance, in the CBD area today, inspite of being a high-risk zone, the value of commercial lands can run as high as P40,000 per sq. meter.

Clearly, flooding hazard is not considered by the city's population as an important factor in location decisions, both for residence and commercial endeavors. Whatever damages or casualties incurred in some flood events in the past seemed to be taken as of little consequence compared to the socioeconomic benefits derived from the existing location. The worst is that a number of poor people even think they are better off during flood events because government provides for relief assistance. Moreover, the city government itself appears to maintain the same attitude. It has not factored in flooding hazard in the land use plan and zoning regulations of the city nor has it invested in the implementation of adequate drainage infrastructures. Even the city's program to resettle urban poor has not considered flooding, thereby increasing vulnerable population and further burdening the city's coffers during typhoon events to provide for evacuation centers and relief operation in resettlement areas.
The rather fatalistic attitude of the general populace towards flooding risks tend to further increase the vulnerability of identified population sectors and groups. Such perception and attitudes breed some kind of indifference to the situation. While there are certainly individual, government and some multi-sectoral efforts being taken as counter measures to address flooding risks, they are mostly piece meal, uncoordinated and reactive in nature. The outcome of such initiatives, while benefiting a few households, often shift and/or aggravate the flood situation at the disadvantage of marginal groups. Other measures also tend to encourage dependency in government for relief assistance. The social and economic costs of flooding to the city can no longer be ignored as its impacts/risks involve human and economic welfare.

In the case of wind risk, the city and the region for that matter being within the typhoon belt, people are more conscious of the need to build typhoon-resistant residential dwellings. However, income limitations preclude particularly the urban and rural poor communities from investing in more sturdy houses resistant to storm wind risks.

4.2.7 Risk Evaluation

Estimated risk based on the annual probability of occurrence of different flood magnitudes indicate the following:

Flood Magnitude	Frequency	Estimated Cost/Year
1.8-year RP	56%	P21.7 million
3.5-year RP	29%	22.5 million
5-year RP	20%	18.8 million
10-year RP	10%	14.0 million
20-year RP	5%	8.6 million

The above shows that a 3.5-year flood return period will likely cost the most risk given a 29% probability of occurring in a year.

To further assess the magnitude of severity and importance of the risks identified, the frequency-consequence matrix was employed as shown in *Figure 23*. The risks have various degrees of probability of occurrence spread over a 20-year period with corresponding probable consequences.

Based on the risk matrix, a 1.8-year flood/wind return period will be the most probable to occur within a year with limited consequences which are within acceptable range. A 3.5- to 5-year flood return period has the probability of occurring once every 5 years or less with already serious consequences. Very serious and catastrophic effects are highly probable for a 10-20-year flood return periods.

Figure 22: Risk Matrix

Figure 41. Risk Matrix

VERY PROBABLE (once every 5 years or less)	1.8-year RT	3.5-year RT 5-year RT		
QUITE PROBABLE (once every 10 years or less)			10-year RT	
SELDOM (once every 20 years or less)				20-year RT
Frequency / **Damages**	**LIMITED** (less than P 50 M)	**SERIOUS** (P 50 - 100 M)	**VERY SERIOUS** (P 100 - 150 M)	**CATASTROPHIC** (above P 150 M)

In terms of risk acceptability and mitigation, a magnitude equivalent to up to a 5-year return period could be within acceptable range. Risk mitigation options could be instituted within the immediate and medium term at reasonable costs. A 10-20-year flood magnitude however will most likely require long-term planning and heavy investments in structural measures.

Table 10: Damage Assessment: Typhoon Loleng; Date of Occurrence: October 21, 1998; Coverage: Naga City

	Barangay	Total Population (1995)	Population Affected/ Served	% to Total HHs	Number of Casualty		Number of Houses Damaged		
					Dead	Injured	Total	Partial	Total No.
1.	Abella	5,740	3,050	0.53			1	78	79
2.	Bagumbayan Norte	1,952	1,794	0.92			15	59	74
3.	Bagumbayan Sur	5,544	3,066	0.55			13	243	256
4.	Calauag	6,707	4,572	0.68	1		20	359	379
5.	Dayangdang	5,216	3,900	0.75			21	76	97
6.	Dinaga	741	693	0.94			1	17	18
7.	Igualdad	2,620	2,315	0.88			21	63	84
8.	Lerma	2,363	2,300	0.97			4	184	188
9.	Liboton	3,269	2,178	0.67			13	56	69
10.	Mabolo	5,751	5,672	0.99	2	3	70	246	316
11.	Penafrancia	5,644	2,100	0.37			6	155	161
12.	Sabang	6,179	5,437	0.88	1	4	28	507	535
13.	San Francisco	1,483	1,392	0.94			1	35	36
14.	Sta Cruz	6,135	5,100	0.83			6	107	113
15.	Tabuco	4,392	3,000	0.68	3	5	10	158	168
16.	Tinago	3,721	1,860	0.50			2	57	59
17.	Triangulo	6,576	4,008	0.61	1		175	393	568
	Sub-Total	**74,033**	**52,437**	**0.71**	**8**	**12**	**407**	**2,793**	**3,200**
18.	Balatas	5,719	3,300	0.58			150	307	457
19.	Cararayan	5,469	5,628	1.03	2		94	848	942
20.	Carolina	3,330	2,732	0.82			102	451	553
21.	Concepcion Grande	7,598	2,712	0.36			21	367	388
22.	Concepcion Pequena	15,615	5,790	0.37			105	942	1047
23.	Del Rosario	5,021	1,254	0.25			44	161	205
24.	Pacol	3,146	1,986	0.63		2	316	911	1227
25.	Panicuason	1,366	1,128	0.83			65	298	363
26.	San Felipe	3,977	2,700	0.68			57	137	194
27.	San Isidro	1,698	1,140	0.67			30	28	58
	Sub-total	**52,939**	**28,370**	**0.54**	**2**	**2**	**984**	**4,450**	**5,434**
	GRAND TOTAL	**126,972**	**80,807**	**0.64**	**10**	**14**	**1,391**	**7,243**	**8,634**

Source: DSWD and Office of the City Mayor

Table 11: Overall Estimated Flood/Wind Damage/Losses in Naga City * [Typhoon Loleng (10-Year Flood Return Period)

Barangay		Gov't Relief Asst (P)	Property Damage (P)	Damage to Agriculture (P)	Damage to Infrastructure (P)	Business Losses (P)	GRAND TOTAL (P)
1.	Abella	35,676	1,300,000		1,150,000	1,260,000	3,745,676
2.	Bagumbayan Norte	9,443	700,000		44,800	25,240	779,483
3.	Bagumbayan Sur	16,948				93,030	109,978
4.	Calauag	32,626	800,000		18,400	10,250	861,276
5.	Dayangdang	26,581	800,000		920,000	95,000	1,841,581
6.	Dinaga	4,030	2,000,000		220,000	2,011,290	4,235,320
7.	Igualdad	17,028	1,000,000		900,000	23,168,430	25,085,458
8.	Lerma	18,792	800,000		315,000	84,180	1,217,972
9.	Liboton	1,151	800,000		0	98,910	900,061
10.	Mabolo	54,128	1,500,000		710,000	190,330	2,454,458
11.	Penafrancia	12,440	1,000,000		1,090,000	626,280	2,728,720
12.	Sabang	71,015	2,500,000		695,000	1,180,750	4,446,765
13.	San Francisco	13,663	800,000		100,000	503,990	1,417,653
14.	Sta Cruz	34,098	750,000	60,500	76,350	1,458,140	2,379,088
15.	Tabuco	26,616	1,500,000		470,000	464,450	2,461,066
16.	Tinago	11,440	1,000,000		500,000	273,860	1,785,300
17.	Triangulo	58,568	2,800,000		5,700,000	43,950	8,602,518
	Sub-Total	**444,243**	**20,050,000**	**60,500**	**12,909,550**	**31,588,080**	**65,052,373**
18.	Balatas	25,420	1,000,000		1,030,000	124,508	2,179,928
19.	Cararayan	9,093	1,000,000	2,300,000	1,360,000	5,440	4,674,533
20.	Carolina	20,095	300,000	10,900,000	12,600	1,806	11,234,501
21.	Concepcion Grande	18,164	1,000,000		470,000	3,374,169	4,862,333
22.	Concepcion Pequena	24,228	1,300,000		1,300,000	9,284,669	11,908,897
23.	Del Rosario	5,613	1,800,000	3,400,000	490,000	210,876	5,906,489
24.	Pacol	11,882	600,000	10,000,000	35,300	155	10,647,337
25.	Panicuason	14,457	1,200,000	9,300,000	30,000	253	10,544,710
26.	San Felipe	7,605	1,200,000	3,600,000	51,900	39,509	4,899,014
27.	San Isidro	16,381	0		1,120,000	83	1,136,464
	Sub-total	**152,937**	**9,400,000**	**39,500,000**	**5,899,800**	**13,041,467**	**67,994,204**
		57,028					57,028
	GRAND TOTAL	**654,208**	**29,450,000**	**39,560,500**	**18,809,350**	**44,629,547**	**133,103,605**

Source: DSWD and Office of the City Mayor (columns 1 to 4); business losses was estimated by Consultant

- Flood damage assessment was limited only to data available and quantifiable.

Table 14: Land Area and Demographic Trend (1980-1995), Naga City

	Barangay	Land Area (Ha)	Total Population (1980)	Total Population (1990)	Ave Annual Growth Rate (1980-1990)	Total Population (1995)	Ave Annual Growth Rate (1990-1995)	Population Density (P/Ha)			Number of Households			Average HH Size (1995)
								1980	1990	1995	1980	1990	1995	
A.	**FLOOD PRONE AREAS**													
1.	Abella	22.11	6,294	6,348	0.09%	5,740	-1.99%	285	287	260		1,129	1,043	5.50
2.	Bagumbayan Norte	23.32	1,557	2,099	3.03%	1,952	-1.44%	67	90	84		377	425	4.59
3.	Bagumbayan Sur	56.86	4,090	5,482	2.97%	5,544	0.23%	72	96	98		1,024	1,071	5.18
4.	Calauag	49.77	3,347	5,045	4.19%	6,707	5.86%	67	101	135		862	1,209	5.55
5.	Dayangdang	29.57	4,298	4,653	0.80%	5,216	2.31%	145	157	176		815	936	5.57
6.	Dinaga	7.35	1,218	887	-3.12%	741	-3.53%	166	121	101		172	146	5.08
7.	Igualdad	9.86	2,047	2,290	1.13%	2,620	2.73%	208	232	266		433	519	5.05
8.	Lerma	3.82	1,921	2,235	1.53%	2,363	1.12%	503	585	619		396	411	5.75
9.	Liboton	25.31	2,127	2,712	2.46%	3,269	3.81%	84	107	129		504	659	4.96
10.	Mabolo	105.26	4,113	5,167	2.31%	5,751	2.16%	39	49	55		821	972	5.92
11.	Penafrancia	37.57	5,456	5,753	0.53%	5,644	-0.38%	145	153	150		1,020	1,024	5.51
12.	Sabang	41.06	4,461	5,587	2.28%	6,179	2.03%	109	136	150		973	1,080	5.72
13.	San Francisco	10.54	2,219	1,628	-3.05%	1,483	-1.85%	211	154	141		308	318	4.66
14.	Sta Cruz	65.03	6,715	6,603	-0.17%	6,135	-1.46%	103	102	94		1,160	1,186	5.17
15.	Tabuco	147.63	4,127	4,578	1.04%	4,392	-0.83%	28	31	30		853	826	5.32
16.	Tinago	34.46	5,322	4,844	-0.94%	3,721	-5.14%	154	141	108		857	738	5.04
17.	Triangulo	132.06	3,869	6,162	4.76%	6,576	1.31%	29	47	50		1,098	1,206	5.45
	Total	**801.58**	**63,181**	**72,073**	**1.33%**	**74,033**	**0.54%**	**79**	**90**	**92**		**12,802**	**13,769**	**5.38**
	% of Total Area	**10%**	**70%**	**62%**		**58%**				**1**				
B.	**REST OF NAGA (10 bgys)**	**6,946.42**	**27,533**	**43,256**	**4.62%**	**52,939**	**4.12%**	**4**	**6**	**8**		**7,686**	**9,863**	**5.37**
	% of Total Area	**90%**	**30%**	**38%**		**42%**		0	0					
18.	Balatas	182.01	2,592	5,092	6.99%	5,719	2.35%	14	28	31		886	1,014	5.64
19.	Cararayan	972.28	1,991	3,487	5.76%	5,469	9.42%	2	4	6		616	1,024	5.34

	Barangay	Land Area (Ha)	Total Population (1980)	Total Population (1990)	Ave Annual Growth Rate (1980-1990)	Total Population (1995)	Ave Annual Growth Rate (1990-1995)	Population Density (P/Ha)			Number of Households			Average HH Size (1995)
								1980	1990	1995	1980	1990	1995	
20.	Carolina	1,605.29	2,456	3,248	2.83%	3,330	0.50%	2	2	2		564	597	5.58
21.	Concepcion Grande	306.37	2,768	6,095	8.21%	7,598	4.51%	9	20	25		1,120	1,432	5.31
22.	Concepcion Pequena	333.06	8,893	12,943	3.82%	15,615	3.82%	27	39	47		2,313	2,832	5.51
23.	Del Rosario	201.52	999	1,824	6.21%	5,021	22.45%	5	9	25		341	1,005	5.00
24.	Pacol	1,184.61	2,154	3,158	3.90%	3,146	-0.08%	2	3	3		573	630	4.99
25.	Panicuason	1,413.21	833	1,236	4.02%	1,366	2.02%	1	1	1		222	214	6.38
26.	San Felipe	518.26	3,853	4,840	2.31%	3,977	-3.85%	7	9	8		814	809	4.92
27.	San Isidro	229.81	994	1,333	2.98%	1,698	4.96%	4	6	7		237	306	5.55
D.	**TOTAL NAGA**	**7,748.00**	**90,714.00**	**115,329.00**	**2.43%**	**126,972**	**1.94%**	**16**	**15**	**16**		**20,488**	**23,632**	**5.37**
E.	**CBD-I**	**90.92**	**16,239**	**16,740**	**0.30%**	**16,763**	**0.03%**	**179**	**184**	**184**		**3,015**	**3,106**	**5.40**
F.	**CBD-II**	**279.69**	**7,996**	**10,740**	**2.99%**	**10,968**	**0.42%**	**57.25**	**38**	**39**		**1,951**	**2,032**	**5.40**

Source of basic data is NSO

Table 15: Projected 1999 Population, Number of Families and Density, Naga City

	Barangay	Land Area (Ha)	Total Population (1995)	% Distribu-tion	Population Projection (1999)	Population Density		No. ofHHs		Average HH Size (1995)
						1995	1999	1995	1999	
A.	**Flood Prone Areas**									
1.	Abella	22.11	5,740	0.05	6,199	260	280	1,043	1,126	5.50
2.	Bagumbayan Norte	23.32	1,952	0.02	2,108	84	90	425	459	4.59
3.	Bagumbayan Sur	56.86	5,544	0.04	5,987	98	105	1,071	1,157	5.18
4.	Calauag	49.77	6,707	0.05	7,243	135	146	1,209	1,306	5.55
5.	Dayangdang	29.57	5,216	0.04	5,633	176	191	936	1,011	5.57
6.	Dinaga	7.35	741	0.01	800	101	109	146	158	5.08
7.	Igualdad	9.86	2,620	0.02	2,830	266	287	519	561	5.05
8.	Lerma	3.82	2,363	0.02	2,552	619	668	411	444	5.75
9.	Liboton	25.31	3,269	0.03	3,530	129	139	659	712	4.96
10.	Mabolo	105.26	5,751	0.05	6,211	55	59	972	1,050	5.92
11.	Penafrancia	37.57	5,644	0.04	6,095	150	162	1,024	1,106	5.51
12.	Sabang	41.06	6,179	0.05	6,673	150	163	1,080	1,166	5.72
13.	San Francisco	10.54	1,483	0.01	1,602	141	152	318	343	4.66
14.	Sta Cruz	65.03	6,135	0.05	6,626	94	102	1,186	1,281	5.17
15.	Tabuco	147.63	4,392	0.03	4,743	30	32	826	892	5.32
16.	Tinago	34.46	3,721	0.03	4,019	108	117	738	797	5.04
17.	Triangulo	132.06	6,576	0.05	7,102	50	54	1,206	1,302	5.45
	Sub-Total	**801.58**	**74,033**	**0.58**	**79,954**	**92**	**100**	**13,769**	**14,870**	**5.38**
B.	**Upper Barangays**	**6,946.42**	**52,939**	**0**	**57,173**	**8**	**8**	**9,863**	**10,652**	**5.37**
18.	Balatas	182.01	5,719	0.05	6,176	31	34	1,014	1,095	5.64
19.	Cararayan	972.28	5,469	0.04	5,906	6	6	1,024	1,106	5.34
20.	Carolina	1,605.29	3,330	0.03	3,596	2	2	597	645	5.58
21.	Concepcion Grande	306.37	7,598	0.06	8,206	25	27	1,432	1,547	5.31
22.	Concepcion Pequena	333.06	15,615	0.12	16,864	47	51	2,832	3,059	5.51
23.	Del Rosario	201.52	5,021	0.04	5,423	25	27	1,005	1,085	5.00
24.	Pacol	1,184.61	3,146	0.02	3,398	3	3	630	680	4.99
25.	Panicuason	1,413.21	1,366	0.01	1,475	1	1	214	231	6.38
26.	San Felipe	518.26	3,977	0.03	4,295	8	8	809	874	4.92
27.	San Isidro	229.81	1,698	0.01	1,834	7	8	306	330	5.55

Barangay	Land Area (Ha)	Total Population (1995)	% Distribu-tion	Population Projection (1999)	Population Density		No. ofHHs		Average HH Size (1995)
					1995	1999	1995	1999	
D. TOTAL NAGA	7,748.00	126,972	1.00	137,127	16	18	23,632	25,522	5.37
E. CBD-1	90.92	16,763	0.13	18,104	184	199	3,106	3,354	5.40
F. CBD2	279.69	10,968.00	0.09	11,845	39	42	2,032	2,195	5.40

Table 16: High Risk Residential Areas by Flood Return Period, Naga City

BARANGAY	High Risk Area (Ha)	% to Total Area	High Risk & Medium Risk Area (Ha)	% to Total Area	Average Flooding Duration	Population Density (P/Ha)	Est Population Affected in High Risk Area	Est No. of HHs Afft	Est Pop Afft in High & Med Risk Areas	Est No. of HHs
					(Days)	1999				
A. 1.8 RETURN PERIOD										
Abella	8.02	78%	8.10	92%	7.10	280	2,246	408	2,268	412
Penafrancia	4.95	63%	4.95	63%	3.00	162	802	146	802	146
Igualdad	5.68	58%	7.79	91%	9.00	287	1,630	323	2,236	443
Tinago	10.69	52%	16.35	100%	7.50	117	1,251	248	1,913	380
Lerma	0.00	38%	0.00	100%	0.07	668	0	0	0	0
Sabang	11.76	38%	28.82	82%	1.21	163	1,917	335	4,698	821
Triangulo	5.50	34%	28.72	79%	31.50	54	297	54	1,551	285
Calauag	8.32	17%	17.99	36%	7.00	146	1,215	219	2,627	473
Dayangdang	3.31	12%	24.18	88%	0.25	191	632	114	4,618	829
Liboton	1.32	8%	1.32	8%	0.17	139	183	37	183	37
Sta Cruz	0.74	2%	32.22	54%	2.00	102	75	15	3,286	636
Bagumbayan Norte	0.00	0%	0.00	2%	41.63	90	0	0	0	0
Dinaga	0.00	0%	0.00	0%	0.17	109	0	0	0	0
Bagumbayan Sur	0.00	0%	0.99	0%	0.50	105	0	0	104	19
Mabolo	0.00	0%	17.74	40%	9.00	59	0	0	1,047	177
San Francisco	0.00	0%	0.00	0%	4.00	152	0	0	0	0
Tabuco	0.00	0%	0.19	74%	6.00	32	0	0	6	1
Total	**60.29**	**8%**	**189.36**	**25%**	**7.65**	**92**	**10,248**	**1,898**	**25,339**	**4,658**
B. 3.5 RETURN PERIOD										
Igualdad	8.26	87%	8.30	100%	15.50	287	2,371	439	2,382	441
Abella	7.84	79%	8.10	99%	7.10	280	2,195	407	2,268	420
Tinago	11.74	71%	15.09	93%	3.67	117	1,374	254	1,766	327
Tabuco	0.00	74%	0.19	95%	6.50	32	0	0	6	1
Penafrancia	5.41	50%	5.55	61%	3.00	162	876	162	899	167
Triangulo	10.71	47%	20.45	73%	4.50	54	578	107	1,104	205
Mabolo	19.56	41%	21.31	43%	9.00	59	1,154	214	1,257	233

BARANGAY	High Risk Area (Ha)	% to Total Area	High Risk & Medium Risk Area (Ha)	% to Total Area	Average Flooding Duration	Population Density (P/Ha)	Est Population Affected in High Risk Area	Est No. of HHs Afft	Est Pop Afft in High & Med Risk Areas	Est No. of HHs
Lerma	0.00	31%	0.00	100%	0.07	668	0	0	0	0
Liboton	4.17	22%	18.27	79%	2.00	139	580	107	2,540	470
Sabang	7.02	21%	33.45	100%	1.04	163	1,144	212	5,452	1,010
Dayangdang	5.58	20%	10.08	36%	0.08	191	1,066	197	1,925	357
Calauag	7.12	14%	22.16	44%	7.25	146	1,040	193	3,235	599
Sta Cruz	0.47	1%	34.24	62%	2.00	102	48	9	3,492	647
San Francisco	0.00	0%	0.00	100%	4.00	152	0	0	0	0
Dinaga	0.00	0%	0.00	100%	0.17	109	0	0	0	0
Bagumbayan Sur	0.00	0%	0.72	2%	0.50	105	0	0	76	14
Bagumbayan Norte	0.00	0%	0.00	0%	41.63	90	0	0	0	0
Total	**87.88**	**11%**	**197.91**	**26%**	**6.35**	**92**	**12,425**	**2,301**	**26,403**	**4,889**
C. 5-YEAR RETURN PERIOD										
Igualdad	8.30	100%	8.30	100%		287	2,382	441	2,382	441
Abella	8.10	87%	8.10	100%		280	2,268	420	2,268	420
Dinaga	0.00	97%	0.00	100%		109	0	0	0	0
San Francisco	0.00	85%	0.00	100%		152	0	0	0	0
Tinago	12.81	76%	16.21	98%		117	1,499	278	1,897	351
Tabuco	0.00	80%	0.19	96%		32	0	0	6	1
Sabang	19.77	61%	33.45	100%		163	3,223	597	5,452	1,010
Triangulo	11.20	52%	21.54	94%		54	605	112	1,163	215
Penafrancia	5.19	44%	5.48	76%		162	841	156	888	164
Mabolo	16.88	44%	26.72	83%		59	996	184	1,576	292
Sta Cruz	22.34	38%	36.27	72%		102	2,279	422	3,700	685
Lerma	0.00	34%	0.00	100%		668	0	0	0	0
Dayangdang	7.09	25%	16.13	58%		191	1,354	251	3,081	571
Calauag	7.77	16%	29.31	59%		146	1,134	210	4,279	792
Liboton	2.03	9%	18.68	81%		139	282	52	2,597	481
Bagumbayan Sur	0.27	0%	3.15	7%		105	28	5	331	61
Bagumbayan Norte	0.00	0%	0.00	0%		90	0	0	0	0
Total	**121.75**	**16%**	**223.53**	**29%**	**0.00**	**92**	**16,891**	**3,128**	**29,619**	**5,485**

BARANGAY	High Risk Area (Ha)	% to Total Area	High Risk & Medium Risk Area (Ha)	% to Total Area	Average Flooding Duration	Population Density (P/Ha)	Est Population Affected in High Risk Area	Est No. of HHs Afft	Est Pop Afft in High & Med Risk Areas	Est No. of HHs
D. 10-YEAR RETURN PERIOD										
Abella	8.10	100%	8.10	100%	7.10	280	2,268	420	2,268	420
Igualdad	8.30	100%	8.30	100%	17.00	287	2,382	441	2,382	441
Tinago	16.35	97%	16.35	100%	7.25	117	1,913	354	1,913	354
Dayangdang	25.42	93%	26.13	100%	1.08	191	4,855	899	4,991	924
Sabang	32.9	94%	33.45	100%	4.50	163	5,363	993	5,452	1,010
Dinaga	0.00	100%	0.00	100%	0.04	109	0	0	0	0
Tabuco	0.19	91%	0.19	96%	10.00	32	6	1	6	1
San Francisco	0.00	89%	0.00	100%	1.75	152	0	0	0	0
Mabolo	29.21	88%	33.63	100%	0.15	59	1,723	319	1,984	367
Sta Cruz	34.23	79%	47.46	100%	3.75	102	3,491	647	4,841	896
Penafrancia	3.79	68%	4.58	97%	0.21	162	614	114	742	137
Triangulo	16.68	63%	29.28	84%	31.50	54	901	167	1,581	293
Lerma	0.00	41%	0.00	100%	0.15	668	0	0	0	0
Bagumbayan Sur	7.58	18%	38.40	100%	14.00	105	796	147	4,032	747
Calauag	7.22	15%	49.38	100%	10.75	146	1,054	195	7,209	1,335
Liboton	1.54	7%	22.37	98%	1.25	139	214	40	3,109	576
Bagumbayan Norte	0.00	0%	19.15	100%	21.31	90	0	0	1,724	319
Total	**191.51**	**25%**	**336.77**	**44%**	**7.75**	**92**	**25,581**	**4,737**	**42,235**	**7,821**
E. 20-YEAR RETURN PERIOD										
Abella	8.1	100%	8.10	100%	14.00	280	2,268	420	2,268	420
Igualdad	9.86	100%	9.86	100%	16.50	287	2,830	524	2,830	524
Sta Cruz	47.46	100%	47.46	100%	3.00	102	4,841	896	4,841	896
Triangulo	37.45	99%	37.45	100%	31.00	54	2,022	375	2,022	375
Tinago	16.35	100%	16.35	100%	10.67	117	1,913	354	1,913	354
Lerma	0	100%	0.00	100%	0.09	668	0	0	0	0
Sabang	33.45	100%	33.45	100%	24.50	163	5,452	1,010	5,452	1,010

BARANGAY	High Risk Area (Ha)	% to Total Area	High Risk & Medium Risk Area (Ha)	% to Total Area	Average Flooding Duration	Population Density (P/Ha)	Est Population Affected in High Risk Area	Est No. of HHs Afft	Est Pop Afft in High & Med Risk Areas	Est No. of HHs
San Francisco	0	100%	0.00	100%	7.50	152	0	0	0	0
Tabuco	0.19	98%	0.19	100%	13.00	32	6	1	6	1
Mabolo	33.63	100%	33.63	100%	37.00	59	1,984	367	1,984	367
Dayangdang	25.21	93%	26.13	100%	0.21	191	4,815	892	4,991	924
Dinaga	0	100%	0.00	100%	7.00	109	0	0	0	0
Penafrancia	5.01	74%	5.56	100%	0.21	162	812	150	901	167
Bagumbayan Norte	6.2	43%	19.15	100%	21.31	90	558	103	1,724	319
Calauag	20.86	42%	49.38	100%	11.00	146	3,046	564	7,209	1,335
Bagumbayan Sur	14.25	29%	38.40	100%	21.00	105	1,496	277	4,032	747
Liboton	1.4	7%	20.50	89%	2.50	139	195	36	2,850	528
Total	**259.42**	**34%**	**345.61**	**45%**	**12.97**	**92**	**32,238**	**5,970**	**43,023**	**7,967**

Table 18: Population at Risk to Wind Hazard by Type of Residential Dwellings

	BARANGAY	Number of Residential Buildings	Building Resistance											
			High Risk	%	Est Pop	Med Risk	%	Est Pop	Low Risk	%	Est Pop	No Risk	%	Est Pop
A.	**FLOOD PRONE BARANGAYS**													
1.	Lerma	400	144	0.36	828	111	0.28	638	106	0.27	610	39	0.10	224
2.	Igualdad	600	406	0.68	2,050	136	0.23	687	55	0.09	278	3	0.01	15
3.	Abella	1,002	279	0.28	1,554	203	0.20	1,131	267	0.27	1,487	253	0.25	1,409
4.	Dayangdang	936	361	0.39	2,076	61	0.07	351	79	0.08	454	435	0.46	2,501
5.	Penafrancia	2,000	60	0.03	331	340	0.17	1,873	79	0.04	435	400	0.20	2,204
6.	Sabang	1,287	322	0.25	1,842	387	0.30	2,214	515	0.40	2,946	63	0.05	360
7.	San Francisco	147	5	0.03	23	37	0.25	172	59	0.40	275	46	0.31	214
8.	Calauag	1,628	46	0.03	255	306	0.19	1,698	637	0.39	3,535	639	0.39	3,546
9.	Liboton	675	115	0.17	570	385	0.57	1,910	72	0.11	357	103	0.15	511
10.	Tinago	716	179	0.25	902	322	0.45	1,623	80	0.11	403	135	0.19	680
11.	Dinaga	137	13	0.09	67	69	0.50	357	14	0.10	73	41	0.30	212
12.	Bagumbayan Sur	1,130	275	0.24	1,425	267	0.24	1,383	367	0.32	1,901	221	0.20	1,145
13.	Sta Cruz	1,203	121	0.10	626	422	0.35	2,182	542	0.45	2,802	118	0.10	610
14.	Bagumbayan Norte	685	98	0.14	450	237	0.35	1,088	249	0.36	1,143	101	0.15	464
15.	Mabolo	1,118	887	0.79	5,251	200	0.18	1,184	22	0.02	130	9	0.01	53
16.	Triangulo	1,563	712	0.46	3,880	421	0.27	2,294	206	0.13	1,123	224	0.14	1,221
17.	Tabuco	855	43	0.05	229	214	0.25	1,138	342	0.40	1,819	256	0.30	1,362
	Sub-Total	**16,082**	**4,066**	**0.25**	**22,359**	**4,118**	**0.26**	**21,924**	**3,691**	**0.23**	**19,771**	**3,086**	**0.19**	**16,733**
B.	**UPPER BARANGAYS**													
18.	Balatas	1,480	296	0.20	1,669	444	0.30	2,504	518	0.35	2,922	222	0.15	1,252
19.	Cararayan	1,062	818	0.77	4,368	71	0.07	379	99	0.09	529	74	0.07	395
20.	Carolina	597	448	0.75	2,500	25	0.04	140	64	0.11	357	60	0.10	335
21.	Concepcion Grande	1,432	158	0.11	839	295	0.21	1,566	400	0.28	2,124	579	0.40	3,074
22.	Concepcion Pequena	4,715	148	0.03	815	925	0.20	5,097	1,250	0.27	6,888	2,392	0.51	13,180
23.	Del Rosario	1,070	154	0.14	770	321	0.30	1,605	482	0.45	2,410	113	0.11	565
24.	Pacol	600	360	0.60	1,796	180	0.30	898	36	0.06	180	24	0.04	120
25.	Panicuason	214	161	0.75	1,027	22	0.10	140	26	0.12	166	5	0.02	32
26.	San Felipe	1,597	482	0.30	2,371	579	0.36	2,849	403	0.25	1,983	133	0.08	654

BARANGAY	Number of Residential Buildings	Building Resistance											
		High Risk	%	Est Pop	Med Risk	%	Est Pop	Low Risk	%	Est Pop	No Risk	%	Est Pop
27. San Isidro	359	179	0.50	993	100	0.28	555	57	0.16	316	23	0.06	128
Sub-Total	**13,126**	**3,204**	**0.24**	**17,150**	**2,962**	**0.23**	**15,733**	**3335**	**0.25**	**17,873**	**3,625**	**0.28**	**19,735**
C. TOTAL NAGA	**29,208**	**7,270**	**0.25**	**39,509**	**7,080**	**0.24**	**37,657**	**7,026**	**0.24**	**37,645**	**6,711**	**0.23**	**36,468**

Source: Community Risk and Resources Mapping, Sept 1998

Table 19: General Profile of Commercial/Industrial Zone in High Risk Areas, Naga City

Barangay	Com/Ind Zone (Ha)	Density Per Ha.	High Risk Area (Ha)					Total No. of Estb.	Annual Gross Sales (Pm)
			1.8-RP	3.5-RP	5- RP	10-RP	20-RP		
A. Flood-Prone Areas									
Abella	14.01	13.63	9.15	9.70	11.18	14.01	14.01	191	126,000
Bagumbayan Norte	4.17	6.71	0.00	0.00	0.00	4.17	3.79	28	2,524
Bagumbayan Sur	9.97	3.01	0.00	0.00	0.00	0.00	0.65	30	9,303
Calauag	0.38	73.68	0.00	0.00	0.00	0.00	0.00	28	1,025
Dayangdang	2.41	16.60	0.00	0.00	0.10	1.01	1.33	40	9,500
Dinaga	6.36	50.47	0.00	0.00	6.16	6.36	6.36	321	201,129
Igualdad Int	1.56	494.23	0.00	0.27	1.29	1.53	1.56	771	2,316,843
Lerma	3.74	9.89	1.41	1.16	1.29	1.53	3.74	37	8,418
Liboton	2.21	28.05	0.79	1.46	0.31	0.12	0.45	62	9,891
Mabolo	17.02	1.76	0.60	0.03	6.33	13.49	17.02	30	19,033
Penafrancia	28.99	5.97	16.66	11.66	9.78	19.92	20.47	173	62,628
Sabang	5.07	11.64	2.99	0.92	3.66	3.42	5.07	59	118,075
San Francisco	8.60	19.42	0.00	0.00	7.66	7.54	8.60	167	50,399
Sta Cruz	9.46	32.77	0.00	0.00	0.45	8.94	9.46	310	145,814
Tabuco	43.35	3.21	0.00	24.64	28.84	42.72	42.72	139	46,445
Tinago	14.41	8.40	3.80	9.20	9.94	13.39	14.41	121	27,386
Triangulo	68.04	0.51	40.02	45.86	51.27	58.58	68.04	35	4,395
Sub-Total	**239.75**	**10.60**	**75.42**	**104.90**	**138.26**	**196.73**	**217.68**	**2,542**	**3,158,808**
B. **Upper Barangays**									
Balatas								91	37,352
Cararayan								12	1,632
Carolina								10	542
Concepcion Grande								174	1,012,251
Concepcion Pequena								377	2,785,401
Del Rosario								33	63,263
Pacol									46
Panicuason								2	76
San Felipe								46	11,853
San Isidro								1	25

Barangay	Com/Ind Zone (Ha)	Density Per Ha.	High Risk Area (Ha)					Total No. of Estb.	Annual Gross Sales (Pm)
			1.8-RP	3.5-RP	5- RP	10-RP	20-RP		
Sub-Total								**746**	**3,912,441**
TOTAL								**3,288**	**7,071,249**

Source of basic Data: BIR, Naga

CHAPTER 5

MITIGATION MEASURES AND MANAGEMENT PLAN

5.1 PLANNING ASSUMPTIONS

Based on the risk evaluation, the threat to public health and safety as well as economic losses can be considerably large. The need therefore for effective and appropriate risk prevention and reduction measures to avert a disaster situation is emphasized.

The formulation of the mitigation and management plan was guided by the results of the series of meetings and consultations with concerned Officers and key Informants of the City. One major consultation conducted was a Workshop on the Formulation of Disaster Mitigation Strategies held on June 7-8, 1999. The workshop was able to identify gaps on the current disaster mitigation program implementation, and recommendations of appropriate mitigation measures to reduce particularly flooding risks to the vulnerable sectors.

The plan takes into consideration the fact that Naga City, due to its geographic location, will still be subjected to typhoon and flooding. The plan was therefore essentially designed to reduce the **physical, economic, and social vulnerabilities** of the communities at risk and the entire Naga area in general. This is envisioned to be attained through strategies and interventions that would effectively control, minimize and **prepare** the city to handle typhoon and flooding hazards.

A comprehensive and integrated strategy has been adopted to simultaneously address the structural/physical, policy and institutional concerns for effective mitigation and management of the flooding problems in Naga within the context of resource limitations. Three major program interventions which are interrelated and supportive of each other have been identified as follows:

- **Physical/Civil Works Development Program**
- **Land Use Policy/Legal Reforms Program**
- **Institutional Development Program**

5.2 PHYSICAL/CIVIL WORKS DEVELOPMENT PROGRAM

This program is intended primarily to provide mitigation strategies aimed at reducing the volume of floodwaters and duration of flooding through structural/physical measures. The set of proposed measures will protect areas whose flooding is not influenced by the Bicol River up to a 5-year flood magnitude. The areas affected by the Bicol River flooding will likewise benefit from improved drainage that will reduce the duration of flooding to coincide with flood recession time along the Bicol River. The proposed sub-projects under this program includes the following:

a) Naga River Improvement Project
b) Naga City Drainage Rehabilitation Project
c) Strengthening Lifeline Facilities Project

5.2.1 Naga River Improvement Project

The full bank capacity of Naga River is only 113 cumec and this is slightly over the 2-year flood of 109 cumec. For higher probable flood events such as the 5-year and 10-year return period, Naga river will overflow its banks and the intensity of flooding will be compounded by the occurrence of high water level at the Bicol River and the incidence of the high tide. The estimated riverflow capacities of Naga River are the following:

Fullbank Capacity	-	113 cumec
2-year Probable Flood	-	109 cumec
5-year Probable Flood	-	229 cumec
10-year Probable Flood	-	333 cumec
20-year Probable Flood	-	448 cumec

The solution to the inadequate capacity of Naga River would be to either increase its full bank capacity or to divert some of the floodwater to another river. More detailed study is required to determine which is more effective in terms of cost and operational efficiency. It may be possible to combine the two options to maximize the benefits from the two schemes.

5.2.1.1 Increasing the Fullbank Capacity

The stretch of the river between Magsaysay Bridge down to the new tidal control structure will be improved to increase its capacity. Improvement activities to be undertaken include river dredging, bank restoration, and improvement and construction of a 1-meter parapet riverwall along both sides of the river. Sediment deposits and river debris that have accumulated in front of the bridge piers especially those crossing Lerma street, Gen. Luna street and the tidal structure will be cleared. The riverbanks will be restored and protected with concrete lining and if necessary, the construction of revetments will be undertaken. These improvements will increase the river's conveyance efficiency. A 1-meter high parapet wall will be constructed on top of the reconstructed riverbanks to increase the capacity of the river to equal the 5-year flood event. The parapet wall will also act as a protective railing to prevent the residents from accidentally falling into the river. It will be necessary to provide for an effective floodgate on all drainage outfalls leading to Naga River to prevent a backflow of the river water to the neighboring streets.

5.2.1.2 Diversion of Surplus Discharge

This alternative solution calls for the diversion of some of the storm runoff of Naga River to Tabuco Creek. Tabuco Creek is chosen because of its proximity, ideal topographic feature and the relatively low level of development found along its banks. The proposed

amount of Naga River flows to be transferred is between 20 to 50 cumec. A pilot channel can be constructed and gradually allowed to enlarge by controlled erosion to the designed capacity. The gradual diversion of the flow will give time for Tabuco Creek to adjust its river section to accommodate the additional discharge.

Further field investigation is necessary to finalize the location of the proposed diversion channel. One possible diversion site can be located between Concepcion and Palestina which is the nearest point between Tabuco Creek and Pacol River, a tributary of Naga River. The identified site is shown in *Figure 23*.

5.2.1.3 Study of the Naga River Tidal Gate Structure

There are collaborated reports that the tidal gate structure at the mouth of Naga River is impeding the river flow. It was also observed to have caused an afflux built-up as high as 1 meter. Afflux is the difference in the water surface elevations between the upstream and downstream faces of the piers of a river structure. The presence of the pier will cause the water level to rise due to the contraction of the river section. In the case of the Naga City tidal gate structure, the river was divided into 8 bays with a clear width of only 4 meters each. The many numbers of piers and the narrow clearance can cause the built-up of the water and this can be compounded with the clogging and blocking of the river by floating and submerged debris. A 0.5 to 1-meter rise in the water level will result in a significant increase in the flood affected areas.

A study of the tidal gate structure is necessary to evaluate the effect on the river discharge and find ways of decreasing the afflux built-up. The problem of the obstruction caused by the river debris will also be studied especially the large ones that are lodged between the piers. The retrofitting of the structure with automated gate lifting equipment needs to be evaluated for an effective operation.

5.2.1.4 Proposed Replacement of Magsaysay Bridge

Since the Magsaysay Bridge will be replaced soon, it is suggested that a single span bridge be constructed to remove the possibility of large river debris like tree branches, coconut trunks and bamboos from blocking the waterway during flood as what happened before. Accordingly, the old center pier should be removed as it will serve no purpose.

5.2.1.5 Naga River Easement Recovery and Improvement Project

Naga City has been implementing projects to improve the easements along Naga River to serve as promenade area or Riverside Park, and viewing deck during the Peñafrancia celebration. However, the undertaking is proving to be difficult due to many factors including the need to relocate the squatter families, right of way problems and funding constraints. In this new proposal, only a short stretch will be covered to minimize the problems encountered in previous attempts and this will serve as a showcase development to rally community support for its full implementation later. The portion to be included in the pilot project is from the Magsaysay Bridge to Panganiban Bridge,

which is generally clear of squatters and right of way problems. The development of the easement will be planned to include landscaping, lighted walkways, flower gardens, benches and playground, exhibit areas and food kiosks. The existing barangay hall can be integrated in the overall development plan. The development of the easement areas should be linked to the Naga River Improvement Project to prevent duplication of work activities especially on the riverbank portions.

5.2.1.6 Naga River Watershed Reforestation Program.

Another effective way of reducing the intensity of flooding downstream is the preservation of the watershed of Naga River. The forest retards the movement of water allowing it to evaporate, be absorbed and percolate into the ground. A good forest can store substantial amount of storm runoff and gradually release it as groundwater flow. The forest also serves as habitat to wildlife and various fauna species.

There is already an ongoing watershed protection and reforestation project being undertaken by the Department of Environment and Natural Resources (DENR) and the planning phase of the project has been reportedly completed. The implementation of the project is going to be for 9 years.

5.2.2 Naga City Drainage Rehabilitation Program

One of the identified causes of flooding is the poor condition and inadequacy of the existing drainage system. Naga City is making progress in trying to construct drainage facilities but it seems that localized flooding continues to be a major problem. The proposed improvement of the drainage system should consider integrating alternate main drainage canals to minimize or completely eliminate the discharge of storm runoff into Naga River thus preventing the backflow from the river. Furthermore, the construction of the street drainage facilities was found not systematic and inconsistent in their capacity. The absence of an up-to-date storm drainage masterplan and the rapid changes in the land use is also making the work difficult for the City Engineer's office. A storm drainage masterplan was prepared in 1981. However, this was destroyed during one of the major floods that inundated the City Engineer's office.

5.2.2.1 Comprehensive Storm Drainage Masterplan

To effectively improve and rehabilitate the storm drainage system, it is necessary that a masterplan be prepared. The masterplan will cover the upgrading of the existing drainage system and the expansion into unserviced areas and proposed developments. The advantage of having as wide area of coverage is to eliminate future problems of inconsistent drainage capacities and overload of some of the main drains due to unprogrammed developments.

Although the area of coverage is large, implementation of the improvement and rehabilitation can be done by phase or by section but with the assurance that the overall system will remain consistent and adequate.

The masterplan should be done using the latest hydro-dynamic models such as the SWMM and BRANCH computer programs. A geographic information system (GIS) for the storm drainage system should be set-up to locate and catalogue all the drainage facilities such as the drainage pipes, manholes, street inlets, outfall and others. The GIS will be helpful in the future repair and maintenance work.

5.2.2.2 Waterway Restoration and Rehabilitation

It has been observed that many of the natural waterways and drainage creeks have been silted or built-over with illegal structures. It is essential that the existing waterways be recovered and improved. These waterways have high flow capacity and could be used as main drainage canal for the urban storm drainage system. The waterways should have the required easement of 3 meters on both banks to serve as buffer during flood and facilitate the inspection and clearing of any debris and obstructions.

5.2.2.3 Proposed Drainage Interceptor Canals

Some of the low-lying areas are flooded even during moderate rainfall and are even subjected to prolong inundation due to absence of any natural drainageways. In Barangay Triangulo, a natural waterway draining a low-lying area was blocked by the construction of a new commercial center. There is also no main drainageway for the low-lying area of Barangay Sabang. The natural waterway near Abella and Igualdad, and Calauag should be extended to drain these areas. It is, therefore, proposed that the following drainage interceptor channels be constructed to remove the flood water in the affected communities and serve as an alternate main waterways for the smaller lateral placed along the streets.

1. Triangulo- Tabuco Interceptor Canal
2. Sabang Waterway Extension Canal
3. Abella-Sta. Cruz Interceptor Canal
4. Calauag Waterway Extension Canal

5.2.2.4 Naga City Drainage Maintenance Program.

Aside from the proposed improvement of the drainage system, poor maintenance is found as another reason for the occurrence of localized flooding. The maintenance of the drainage system is both the responsibility of the barangays and the city engineer's office. The barangay usually conducts inspection of the drainage canals and do regular cleaning of the curbs and streets to prevent rubbish from clogging the street inlets. The city engineer's office handles more serious problems like declogging and desilting of the drainage pipes, repairs of the drainage facilities and declogging of the main waterways.

There are times when this cooperation is not functioning properly resulting to poor drainage maintenance and eventually flooding. It is necessary to strengthen the established cooperation by institutionalizing the function and responsibility of drainage maintenance work to the concerned units such as the barangays. The barangays will have to be supported with funds to do the job. Training of the personnel is needed to ensure

that the maintenance work is properly done or implemented. Furthermore, the barangays and the city engineer's office need to have the proper tools and equipment to undertake the maintenance work. An effective reporting and monitoring system also needs to be established to coordinate and facilitate the maintenance work of the barangay and the city engineer's office.

5.2.3 Strengthening of Lifeline Facilities Program

One of the key concerns of those involved in the emergency response is the condition of the lifeline facilities like the evacuation centers, hospitals, communication system, electric power system and the water supply system. The responsibility of maintaining these facilities lies with the different private and government agencies. Some of these facilities require repair and rehabilitation, which are often times overlooked by the concerned authorities.

This proposal aims to evaluate the immediate rehabilitation needs of these facilities and to coordinate with the concerned authorities the implementation of the repairs and improvement. The scope of work includes the conduct of inventory and inspection of all the lifeline facilities, evaluation of the repair requirement and cost estimates, coordination and monitoring of the repairs undertaken. The inspection of the facilities can be conducted jointly with the disaster management office, city engineer's office and the concerned agencies. A database of the information gathered can be set-up for monitoring and future reference. The concerned offices will prioritize the repair work depending on the available funds and the other logistic requirement such as technical staff and equipment. A timetable of all the repairs will be prepared to have a clear idea on which facilities are available, on standby and non-functional in times of emergencies.

The critical Lifeline Facilities and Infrastructures are shown in *Table 20*, and their general location is shown in *Figure 24*.

Table 20: Key Lifeline Infrastructure / Facilities

Major Road Networks	Bridges	Hospitals	Possible Evacuation Center	Influence Barangays
1. Mabolo-Tabuco-Triangulo-Panganiban Drive Alternate Route: Mabolo-Tabuco-Peñafrancia-Magsaysay-Panganiban Drive	Mabolo Bridge Tabuco Bridge Sabang-Tabuco Bridge	1. Mother Seton 2. BMC 3. Ago Foundation	1. Concepcion Pequeña Public School 2. Concepcion Grande Public School 3. Concepcion Parish Church Complex 4. Ago Foundation School Complex 5. St. Joseph School Complex	Mabolo, Tabuco, Triangulo & Sabang
2. Elias Angeles-Peñafrancia-San Felipe Alternate Route: Peñafrancia-Magsaysay-Panganiban Drive	- Magsaysay Bridge	1. Dr. Roa Memorial Hospital 2. Naga City Hospital 1. Mother Seton 2. BMC 3. Ago Foundation	1. Cathedral Parish Church Complex 2. Colegio de Sta, Isabel 3. Cam Sur National High School 4. Super Market 5. Naga College Foundation 6. BCAT 7. Peñafrancia Shrine 8. San Felipe Public School 9. Peña de Francia College 10. Naga City Scince High School	Igualdad, Dinaga, San Francisco, Peñafrancia, Abella, Sta. Cruz & Sabang
3. Tinago-Dayang-dang-Magsaysay-Panganiban Drive Alternate Route: Dayangdang-Tinago-Peñafrancia-Magsaysay	- 1. Calgante 2. Panganiban 3. Magsaysay	1. Mother Seton 2. BMC 3. Ago Foundation	1. Naga City Gov't. Building Complex 2. Bolatas Public School 3. Basilica Complex 4. Mariners Polytechnic College	Lerma, Tinago and Dayandang
4. Bagumbayan-Liboton-Magsaysay-Panganiban Drive	Magsaysay Bridge	1. Mother Seton 2. BMC 3. Ago Foundation	1. Naga Central School 2. Naga College Foundation 3. Peñafrancia Shrine Complex 4. Abcede Elementary School 5. Barangay Halls	Bagumbayan Norte, Bagumbayan Sur, Calauag and Liboton

5.2.4 Key Activities

The physical mitigation measures could be phased over a ten-year period in the following manner:

- Phase – 1: Immediate implementation of projects already on stream or with approved funding and requiring only some design modification.
- Phase – 2: Comprehensive Study of Storm Drainage and Detailed Architectural and Engineering Design of viable project components.
- Phase – 3: Implementation of viable project components.

5.2.4.1 Phase -1 Implementation

This phase would involve most of the components under the Naga River Improvement Project, with approved funding requiring some modification of design as follows:

i. Magsaysay Bridge Project - The construction of new bridge to replace the existing Magsaysay Bridge has been funded and ready for implementation after the Peñafrancia on September 1999. The City Government should make representation with DPWH to design the bridge with a single span only which is an improvement of the existing bridge with 4 span RCDG bridge.

ii. Naga River Easement Recovery and Improvement Project - The final design of this project should integrate the increase of the full bank capacity of the Naga River to accommodate the five-year return period flood flows. As a strategy, a pilot site will be selected between the stretch of Panganiban and Magsaysay bridges.

iii. Naga River Watershed Reforestation Program

iv. Study of the Naga City Tidal Gate Structure to evaluate its effects on the river and formulate remedial measures. The City Government should again make representation with the DPWH to conduct the said study in the light of the observed backwater effects of the said structure.

v. Inventory and evaluation of the identified lifeline facilities and infrastructures for immediate improvement and rehabilitation by concerned agencies and/or private institutions.

5.2.4.2 Phase - 2 Implementation

This phase would include the preparation of a storm drainage masterplan as the first stage, and the second stage would involve the planning and detailed design of priority drainage facilities. These may include the (a) recommended new and improvement of existing drainage system, (b) restoration and improvement of existing waterways or natural drainageways, and (c) construction of the proposed interceptor canals and extension of major waterways to include the proposed diversion of flood discharge to Tabuco creek from Pacol River. The estimated duration for this phase is about 24 months.

5.2.4.3 Phase – 3 Implementation

Implementation of the recommended drainage system, to include the construction of the following:

i. Waterway Restoration and Improvement,

ii. Construction of proposed drainage interceptor canals and extension of major waterways, to include the Pacol-Tabuco Diversion Channel,

iii. Construction of new drainage system and upgrading of existing drainage facilities covering an area of about 1,000 hectares, and

iv. Implementation of Drainage Maintenance Program.

5.2.5 Estimated Project Cost and Duration

A preliminary cost estimate of the proposed projects has been prepared based on certain assumptions on the scope of work to be undertaken. A more accurate estimate will require an investigation that is more detailed and consultation with regards to the manner of implementation. Nonetheless, the estimated cost and project duration can assist in deciding which among the proposed projects has a good potential and may be urgently required. Some of the projects are already ongoing like the Naga City Watershed Protection Program while the Naga River Easement Recovery and Improvement Project is currently being undertaken but needs to be reformulated into a pilot project. A summary of implementation plan (i.e., cost and schedule) is presented in Section 5.5.2.

5.3 LAND USE POLICY/LEGAL REFORMS PROGRAM

This program is aimed at introducing refinements and/or changes in the land use planning, policy and pertinent regulations in the existing and planned developments of the city. The primary consideration is to rationalize land use decisions and development direction within the context of flooding constraints. It provides a short-term and long-term perspective of the alternative options available given practical and political considerations.

5.3.1 An Alternative Naga Land Use Framework

The present Land Use Plan of Naga lacks only the refinements due the perspective of a city that is naturally flood prone. This oversight in appreciating as critically important the factoring of the flooding perspective as a primary planning constraint in Naga's land use planning has led to the flaws described in the preceding sections. Had this primary constraint been recognized from the beginning, then hydrological studies would have been the first order of the day and the concept of "open spaces" for environmental purposes including flood mitigation, would have certainly been prominent in Naga's Land Use Plan and Zoning.

Nevertheless, the present Plan has much strength and exemplifies the solid developmental directions of Naga's leadership. Its expansion of the agricultural districts and forest reserves erases any doubt about the sincerity of the City in addressing environmental issues and food security.

The following proposed mitigation measures assume that the present plans of Naga only need to be adjusted or re-aligned, albeit in certain cases very significantly, based on a greater consideration of the flooding factor. Thus, the short term options presented below merely require at most, a retention of certain features of the 1978 Plan. What is somewhat far-reaching in the change that it sought is the long-term scenario of a new growth area in the middle eastern part of Naga's land area.

5.3.1.1 Land Use Mitigation Measures: Options for the Short-Term

Two options are presented. The first option accepts as given a "no change" scenario in the present Land Use Plan. The recommendations are therefore in the nature of "add-ons" to the Plan including the overlay of a "flood hazard zone" (FHZ), see *Figure 25* over 17 barangays and a "most vulnerable area" (MVA), see *Figure 26*, delineation within the FHZ.

The second wills a change back to the land use categories of districts priorly delineated as green districts in 1978 but are now categorized as residential or commercial. It is assumed that the formal conversions of these lands have not yet been executed, considering that the present Land Use Plan has not yet been approved by the Housing and Land Use Regulatory Board (HLURB) and thus the 1978 Plan may be interpreted to be technically still in effect.

5.3.1.2 The First Option

The first option assumes that the city feels that the option of changing back designated commercial or residential areas (mentioned later in Option 2) to "open spaces for environmental purposes" or agricultural use, is untenable or political unviable. Thus, the recommended direction here is to make the flooding hazard an omnipresent concern of zoning and land use controls. It is proposed that:

a) the formal delineation of a Flood Hazard Zone (FHZ) and within the FHZ, a Most Vulnerable Area (MVA) as defined in the physical and hydrological study report be provided. The FHZ shall define a special zone within which a flood mitigation and support system shall be operative. Within the MVA, a special sub-system of regulations shall be established.

The FHZ is proposed to cover the following Barangays:

1) Abella
2) Sta. Cruz
3) Liboton

4) Sabang
5) San Francisco
6) Calauag
7) Mabolo
8) Bagumbayan Sur
9) Peñafrancia
10) Triangulo
11) Bagumbayan Norte
12) Tabuco
13) Tinago
14) Dinaga
15) Igualdad
16) Lerma
17) Dayangdang

Within this zone, the MVA is proposed to constitute the severely flooded sub-areas of the following barangays:

Sabang, Igualdad, Abella, Lerma, Tinago, Triangulo, Sta. Cruz, Calauag, Dayangdang, Liboton and Peñafrancia as delineated by the 1.8-year return period inundation map, see *Table 21* showing the area per barangay under severe flooding.

The FHZ shall immediately be the subject of a comprehensive drainage study for the purpose of generating the detailed design for a comprehensive drainage system linking together natural processes and the natural drainage system available with the technical infrastructure, both present and planned for construction. This should entail a trace of the historical natural drainage system and the prospect of economically restoring all or part of the natural system. The results of the study shall be explicitly utilized in adjusting land use delineation and enhancing zoning regulations within the FHZ.

b) The Revised Comprehensive Zoning Ordinance of Naga City should be amended to include the FHZ and the MVA. All relevant Articles and Sections in the Ordinance should cover the FHZ and MVA subject to the recommendation of the appropriate body (i.e., the Naga City Disaster Management Board if this is established or the current Naga City Disaster Mitigation Council or whichever body as appropriate). However, the following particular policies should be implemented within the FHZ:

Table 21
1.8-Year Inundation Return Period (1987 Typhoon Sisang)

Barangay Name	Total Area (ha)	SEVERELY FLOODED AREA (Ha.)						Total Area Severely Flooded	% to Total Area
		Res.	Inst.	Com.	Ind.	Parks	Agri.		
Abella	22.11	8.02		9.15				17.17	77.66
Bagumbayan Norte	23.32								
Bagumbayan Sur	56.86								
Calauag	49.77	8.32						8.32	16.72
Dayangdang	29.57	3.31						3.31	11.19
Dinaga	7.35								
Igualdad Int.	9.86	5.68						5.68	57.61
Lerma	3.82			1.41				1.41	36.91
Liboton	25.31	1.32		0.79				2.11	8.34
Mabolo	105.26								
Peñafrancia	37.57	4.95	0.91	16.66				22.52	59.94
Sabang	41.06	11.76		2.99				14.75	35.92
San Francisco	10.54								
Sta. Cruz	65.03	0.74	0.55					1.29	1.98
Tabuco	147.63								
Tinago	34.46	10.69	3.15	3.80				17.64	51.19
Triangulo	132.06	5.50		40.02				45.52	34.47
TOTAL	**801.58**	**60.29**	**4.61**	**74.82**	**0.00**	**0.00**	**0.00**	**139.72**	

5-Year Inundation Return Period (Probable Flood Inundation)

Barangay Name	Total Area (ha)	SEVERELY FLOODED AREA (Ha.)						Total Area Severely Flooded	% to Total Area
		Res.	Inst.	Com.	Ind.	Parks	Agri.		
Abella	22.11	8.10		11.18				19.28	87.20
Bagumbayan Norte	23.32								
Bagumbayan Sur	56.86	0.27							
Calauag	49.77	7.77						7.77	15.61
Dayangdang	29.57	7.09		0.10				7.19	24.32
Dinaga	7.35			6.16					
Igualdad Int.	9.86	8.30		1.56				9.86	100.00
Lerma	3.82			1.29				1.29	33.77
Liboton	25.31	2.03		0.31				2.34	9.25
Mabolo	105.26	16.88			6.33		18.34		
Peñafrancia	37.57	5.19	0.91	9.78				15.88	42.27
Sabang	41.06	19.77		3.66				23.43	57.06
San Francisco	10.54			7.66		0.50			
Sta. Cruz	65.03	22.34	1.88	0.45				24.67	37.94
Tabuco	147.63			6.11	22.73		79.43		
Tinago	34.46	12.81	3.15	9.94				25.90	75.16
Triangulo	132.06	11.20		51.27			5.99	68.46	51.84
TOTAL	**801.58**	**121.75**	**5.94**	**109.47**	**29.06**	**0.50**	**103.76**	**206.07**	

i. Strict and continuing enforcement of current land use controls particularly on:

- River and stream development management measures including the 3-meter riverbank easement regulation,
- Solid waste disposal measures, and
- Environmental management standards.

ii. The following measures should be inserted as an amendment or added provision in the current zoning ordinance:

- Industrial and commercial waste shall be disposed of by establishments in accordance with the system and procedure to be laid by the city for all commercial and industrial establishments within the FHZ;
- Sewage disposal shall be disposed of in strict accordance with paragraph g, Section 24, ARTICLE V of City Ordinance 98-076 (Series of 1994).
- Any development or activity requiring any major construction shall priorly secure the approval of the City. For this, the proponent shall submit to the City his/her plans for development and construction complying with the standards of the City's building code and other specific standards within the FHZ. An initial environmental examination report or an environmental impact statement, should the former not suffice, should be submitted for the City's review and concurrence.
- Strict compliance with Section 26, ARTICLE VI of the Zoning Ordinance.

c) Greater detailing of performance and safety standards on flooding to include:

i. Specific drainage requirements;

ii. Flooding safeguards particularly in institutional facilities for children, the aged and the sick;

iii. Life saving equipment including generators should be placed where they shall be unaffected by flood waters; and

iv. Life support systems in hospitals and emergency clinics should have provisions for quick evacuation and reinstallation in higher floors, secure from rising floodwaters.

d) Promotion of compatible uses or projects on privately-owned vacant lots or agricultural districts that could be ideally reserved for open spaces but have already been converted from agricultural to urban use:

i. the drawing up of incentives for compatible theme parks, other "green" recreational use projects, re-conversion to agricultural use,

ii. swap arrangement with land acquired by the city in the far Eastern part of Naga, and

iii. joint venture in compatible projects between the city government and private owners, etc.

e) Strict evaluation, including a mandatory ocular site inspection, of building construction plans and the issuance of building permits only upon complete adherence to building standards.

i. The system should include a specific clearance from the relevant Barangay that the community accepts that no flooding effect shall ensue from the construction. This should be included as part of the requirements for the issuance of building permits.

ii. Additionally, there shall be a mandatory ocular inspection of the completed building ascertaining that all standards have been properly met.

iii. Landfilling standards* shall be provided and strictly followed.

f) The Most Vulnerable Area or MVA should, in addition to all the foregoing, be subject to the following policies:

i. a requirement for private developers to undertake the installation of drainage systems in their residential or commercial projects that are integrated in the city system and strictly conform with city standards; a specific drainage clearance procedure to the effect that the desired drainage system has been installed shall form part of this system;

ii. no conversion rule for all land use categories, except for one exemption only - if the conversion is towards the use for open space for environmental purposes, agriculture, public park, low density institutional use or "green" recreational use such as environmental theme parks featuring ponds or lakes for boating, swimming, etc.;

iii. deletion of provisions that allow livestock and poultry raising; and

iv. deletion of provisions that allow the establishment of additional tertiary level medical facilities, elementary schools, childcare facilities, senior citizen facilities and the like, within the MVA;

g) The following violation and penalty clause should be added as a second paragraph to SECTION 61 of the Zoning Ordinance:

"...Provided THAT any person or juridical person or persons who violate any of the provisions of the Ordinance as it pertains to the Flooding Hazard Zone or the Most Vulnerable Area, shall, be punished by a fine of Ten Thousand Pesos (P10,000.00) or an imprisonment of one year, or both, at the discretion of the court; Provided Further THAT, in the case of the first offense, the person or persons shall be punished with a fine of Three Thousand Pesos (P3,000.00) or imprisonment of six months, or both, at the discretion of the court."

h) Impose a special levy* called the Naga flood tax in the FHZ to fund its programs.

The rationale for a special annual levy on establishments and residences within the FHZ is that the city will pay great amounts for mitigating floods within the FHZ. Flooding related studies, construction of sophisticated drainage systems, establishment and maintenance of a flood mitigation, disaster preparedness and management system, not to mention the direct costs of rescue and relief operations within the FHZ, entail tremendous budgetary outlays. To draw the funding for this from all taxpayers is to effectively penalize those who do not need all these measures because they had the foresight or took the decision to locate or move away from the FHZ. Hence, the rationale is simply to make those who are benefited by city activities for the FHZ pay for those benefits.

This measure will also force residents to mull the economy of living within the FHZ both in the case of those already there and those thinking of moving into the FHZ. In the end, it might be economical only for those conducting business within the FHZ to stay on. The out-migration of residential dwellers within the FHZ is desirable and need only to have their movement guided towards the desired places within Naga's desired urban framework.

5.3.1.3 The Second Option

This option essentially asserts that an environmental study needs to be done on the lands long assumed water catchment areas or natural drainage basins or aquifer recharge areas. These had formerly been designated agricultural districts in 1978 but some were actually seasonally "vacant" areas. Today they have been designated as either commercial or

residential districts and, therefore, just waiting for conversion to such use. In addition to this, it proposes certain directions in the amendment of the current zoning rules, and the promotion of certain undertakings.
Specifically the Second Option proposes the following sets of actions:

a) The retention of the remaining open areas reserved for agricultural use in the 1978 Land Use Plan as areas reserved for "open spaces for environmental preserves" or agriculture or "green" use subject to an environmental study* of its final land use to be completed within one year. Should the study conclude the areas to be environmentally sensitive and need to be reserved, this reserve classification could include a variance in use. If feasible in the study conclusions that compatible recreational use could be allowed, this should be subject to approval by the City Mayor upon the recommendation of the city's Planning and Development Office;

The lands referred to include the following:

i. the erstwhile "agricultural" area straddling the boundaries of Calauag, Liboton and San Felipe;

ii. the vacant Sabang area, directly northwest of the junction of the Bicol and Naga rivers near the barangay boundary with Igualdad;

iii. the still undeveloped portions of the CBD II area in Triangulo;

iv. the Mabolo area; and

v. the Tabuco and Triangulo areas on the southern side of the diversion road beyond the current strip of development along the southern side of the said road.

b) Implement all sets of actions of the First Option.

5.3.1.4 Other Measures Common to Both Options

The following proposed strategies are indifferent to whichever option for short-term flood mitigation is chosen. These proposed measures should be undertaken under any option.

a) Alternative *Kaantabay sa Kauswagan* Approach

Current efforts at providing housing for the urban poor must consider flooding vulnerability. Current "on-site relocation" programs within the FHZ cannot but be viewed as undesirable. First, considerable sums must be paid by Naga taxpayers for the acquisition of relatively expensive land for on-site demands of the urban poor. Second, the same taxpayers will have to pay added large amounts for more sophisticated drainage systems in the "on-site relocation" areas within the flood hazard zone. Thirdly, Naga taxpayers will again pay for the incremental

portion of the flood mitigation and disaster preparedness systems specifically addressed to the urban poor. Finally, taxpayers will have to let go of even more money to pay for the maintenance of all of those. All these costs may be difficult to be perceived as equitable by Naga's taxpayers if in fact there are other locations less expensive to acquire, develop and maintain.

In fact, the urban poor of Naga may be assisted by way of housing and livelihood outside of the FHZ. This can be done via the acquisition of relocation sites in the Cararayan - Carolina area within easy reach of the agro-industrial cluster in San Isidro. The cluster can be an immediate provider of employment opportunities for the urban poor. The City can also encourage other (non-pollutive) agro-industrial or commercial activities within the area pointing to the urban poor relocation sites as ready labor pools. Since the lands are still relatively less expensive than within the present urban core of Naga, the City can acquire more lands and have more development funds if it acquires lands for urban poor programs in the said areas rather than in the present urban built up areas. The areas to be acquired and designated for the urban poor may be priorly identified through planning.

For existing "on-site" urban poor relocation and development programs, a major effort to persuade them to relocate in higher areas should be done. Included in this approach should be the discontinuance of further investments in "on-site" relocation programs and the withdrawal of financial or economic incentives and any type of support for proposed sites. These measures are needed to reinforce efforts in persuading the concerned groups to relocate in the sites suggested herein. Otherwise, the prospect of the urban families "selling out" or disposing of their designated residences within the FHZ should be anticipated and planned for. The policy should be to repossess these sites from leaving urban poor families and reserved them for institutional use or as open spaces, if feasible.

b) Land Use Planning and Monitoring Capability Building

There should be established within the City staff a sustainable land use planning and monitoring capacity to enable the appropriate updating of the Land Use and Zoning Plans, Rules and Regulations and effectively monitor compliance with such as well as check deviations from those plans and rules. Initial activities should be:

i. specific HRD needs analysis for relevant offices within the City organization;

ii. orientation briefing/seminar for a) Sanggunian and Executive Officials of City, and b) CPDO, Engineering Office, other relevant Office staff e.g., at the School of Urban and Regional Planning, UP;

iii. intensive certificate course training e.g., at the SURP, UP, in Land Use Planning;

c) Citywide Awareness Campaign on Zoning and Flood Mitigation*

A crucial component for the effectivity of flood mitigation measures is a sustained citywide awareness campaign. This is specially critical for all sectors residing or doing business in the FHZ and all government agencies and instrumentalities, including non-government organizations, that have to do with flood mitigation and flood preparedness and disaster management.

The specific approach that has been proffered is to harness the public service component of local media for the mass media component of the awareness campaign. Corrolarily, government agencies as well as civic organizations could be persuaded or induced and mobilized without cost or at least cost for the effort. In the latter case, Memoranda - Agreements could be forged with the said organizations for the aforementioned purpose.

d) Incentive systems for medium rise buildings within the FHZ.

Conditioned on the technical feasibility and strict conformity with all other standards for safe and secure buildings, as well as all other rules and regulations within the FHZ particularly zoning provisions, an incentive system for the use of medium rise housing or commercial buildings within the built up area of the FHZ should be provided.

5.3.2 A Long Term Perspective: An Alternative Growth Center.

Hydrological analyses indicate that a simple drainage system rationalization scenario will reduce localized flooding and mitigate flooding within the 1.8- to 3.5-year return period but longer return period floods will continue to affect the BUA (Built-Up Area), *see Figure 27*, and CBD, sometimes severely. In a long-term scenario, however, the full-scale flood reduction infrastructure program involving the rationalization of the drainage system and the construction of dikes and revetments will simply be prohibitive for Naga taxpayers.

Moreover, any land use planning exercise for the current built-up area of Naga city will invariably meet with a fixed constraint: the urban area's room for expansion is now extremely limited. In fact, earlier discussions seem to indicate that at least as far as residential areas are concerned, it may be nearing its limits, if it has not already reached it yet.

The agricultural lands below Bagumbayan Sur in the north and before Concepcion Pequena in the east that current city planners included as expansion zones for commercial or residential uses have acted as natural water catchment depressions. There are similar depressions in Sta.Cruz, Igualdad Interior, Sabang, part of Mabulo and Tabuco, Triangulo and Tinago. Those have long acted as natural floodwater catchment and soil infiltration areas which should ideally be conservation areas where, if at all, only compatible recreational or institutional facilities should exist. The agenda should be to protect the

natural processes in these areas which are very vulnerable to urbanization. Since the outright elimination of these natural processes might generate in their place hazards that pose danger to urban populations and activities, care must be exercised to conclusively determine the nature of these lands before final land use classification is made.

Further building up in the aforementioned areas will in any case generate much more sophisticated drainage requirements that the natural and technical drainage systems can meet. The failure here might result in seriously compounding flooding during typhoons. Other considerations such as the increase in health hazards stemming from contamination of water supply systems, the over extraction of ground water aquifers due to heavier supply requirements, and the propensity for greater pollution to the Naga and Bicol river systems, can not be overlooked.

Particular attention is focused on the CBD II transition area, which cannot but be described as unideally located. It is a cardinal land use planning rule NOT to locate any urban transition area and more so a CBD transition area, in a hazard area, or within highly vulnerable natural systems, or in land needed for catchment area for water supply reservoirs. If this CBD II project will be completely pushed through, then care must be taken to install a drainage system that will not only secure the particular area from flooding but will ensure that the flood waters are not merely transferred to adjacent areas.

The promotion of strip development along the Cararayan road and, parallel to it, a wider strip development along the Panganiban - Del Rosario corridor could eventually result in uncontrolled growth that will join both strips to form an urban swath from the Dayangdang/Tinago/Triangulo area of Naga going East all along up to the lower Cararayan and San Isidro areas. This alignment of the built up area would run counter to the natural flow of rainwater from the higher areas of Naga. Where formerly rainwater infiltrated into the agricultural soils in Balatas, Concepcion Grande and Cararayan, it would now meet with concrete and compacted soil and therefore run rapidly towards the urban areas. The probability is this would exacerbate the flooding problem of Naga's built up area.

5.3.2.1 The Alternative Growth Center

Following the aforementioned limitations on the city's urban growth, there is a real need to delineate urban transition areas in the only direction where there is still an abundance of suitable land - the Eastern portion of Naga. Indeed, the planned Cararayan residential strip development and the Panganiban-Del Rosario development corridor correspond to current land use trends East of the built-up area. But considering the undesirable orientation of the proposed strip and corridor development as far as the sensitive flood water runoff is concerned, what is proposed as an alternative is the development of an urban transition growth zone farther to the East in the very middle part of Naga's land area. This area is centered along the road that runs perpendicular to the Northern Carolina road going down straight South to San Isidro.

This location is proposed for urban growth transition for the following reasons:

a) It will allow a "greenbelt", from the top of San Felipe and Pacol going South in an arc to Concepcion Grande then connecting to the Tabuco ricelands, that will act as a buffer between the flood prone urban area and the new growth area. This buffer will act as a braking mechanism for rainwaters running off the growth area and constitute natural soil infiltration areas for both absorbing rainwaters and recharging ground aquifers. This "greenbelt" is feasible over the short- to medium-term since most of the areas covered by the "greenbelt" are either irrigated lands non-convertible in accordance with food security rules or lands covered by CARP and therefore similarly protected against conversion by law. The land use category of open space or agricultural use will seal the feasibility of this "greenbelt" for at least the next five (5) years.

b) The new growth area will be entirely flood hazard free (although typhoon wind vulnerability will remain a problem). While the area is mostly privately owned, it is proposed that urban design commence in the area adopting the approach of induced planned development through planned infrastructure development, firm land use controls, and participatory law enforcement.

The frame for a viable circulation network is already appearing. Current road arteries in the area show that it is conceivable to look at a growth center with access to "primary" Naga, Pili, Magarao, Calabanga and even Goa via Mt. Isarog. Plans for another diversion through Tabuco skirting Panganiban could easily link this proposed growth area directly to the Pan Philippine highway towards Manila.

5.3.2.2 Incremental Development Approach.

Given the policy decision to locate an urban growth transition area in the middle portion of Naga's land area, specifically in the Carolina area close to its boundaries with Pacol and Cararayan, then a strategy of incremental implementation based on an induced development approach can be implemented. This means that from the outset, two facts are assumed: 1) the city cannot afford a huge capital outlay for a singular, large-scale "one time project"; and 2) the city does not control the area since most of it is privately owned and thus the city must rely on effective utilization of its persuasive and inducing resources. Additionally, a comprehensive plan for the growth area should be formulated and adopted.

Given these, the strategy requires a part by part implementation of the plan or incremental implementation over time. The time frame for such should also be determined by the comprehensive plan for the growth area. A crucial factor here will be the correct sequence of implementation to allow maximum cooperation, participation and entry of the private sector even on the basis of a pure private sector self interest. Once this sequence is achieved, a "critical mass" of urban functions could be reached. At this point, a demonstration effect is generated through the reality of vibrant and progressive urbanization process that shall be seen as the growth area having developed past the threshold of reversal. Then it will simply be natural for investors to invest and for families to reside in the growth area.

It is, therefore, crucial that particularly in the initial period, land speculators are effectively dissuaded from the proposed area. It is the investors who will build and operate, and families who will buy lots, build their homes on them and reside in them, who should be persuaded or induced into the urban growth transition area. It is imperative that speculative investment is effectively arrested if the growth area is to be realized. The city should exercise a will that will firmly and loudly say: *We do not want mere speculators*! Towards this, the city needs to wield its "persuasive" and inducement powers - land use controls and zoning regulations, taxing powers, mobilization of development allies such as clergy, civic organizations etc. - very effectively.

5.3.2.3 *Kaantabay sa Kauswagan* Clusters in the Growth Area

We should approach the urban poor "off- site relocation" projects as a direct component for developing the urban growth area. Hence, not only should they be planned as residential communities but places for work or livelihood as well. Moreover, planning should also provide for lifeline and community facilities including schools and small scale open space and promote the inducements for locating within the cluster, local shopping and recreational facilities. Community facilities should include police and fire stations, water and sewage plants, and terminals. Such facilities should be located to be convenient to specific user groups, economic for construction and of sufficient size to accommodate future expansion. Sources for future water supplies should be delineated and controlled to protect watersheds and groundwater aquifers.

It had been earlier pointed out that the San Isidro area that is to be part of the proposed Naga's urban growth transition zone is the designated site for agro-industrial development. It will therefore be a zone devoted to employment in manufacturing, wholesale trade, office and service industries. *Kaantabay* projects could be located near this zone in convenient proximity to where transit and thoroughfares can ensure easy access. The circulation system can be planned to be convenient to other work areas as well as regional highways and public transportation. The system should be located away from vulnerable environmental systems and distributed in such a manner as to minimize concentrations of air pollution.

5.3.2.4 Urban Growth Area Planning

Beyond the *Kaantabay* activity, the proposed urban growth area needs to be comprehensively studied and planned as already stated. Following are some proposed components for such an undertaking:

a) Incentives

A promotion package with substantial incentives should be ordained for pursuing development in the new urban growth area (call it the **Eastern Growth Area**) following a system where the earliest takers get the most incentives. Planned residential, commercial and institutional sites should be buffered by green zones,

should be adequate in size and should be economical to develop by both the public and the private sector.

b) Anti-flooding

Needless to say an anti-flooding system with comprehensive measures to ensure the correct orientation of the drainage system such that it does not, over time and under any scenario, lead to compounding the flooding problems downstream, must be developed. Very strict measures of zoning and building regulations in the urban growth area should be established. Such rules and regulation should also cover waste disposal concerns. Stream zones should be necessary and strict laws on protecting the stream ecology should be established.

c) Transportation Planning

Planning for the transportation system should be towards a safe, energy-efficient, comfortable, convenient and multi-modal, if the urban complex is large enough. It should relate to the interregional highway, rail, and air transportation systems and located to serve but not disrupt work areas and shopping-entertainment-cultural centers. Corridors for utilities and pipelines should be provided.

d) "Green" Concerns

The forest reservation in Panicuason at the foothills of Mt. Isarog should be expanded westward to include a large portion of Carolina. This would insulate the Mt. Isarog watershed from the greed of "carpetbagger" type real estate developers marauding eastward once the **Eastern Growth Area** accumulates an urban mass of its own.

Agricultural areas, prime forest lands and natural systems, major parks and large open spaces should be reserved in locations that take advantage of, as well as protect, natural processes, vulnerable environments, and unusual natural features. They could also function to provide a variety of recreation opportunities. Most development should be kept away from environmentally hazardous areas such as fault lines, steep slopes susceptible to sliding and unstable soils. Low-density development using on-site sewage treatment should be prohibited from areas of unsuitable soils. Present and future water supply watershed areas should be restricted to development except those compatible with protection of water quality.

e) Open Spaces and Environmental Zones

Open space is recommended to be addressed first. This is a broad land use category that includes environmental processes (e.g., hydrology), hazards to urban development (e.g., floodplains), environmental resources (e.g., prime agricultural land and gravel deposits), cultural resources (e.g., historic sites), regional outdoor

recreation sites and areas where open space serves esthetic purposes (e.g., defining the edge of the neighborhood or providing foreground with skyline view). Open spaces could be located to provide definition to neighborhoods as well as to moderate climate, noise, light, and air pollution.

In this particular instance, there is a unique basis for focusing on open spaces first. For one thing, the flooding perspective particularly the vulnerability of compounding flooding problems in the "original" urban area requires a prior analyses of open spaces. Requirements for natural processes are less flexible than requirements for most urban uses; natural processes must occur where conditions permit and are not viable in different locations. Technical solutions, after the fact, to environmental problems are becoming increasingly costly and inefficient, and they are often ineffective. It is wiser to anticipate and avoid such problems through land use design.

Another reason for designating open space first is that the market oriented spontaneous urban growth process does not provide sufficient open space in the right locations for environmental and recreational purposes. Thus, open space, particularly open space for natural processes, is vulnerable in the market-determined process.

f) Specific Location Standards

Explicit standards can add meaning and usefulness to general principles. Convenient proximity or easy access is converted to a specific distance, measured in meters or kilometers or travel time; e.g., half-kilometer service area for a neighborhood park. Adequate size might be converted to a specific number of hectares. For instance 1,500 square meters for a standard community park serving per 10,000 population. Standards can be mapped more precisely than principles and thus will provide a clearer basis for suitability analysis. They can also be assessed more easily to determine whether policy is being followed.

Standards can be established by ordinance. They typically take the form of minimum standards necessary to protect public health, safety, and general welfare. Minimum standards are particularly useful for land use regulations. Planning should further disaggregate the broad categories as plans and policies are refined. For example, open space for environmental protection might be distinguished from open space for recreational purposes.

g) Space Requirements and Carrying Capacity

The basis for space requirements are projections of populations and employment. Studies of the densities of present and projected development, and policies about the future character of development, e.g. the mix of housing types and densities, all these need to be assessed.

Carrying capacity also called the analysis of holding capacity essentially determines the available land supply in non-urban uses (e.g., agricultural uses), vacant land, and developed land slated for clearance or substantial rehabilitation. The number of hectares available is summarized for each barangay at each level of suitability. Based on the standards for space consumption developed under space needs, the suitable hectarage can be converted to an equivalent number of dwellings, population, or number of employees.

5.3.2.5 The Metro Naga Dimension

Shortages of suitable land might cause the planner to relax the standard of suitability, allow for greater densities, expand the planning area or reduce the levels of population, employment, and other activities planned for the area. In the case of Naga, it is certain that even with the creation of an Eastern Growth Area, more space will eventually be required for the ever compelling population and human activities' space requirement. The prospects in a Metro Naga conurbation or a circumferential or nodal development pattern involving municipalities proximate to Naga, therefore, cannot but be explored.

It is, hence, recommended that the Metro-Naga dimension be already seriously studied and recommendations based on its prospects presented. This will help delineate those areas where new urban development should be encouraged in contiguous, neighboring municipalities. Land use design can be aided by the appreciation of the regional perspective. Regionally oriented urban land uses and facilities may even be delineated.

Anticipating an Objection

One may comment that why create a growth area in the very area that is still green today. Such a project will only result in the "de-greening" of the area.

In the first place, development and growth will most certainly reach the upper eastern reaches of Naga. Even today, resorts and subdivisions have already made their inroads in the area. The rise in land values is a sure sign that real estate developers have started speculating on the area. The present Land Use Map already designates residential districts in the uppermost portions (Carolina) and an agro-industrial district in the lower portion (San Isidro). It is certain that over time, urbanization will creep or burst into the area. The only question is how.

A decision to plan the Eastern Growth Area could provide order to that march of urbanization and ensure the environmental integrity of the whole of Naga.

5.4 INSTITUTIONAL DEVELOPMENT PROGRAM

The institutional development program intends to mobilize and harmonize government and community resources and capabilities towards a cohesive and participatory approach for disaster preparedness. Building on existing initiatives, it seeks to encourage greater

awareness and cooperation by the broad sector of society to provide direction and sustained effort for disaster management.

5.4.1 Establishment of A Flood Database System for Naga

While there exists today some information on occurrence and effects of typhoon/flooding in Naga from various local government offices and national agencies, there are certain data gaps, duplications and problems in effectively utilizing and communicating such information.

Given the limitation of the existing information on typhoon/flooding, there is a pressing need to establish a coordinated database system that would regularly provide updated information on important technical, social and economic parameters relevant to effective disaster planning, response and monitoring. The proposed database system will provide a historical database that would measure changes overtime, both in terms of the physical and socioeconomic environment, arising from measures implemented or from inability to act on recommended measures. Moreover, such database will input in the formulation of information materials to increase community awareness and solicit broad support for proposed mitigation measures.

5.4.1.1 Scope of the Flood Database System

The proposed database system will provide for the design and establishment of a data collection system, processing and communication of results. It will comprise of three major components that include the following:

- Technical data
- Flood damage data
- Computer-Based Mapping and Information System (GIS)

5.4.1.2 Technical Database

This component will address specifically the improvements and gaps in technical information and analysis directly relating to meteorological data, such as weather prediction, rainfall/wind data, flood water measurements (through establishment of gauging stations), river characteristics and flow measurements, etc.. These data will provide inputs to determine flood magnitudes, causes and appropriate design or validation of structural measures.

<u>Naga City Flood Forecasting System</u>

It will be a great advantage if the authorities concerned are able to predict when and where the disaster will happen so that emergency measures can be implemented in advance. In effect, that will save lives and minimize damage to properties. In the case of the flooding of Naga City, it is possible to establish a flood forecasting system that can provide advance information on the depth, extent and duration of flood. A flood forecasting

system has already been set-up for the Bicol river basin by PAGASA. However, the PAGASA system seems to be not fully functional or operational since it is not providing any quantitative predictions on the water level of the Bicol River.

The proposed flood forecasting project for Naga City would include the establishment of a real time hydromet and flood monitoring network, development of a flood forecasting model and training of city and PAGASA staff in the operation and maintenance of the system. The hydromet and flood monitoring network will include automatic rainfall and river water level gauges connected to a telemetry system that will provide continuous measurements on real time. A flood-forecasting model will be set-up to convert the information gathered into predicted river discharges and water levels. The model will be probably a combination of a catchment model and hydrologic or hydraulic routing model. The forecasting model will also use the data collected by PAGASA from its own flood forecasting system to include the influence of Bicol River to the Naga River system. The forecasting model could also be expanded to make predictions on the water levels in key locations in the different barangays for use in the emergency response and disaster management.

Community-Based Flood Monitoring System

A community-based flood monitoring system could be immediately set-up in the flood affected barangays. One or more strategically located staff gauges can be installed in each flood prone barangay. The staff gauge will be at least 2 meters long, graduated similar to a meter stick, and will extend from the ground to the highest historical flood level. The zero reading of the staff gauge shall be surveyed to determine the equivalent elevation with respect to the mean sea level for later conversion of the staff readings to ground elevations. The readings of the staff gauge can be done as many times during the flood event but the time and date of reading should be recorded properly. A special training can be organized to orient the observers on the purpose and method of conducting flood measurements. The gauge readings can be correlated to the river gauge to establish a mathematical relationship that can be used in predicting the water level at each barangay.

5.4.1.3 Flood/Wind Damage Database

This is one of the most important components of the database system that will show the extent of social and economic consequences of flood/wind hazards to affected areas. It is expected to awaken consciousness of people so that appropriate measures and priorities for interventions can be planned and implemented properly.

The city government through the barangay officials, DSWD, DA and other agencies has been conducting their own damage assessment every after typhoon event. The intent of these surveys however is essentially for disaster response and generating calamity fund support. There are therefore certain data which are critical for planning as well as duplications in data gathered including cases of inconsistencies in the same data generated. The content and method of data gathering are not also clear especially the basis for estimation of damages.

The proposed flood database system will be lodged at the barangay level which has intimacy on the conditions of their respective area during typhoon/flood events. Two types of information will be established, a general profile of the barangay and a flood damage survey to be executed every after typhoon.

Barangay Profile

There already exist some kind of profile and map for each barangay in Naga City. All that is needed is to update, validate and add some other information. The general profile of each barangay should contain the following essential information:

a) Topographic map of the barangay (preferably at a scale of 1:10,000) containing the location of rivers/creeks and other natural or man-made waterways, roads (national, provincial, municipal, barangay), and political boundaries w/ adjacent barangays.

b) Sewerage and drainage map of the barangay.

c) General land use map indicating the **spatial distribution of existing land uses**: residential, commercial, industrial, institutional, parks and others. Together with this is the data on location by zone and area for each land use category.

d) Demographic data by barangay zone including population, number of households, family size, type of residential unit (single detached, duplex, multi-storey, etc.), type of building materials (concrete, wooden, etc.) and status of ownership of house/lot. The spatial distribution of settlement areas should be preferably mapped, especially houses located along the river, urban poor/squatter areas, resettlement sites, subdivisions and others.

e) Inventory of commercial/industrial establishments and their location. This includes data on number by type of business establishment, building type and status of ownership and location within the barangay zones.

f) Inventory of institutional establishments (schools, church, government offices, hospitals etc.) including location, type, facilities and other relevant info, such as a school offering elementary and secondary education with 5 buildings and a school population of say 1,000.

g) Inventory of infrastructures and utilities in the barangay such as roads (type, length), water supply system (piped system, deep/shallow wells, etc.), power source (cooperative or with emergency generators, etc.), telecommunications and others.

h) Barangay officials and local socio-civic organizations (name, purpose, activities, key persons) operating in the barangay.

The maps can be requested from the City Government's EDP unit for updating by the barangay officials. Inventory of population and land uses can be undertaken based on ocular survey and simple questionnaire.

Flood Damage Survey

A flood damage survey design should be formulated to integrate the information requirement of various data users. Preferably, there should only be one instrument to be used for purposes of the survey that will be administered at the barangay level and complemented by other data collected by different agencies every typhoon/flood event. However, data analysis can be distributed to various local and national agencies based on their respective requirements.

At the minimum the following information should be provided at the barangay zone level:

A. Respondents: Community/Barangay Residents

1. Extent of flooding in the area to include:

   - estimated water depth during and after the typhoon/flooding and corresponding duration (in hours or days) of inundation by water level (e.g., 2 feet-5 hours; 4 feet thereafter for 2 days)

2. Number of fatalities (death) including cause of death, location, profile of casualties to cover the following:

   - name, gender and age
   - marital status (if married indicate no. of children)
   - health status prior to death (e.g., healthy, with existing illness - specify)
   - existing occupation (if not working indicate whether student or not working)
   - daily/monthly earnings
   - cost of hospitalization/medication, if brought to the hospital prior to death

3. Number of persons injured or got sick during and a week after flooding (due to flood exposure) including location, cause of injury or illness and profile of morbidity cases to include the following:

   - name, gender and age
   - marital status
   - health status prior to sickness
   - existing occupation and daily/monthly earnings
   - number of days sick
   - cost of medical consultation and/or confinement

- cost of medicine

4. Property Damage (Residential) to include as follows:

- type of house
- extent of damage: partial or total
- type of damage (e.g., roofing was flown, windows broken, etc.)
- estimated value of the house prior to damage
- estimated value of damage to the house (P)
- other personal properties damaged (specify type and number)
- estimated value of personal properties damaged

5. For working family members:

- occupation of working family members
- how many days did not report for work
- daily income (P) of each

6. Student family members

- number of family members enrolled (including level: elementary, secondary and college)
- number of days absent
- number of days school was closed

7. Disruption of basic utilities:

- number of days/hours without electric power
- number of days/hours without water

B. Respondents: Business Establishments (commercial/industrial)

1. Location, type of business (sari-sari store, general merchandise, banking, insurance, etc.) and category (small, medium, large)

2. Estimated annual gross sales/revenue (P)

3. Damage to fixed assets and goods to include:

- type of fixed assets damaged and estimated value of damage
- type and volume of goods damaged including estimated value of damaged goods

4. Disruption to business operation:

- number of days business establishment was closed
- number of hours/days without power and water
- reason for temporary closure
- estimated value of revenue lost (from sales and overhead expenses)

Other complementary data collected by various organizations should be integrated into the flood damage database. Arrangements should be made to collect data from the following organizations that regularly collect information on flood damage:

1. Office of the Provincial Agriculturist and/or Department of Agriculture for agricultural damages/losses. These institutions have already established method of estimating damage to crops/livestock.

2. Office of the City Engineer and the Department of Public Works and Highways for damage estimates on roads, bridges, flood control works and drainage system. Information should also be gathered on areas where access was not possible and for how many hours or days.

3. Electric Cooperatives and National Power Corporation for damage to power lines and household connections including number of days without electricity in different areas and cost of damaged facilities and repair.

4. Local Water Utilities for damage to water supply and distribution system and estimated value of damage.

5. DECS and private academic institutions for damage to school buildings and number of days closed.

6. National Irrigation Administration (NIA) for damage on irrigation facilities.

7. DSWD, City Government Office and Barangay officials to provide information on cost of relief operation and assistance to include the following:

   - population evacuated/served
   - number of evacuation centers and population served
   - number of government and private organizations involved in relief assistance
   - cost of relief operation/assistance to beneficiaries and other costs incurred during evacuation

8. Other information from the barangay officials.

5.4.1.4 Computer-Based Mapping and Information System

All data generated from the barangay-level flood damage survey as well as those coming from various agencies should be consolidated as one big database under the Office of the City Government, preferably with the City Planning and Development Office (CPDO). First level processing will be undertaken at the barangay level consolidating zone results into one barangay database. This will be submitted to the city for further processing, integration and consolidation with other data from various agencies. The EDP Unit of the city will handle the electronic data processing and mapping of results while CPDO can do the data analysis, databanking and communication of results to various users.

The data processing aspect will require the development of simple tables of results on a per barangay basis and consolidated as one for the entire city. Geographically referenced information will be mapped to readily visualize the affected areas and extent of damage/impacts across different locations, population and economic sectors. A more reliable estimate of the cost of recurring flood damage to the city will provide a strong basis for justifying investments in flood mitigation measures.

Results of the database system will be made available and/or published by the CPDO for planning and decision basis in the implementation of the disaster mitigation program.

5.4.1.5 Key Activities

The CPDO as the logical office under the City Government to implement the database system shall take the lead to undertake the following essential activities. These activities will lead to the establishment and institutionalization of database support system for disaster planning, management and monitoring:

a) Review and Design of the Flood Database System

This will involve overall review and design of the integrated database system to include the following:

- identification of data requirements, uses and users;
- data collection system involving secondary and primary data gathering including survey methods and forms;
- data processing and analysis including reporting formats for various participating entities;
- communication of results to different users; and
- institutional responsibilities for implementation of the system including coordination and resource requirement.

b) Systems Installation and Training

This will include installation, refinement and operation of the database design. The key inputs will involve essentially conduct of training to the city government/agency personnel that would be involved including barangay officials on the use of survey instruments and data processing. Coordination arrangements for data sourcing/data

distribution from participating agencies will also be established. In addition, the computer-based information system will be installed to handle mapping and data processing.

c) System's Operation

This will involve regular operation and institutionalization of the database system as inputs to disaster planning, management and monitoring.

5.4.1.6 Resource Requirement

The initial requirement for review, design and installation/training is estimated at about P1.7 million. The implementation cost is around P600,000 on an annual basis, assuming occurrence of annual flooding. In addition, the computer and vehicular supports shall be enhanced for a total cost of about P1.00 million.

The estimated cost for the improvement of the PAGASA Flood Forecasting Facilities is about P5.00 million, while the installation of staff gauges and the training of gauge keepers at the barangay level is about P200,000.00. The maintenance of the gauging stations shall be shouldered by the barangay councils concerned.

5.4.2 Information, Education and Communication (IEC) Program

A city-wide IEC program for flood disaster mitigation/management is deemed necessary in view of the limited capability and numerous uncoordinated efforts of institutions involved in disaster mitigation, and the rather indifferent attitude of many city residents to flooding risks including some anthropogenic interventions which tend to aggravate flooding. Specifically this program is intended to achieve the following:

- enhance the capabilities of various organizations involved in disaster management;
- strengthen coordination system for proper resource complementation and effective disaster management activities at various levels;
- enhance awareness and knowledge of concerned communities on disaster preparedness and mitigation;
- broaden the participation and support network for disaster management; and
- encourage community initiatives for disaster preparedness, prevention and mitigation

5.4.2.1 Scope of IEC

The IEC program will cover both the institutions/organizations involved in disaster management and the concerned communities affected by flooding/wind hazards. This program involves the following key components and activities:

- <u>Identification of Training Needs both at the Institutional and Community Levels</u>

This component includes review of existing capabilities of various agencies involved in disaster management as well as assessment of skills, knowledge and attitudes of communities affected by flooding hazards. On the basis of this review, institutional training needs will be identified as well as those for affected communities.

- Preparation of Training Design/Modules and Information Materials/Kits

There are already existing training modules/materials and information kits from different government agencies involved in disaster management. This will be reviewed and refined to incorporate the gaps based on needs assessment. Consequently, training modules will be developed for various types of training. Information materials will be prepared for dissemination to various sectors and residents of affected barangays.

- Orientation Seminars/workshops/training of various institutions involved in disaster management for IEC organizational activities and conduct of IEC

This involves seminars/workshops/training of DM-concerned institutions to organize, pool their resources, plan and synchronize their activities in the conduct of IEC to affected communities. Coordination system and functional responsibilities of concerned groups at different levels shall be agreed upon including resource sharing/complementation and feedback mechanism for timely and appropriate response of concerned agencies in times of emergency.

- Establishment of Tri-Media Communication Network for disaster management

A multi-media communication network will be organized as a vehicle for IEC implementation. Radio, TV and print media will be mobilized in communicating information for disaster prevention, preparedness and mitigation. Specifically, media will be utilized to monitor direction and magnitude of typhoons that may affect Naga. They can provide an early warning to residents for incoming typhoons, cover and document conditions during typhoons/flooding, and most importantly call for assistance in areas where emergency rescue/evacuation are needed.

- Organization of IEC Disaster Action Teams at the Barangay Level

At the community level, a multi-sectoral IEC Disaster Action Team will be organized as the working arm of the Barangay Disaster Management Council to regularly conduct IEC in their respective communities. The same shall be mobilized during typhoon/flood events to inform residents of what to do and respond to emergency.

- Conduct regular/sustained training and information campaign at the community level on disaster management

This provides for regular updating of training modules/materials and information kits as well as conduct of regular training and constant dissemination of information to concerned organizations and community residents utilizing the organizational mechanism established for IEC.

5.4.2.2 Resource Requirement

The initial cost of training/information needs assessment, preparation of training modules and information materials as well as organizing works is estimated at around P1 million. Production of training and information materials and conduct of training/IEC on a sustained basis is estimated at around P1.5 per year.

5.4.3 Community Mobilization and Preparedness Program

This program is intended to enhance community consciousness, instill proper values/attitudes to community residents and develop/strengthen community participation, initiatives and support for disaster management. Its implementation is linked with other programs, such as the database and IEC activities. On the overall, a Community Information Planning System (CIPS) shall be established in all barangays of the city.

5.4.3.1 Scope of the Program

The key components and activities of the program include the following:

- Inventory and profiling of community residents including local organizations in the barangays

  This activity is part of the requirement for the establishment of the database system at the barangay level. Based on the profiling, local socio-civic organizations can be identified to participate in various disaster-related activities based on their capabilities and resources.

- Preparation of community-based disaster management plan which will be formulated with the participation of various groups within each barangay.

  This activity will further refine the initial efforts of the City Government's La Niña Task Force in formulating and implementing disaster management plan at the barangay level with the participation of the Barangay Council. This plan will translate/ operationalize the city disaster management plan at the barangay level. This will include, among others, training and IEC activities (as identified in the IEC Section above); identification of potential contingency evacuation centers which can be offered by private residents/organizations to the barangay (outside of government-provided evacuation centers); identification of minimum equipment/facilities which should be

purchased by the barangay (such as rubber boat, flashlights, etc.) including community residents who can provide support equipment/ facilities which can be accessed in times of emergency; plan for voluntary and orderly evacuation in known high risk areas; and resource sharing/ solicitation plan to augment government funds for food, clothing and medicine supply needs of evacuees. The plan should also provide for measures to reduce risk to population by encouraging residents to comply with the land use and zoning regulation as well as appropriate control by barangay officials of the development in their respective area which can aggravate flooding situations. The clean up operation of drainage canals and other waterways should form part of the barangay disaster mitigation plan.

- Regular Monitoring of Flood Damage and Mitigation Measures

  The Barangay Council through the IEC Disaster Action Team should regularly conduct flood damage assessment (as recommended) and monitoring of the implementation and effectiveness of mitigation measures implemented. The results of the monitoring activities at the barangay level will be communicated to the city government for appropriate replanning and/or formulation of additional measures necessary to avert future disaster events.

5.4.3.2 Key Activities

The program will expand the initial initiative of the City Health Office under the La Niña Task Force in assisting the Barangay Councils in formulating evacuation plans due to the impending effect of the La Niña. The expansion of the current activity is to establish a CIPS in each barangay, which would involved the entire project cycle activities; from profiling, planning, resource generation, implementation, and monitoring and evaluation. This could be done by training the existing Barangay Health Aids (BHAs) on how to assist the Barangay Councils in establishing the CIPS.

The other key activity of the program is the adoption of "Adopt a Family Program" during typhoons and floods. This program was adopted by some Barangays Councils as part of their preparation for the La Niña event to happen. The features of the program involved the community mobilization initiated by the Barangay Council to undertake the following:

a) Identification of most vulnerable families that would require evacuation assistance,

b) Identification of residential and commercial building within the barangay, with very low risk factor to typhoon and flooding, whose owners are willing to adopt family evacuees,

c) Together with the building owners, determine the number and identity of families that could be accommodated in each building,

d) Define guidelines for the evacuation procedure, and the evacuees' ethics while at the evacuation centers, and

e) Conduct IEC to affected constituents in particular and to the general populace of the barangay.

5.4.3.3 Resource Requirement

The community mobilization and preparedness program is estimated at an average cost of around P300,000 per barangay covering some 27 flood-prone barangays. The aggregate cost is about P8.10 million. Priority can be given to the high-risk areas such as Sabang, Triangulo, Mabolo, Igualdad, Abella and Calauag. The cost of profiling, training/IEC are already incorporated in the earlier programs.

5.4.4 Organizational Strengthening

The existing Special Bodies, namely the Naga City Disaster Mitigation Council (NCDMC) and the Emergency Rescue Naga (ERN), are all operating on an ad hoc basis. The reason being is that there are no formal documents to support their operational existence. Under this component, both bodies are proposed to be formally organized through an Executive Order (EO) by the City Mayor and formally sanctioned/adopted by the Sangguniang Panglunsod. The EO should define its memberships, functions, and responsibilities.

5.4.4.1 Creation of the Naga City Disaster Mitigation Executive Board

The membership and functions of the existing NCDMC which evolved from the Naga City Disaster Management Team, created under EO No.98-005, dated June 2, 1998, has to be redefined by issuing another Executive Order amending EO No. 98-005 creating the Naga City Disaster Mitigation Executive Board (NCDMEB). The NCDMEB shall comprise of Executives or chief of offices of the key government and non-government organizations involved in disaster mitigation program implementation. For the Executive Board to be effective in its operation, the City Mayor is proposed to act as Chairman with the City Administrator as the Vice-Chairman. The City Administrator is mandated under the Local Government Code to be in the front line in delivering administrative support services during and in the aftermath of man-made and natural disasters and calamities. This makes him the logical choice to act as vice-chair of the Executive Board. The other members of the Board being proposed are as follows:

- Chairman of the Committee on Public Safety of the Sangguniang Panglunsod
- President, Liga ng mga Barangay
- Supervisor Science and Technology, City Schools Division
- Chief of Office, City Social Welfare and Development Office
- Chief of Office, PAGASA Camaligan Flood Forecasting Station
- City Health Officer, City Health Office
- Chief of Office, Office of the Civil Defense

- Chief of Police, Naga City Police Station
- Fire Marshall, Naga City Fire Station
- President, KBP, Camarines Sur Chapter
- President, Naga City People's Council
- President, Chamber of Commerce and Industry
- Executive Officer, Emergency Rescue Naga Foundation, Inc.

Function and Authorities

The Executive Board shall act as the permanent coordinating center that shall oversee and orchestrate the planning and implementation of all disaster mitigation development programs and projects in the City of Naga. In pursuing this function, the Board shall:

a) Provide policy directions to incorporate disaster mitigation measures to all proposed development programs with the ultimate view of making the City of Naga a safe and livable city,

b) Pass upon all proposed disaster mitigation programs and its budgets, making sure its complementation to optimize resource allocations for greater benefits of the populace,

c) Call upon the assistance of any office of the Naga City Government to avail of the services of their technical personnel or make use of their facilities and equipment,

d) Establish mechanism for collaborative efforts among special bodies, e.g., Naga City Development Council, Naga City Disaster Coordination Council, Naga City School Board, etc., to avoid replication of planning and implementation of disaster mitigation related programs,

e) Monitor and evaluate implementation of all disaster mitigation programs and projects within the city,

f) Act as an Emergency Body to orchestrate the rescue operation during and after typhoons and flooding, and/or other calamities both natural and man-made, and

g) Solicit popular support from its memberships and its instrumentalities to generate resources and implement approved disaster mitigation measures.

Creation of Disaster Mitigation Management Unit (DMMU)

In support of the operation of the Board, a Disaster Mitigation Management Unit shall be organized under the Office of the City Mayor. The Unit shall be headed by an Action Officer, who shall be designated by the City Mayor from its existing officers. Support

staff shall be organized to man the unit, whose functions and responsibilities shall be as follows:

a) Provide the mechanism for coordinating the planning and implementation of all disaster mitigation related programs and projects in Naga City,

b) Provide Technical Secretariat Services to the Board by providing all necessary information needed by the Board during its meetings and, making sure that all its decision are being implemented by its members and their instrumentalities, and other concerned institutions,

c). Establish mechanism to monitor and evaluate the effectiveness of implementation of all approved disaster mitigation related programs,

d) Submit regular status report to the City Mayor and the Board on the implementation of all disaster mitigation related programs, especially those that were pass upon by the board,

e) Initiate activities that are supportive, especially on information and education campaign (IEC), to the disaster mitigation programs that are being implemented by other units and/or agencies,

f) Conduct pilot/research projects on disaster mitigation to test its effectiveness before full adoption for implementation,

g) Provide assistance in the mobilization of the communities to prepare their respective disaster mitigation measures, particularly on disaster preparedness, and

h) Undertake such activities as may be directed by the Board.

Manpower Complement of DMMU

The DMMU shall be headed by an Action Officer and assisted by regular staff as follows:

- Monitoring and Evaluation Officer, who shall be responsible to conduct regular monitoring and evaluation on the status of all the disaster mitigation program being implemented,

- Project Development Coordinator, who shall be responsible in coordinating with other implementing units to make sure that approved programs and projects are being implemented accordingly, and

- Community Development Officer, who shall be responsible in coordinating and assisting the Barangay Councils in developing community preparedness program on disaster mitigation.

Additional contractual staff maybe hired as special activities for implementation by the Unit, as approved by the Board.

5.4.4.2 Strengthening of the ERN

There are two major operating units working for the Emergency Rescue Naga (ERN), these are:

- The ERN Unit. A part of the Naga City Hospital staff and facilities is being mobilized by the Chief of Hospital, who is designated as the ERN Action Officer, during emergency cases requiring medical services within Naga City. This arrangement is being implemented on the basis of the verbal commitment of the City Mayor to operationalize ERN; and

- The Volunteer Groups. These are mostly trained paramedics, professionals and non-professionals, who provide volunteer services to augment the manpower complement of the ERN Unit during emergency cases and/ or occurrence of disasters. Recently, the Volunteers have decided to formally organize themselves into a Non-Government Organization (NGO) by registering their group with the Securities and Exchange Commission (SEC) as the Emergency Rescue Naga (ERN) Foundation, Inc.

In the light of the current development, there is now a need to:

- Formally include in the mandate of the Naga City Hospital the provision of emergency medical services, and formally organizing the ERN Unit in the hospital. This could be done through the issuance of an Executive Order signed by the City Mayor. The formal organization of the Unit would require the identification of the responsible Officers and staff that shall composed the ERN Unit. In addition, the facilities and equipment required for the emergency operation shall be made available for use by the ERN Unit. A development program should be drawn by the Hospital, in conjunction with ERN Foundation, Inc., to enhance the capability of the emergency rescue operation of Naga City.

The City Government to sign a Memorandum of Agreement (MOA) among the Hospitals within Naga City (*See Table 21*), and the ERN Foundation, Inc. This MOA would lay down the complementation arrangement among concerned institutions in providing **efficient emergency medical services** to residents of Naga City in times of disasters and calamities. The Naga City Hospital could be designated as the operating center of the ERN. A common program shall be drawn on how to enhance their capabilities to participate in the disaster mitigation program of the city.

5.4.4.3 Key Activities

To institutionalize the above organizational arrangements, the following basic support requirement should be undertaken:

i. The City Government shall provide appropriate office space (about 50 square meter) within the City Hall Building Complex for the operating center of the Naga City Disaster Mitigation Board and its DMMU, with complete operating facilities like computers with GIS and desktop publishing capabilities, communication facilities, basic office furniture and equipment, at least one rescue and command vehicle (equipped with VHF radio, fire extinguisher, first aid kit, resuscitator, chain saw, and flashlights), and electrical generating set (about 15 kva capacity) to provide emergency electrical power for the operation of the Board during typhoons and other calamities,

ii. Creation of emergency units in each hospital and train them on rescue operation and application of first aid and basic life support system,

iii. Provision of support to the ERN Foundation Inc. to train volunteers, on rescue operations and application of first aid and basic life support system, both at the ERN level and at the barangay levels, and

iv. Enhance equipment capability of the Naga City Hospital for emergency operations, such as acquisition of one additional ambulance, five sets of first aid and basic life support kits, one set electrical generating set with 2.5 KVA capacity.

5.4.4.4 Resource Requirements

The cost for the establishment of the operating center of the Disaster Mitigation Management is about P4.5 million, and the enhancement of the Naga City Hospital's equipment and facilities is about P2.5 million. The training of about 6,000 Training-Person days for paramedics and rescue workers of hospitals, ERN level, and barangay level is estimated at P12.00 million over a two-year period.

5.5 ORGANIZATION AND MANAGEMENT

The Disaster Mitigation Management Plan will be implemented by the City Government through its existing operating units. The City Government shall adopt the participatory approach, in both planning and implementation of the management plan. The popular participation of other institutions in Naga, both Government and NGOs will be solicited by creating the Naga City Disaster Mitigation Board. The communities will be mobilized in implementing specific components of the plan.

5.5.1 Project Organization

The City Mayor shall be responsible in the successful implementation of the plan. He shall be assisted by the City Administrator in overseeing the implementation of all the project components by the designated Units of the City Government. A Disaster Mitigation Unit (DMMU) will be organized under the Office of the City Mayor to coordinate and monitor/evaluate the implementation of the project. The offices of the City Government that will be directly involved in the project implementation are as follows:

- City Planning and Development Office (CPDO) - shall take the lead in implementation of the Land Use and Zoning Planning, and establishment of Flood/Wind Database System,
- City Engineers Office - shall be responsible in implementing the Structural/Civil Works Counter Measures,
- City Health Office - shall be responsible in the community mobilization and disaster preparedness program,
- Naga City Hospital - shall be responsible in implementing the Emergency Rescue Operations that would require medical assistance,
- Information Office - shall take the lead in the implementation of the IEC program of the project,
- Human Resource Management Office - shall be responsible in the overall management training program of the project, and
- City Agriculturist/ENRO - Shall be responsible in coordinating the implementation of the Naga River Watershed Reforestation program.

A Memorandum Order shall be issued by the City Mayor to effect the implementation of the Organizational Functional Chart of the Project Management Implementation as shown in *Figure 28*.

5.5.2 Implementation Schedule and Cash Flow Requirements

The implementation of the Institutional Development and the Land Use and Zoning Planning could be established in five year period, while the implementation of the Structural/Civil Works is planned to be implemented over a ten-year period. The Summary Implementation Plan for the Institutional Development is shown in *Table 22*, the Summary Implementation Plan of Land Use Planning and Capability Building is shown in *Table 23*, while the Summary Implementation Plan of Structural/Civil Works Counter Measures is shown in *Table 24*. The total estimated cost to implement the project is about P720.38 million over a ten (10) year period, please refer to *Table 25* summary implementation schedule and cash flow.

5.6 PLAN EVALUATION

5.6.1 Economic Analysis

A preliminary economic evaluation was undertaken to illustrate the prima facie viability of the plan using the conventional method of economic analysis . The economic life of the project was assumed at 25 years. Project investment is spread over a period of 10 years, after which a 1% maintenance cost is provided. The opportunity cost of capital was assumed at 15 percent.

The project will not entirely solve the flooding problem of Naga. The benefits "with the project" will generally accrue from the reduction in flood levels consequently reducing losses/damages to vulnerable settlements, businesses, agriculture and infrastructures. In addition, the spread of flooding may be controlled thereby protecting some areas from incurring damages/losses. Likewise, it will reduce incidence of casualty of vulnerable population from mortality/morbidity cases and associated medical and income opportunity losses. There are many other indirect environmental benefits from the project relating to improved drainage, river clean up and rehabilitation and watershed protection. These include, among others, incremental benefits from improved health and sanitation and reduction in soil erosion/sedimentation, aesthetics and others.

The present estimation of benefits however is constrained by the absence and/or inadequacy of data that will allow a more realistic quantification of benefits (as earlier cited in the previous sections of the plan). Hence, for purposes of this analysis, data was confined on probabilistic estimates on what has been previously quantified under the consequence analysis. In addition, the following assumptions were employed:

- 50% flooding reduction in areas affected by the Naga River after 5 years
- 20% incremental reduction in flooding-related losses as improvement in the drainage system continues up to the 10th-year alleviating flooding not only in the influence area of Naga River but to some extent the Bicol River.

Four alternative investment scenarios were considered to determine the most economically viable option. These include as follows:

- Option 1 - Full implementation based on a 10-year investment program
- Option 2 - Only the structural costs were considered without the landuse/legal reforms and institutional components
- Option 3 - Only the investment costs for the first five years were considered setting aside drainage rehabilitation
- Option 4 - Implementation will be limited to structural works for the first five years without drainage rehabilitation

Tables *26* to *29* show the preliminary economic analysis for the various options with the following results:

- Option 1 - 8% Financial Internal Rate of Return (FIRR)
- Option 2 - 10% FIRR
- Option 3 - 12% FIRR
- Option 4 - 18% FIRR

Option 4 which is limited to the implementation of the structural works without any drainage rehabilitation is the most economically viable alternative yielding an FIRR above the hurdle rate of 15%. Given the strong socioeconomic dimension of the project however, the other options are still worth considering. An FIRR of about 10% is already acceptable for projects such as this which are socially-oriented in nature. Moreover, considering that much of the social benefits have not been quantified and the rough method by which the damages have been estimated, there is a strong possibility that the full cost scenario (Option 1) will become feasible when sufficient and more reliable data inputted in the analysis. This highlights the need to implement the proposed flood database system.

5.6.2 Environmental Evaluation

From the perspective of environmental soundness, the plan will provide a highly significant positive impact on the biophysical and social environment of Naga City. The recommended mitigating measures provide a comprehensive and integrated courses of action to correct, restore, remedy and prevent further deterioration of the biophysical system that compounds flooding in a naturally flood-prone environment. The combination of the restoration of natural waterways, the clean up of the river, the watershed strategies, the restoration and/or maintenance of green buffers are some of the measures which are anticipated to highly impact not only on mitigating flooding but also reducing the pressure and enhancing the biophysical resources to provide and sustain its functions. The land use options offer as well short-term and long-term perspective towards sustainable use of the city's resources.

On the social environment, the plan emphasizes the paramount concern for public safety and welfare. It emphasizes participatory and collective social responsibility in addressing flooding hazards. It also calls for restraint in anthropogenic activities using both regulations and market instruments to redirect development that would lessen the risks to vulnerable groups who are largely the marginal sector of the community. Moreover, it tackles the issue of social values and orientation to inculcate awareness, consciousness and preparedness to effectively deter and/or manage disaster events.

There are certainly negative social effects of probable dislocation of certain settlements/ businesses and restrictions in private property utilization and development as a consequence of the plan. As in any proposed change, there are always trade-offs. However, the net positive impact of the plan in the long run will more than compensate for the negative effects. It will substantially contribute to the city's goal of a safe and livable cityscape.

Figure 23: Pacol-Tabuco Diversion Channel Project

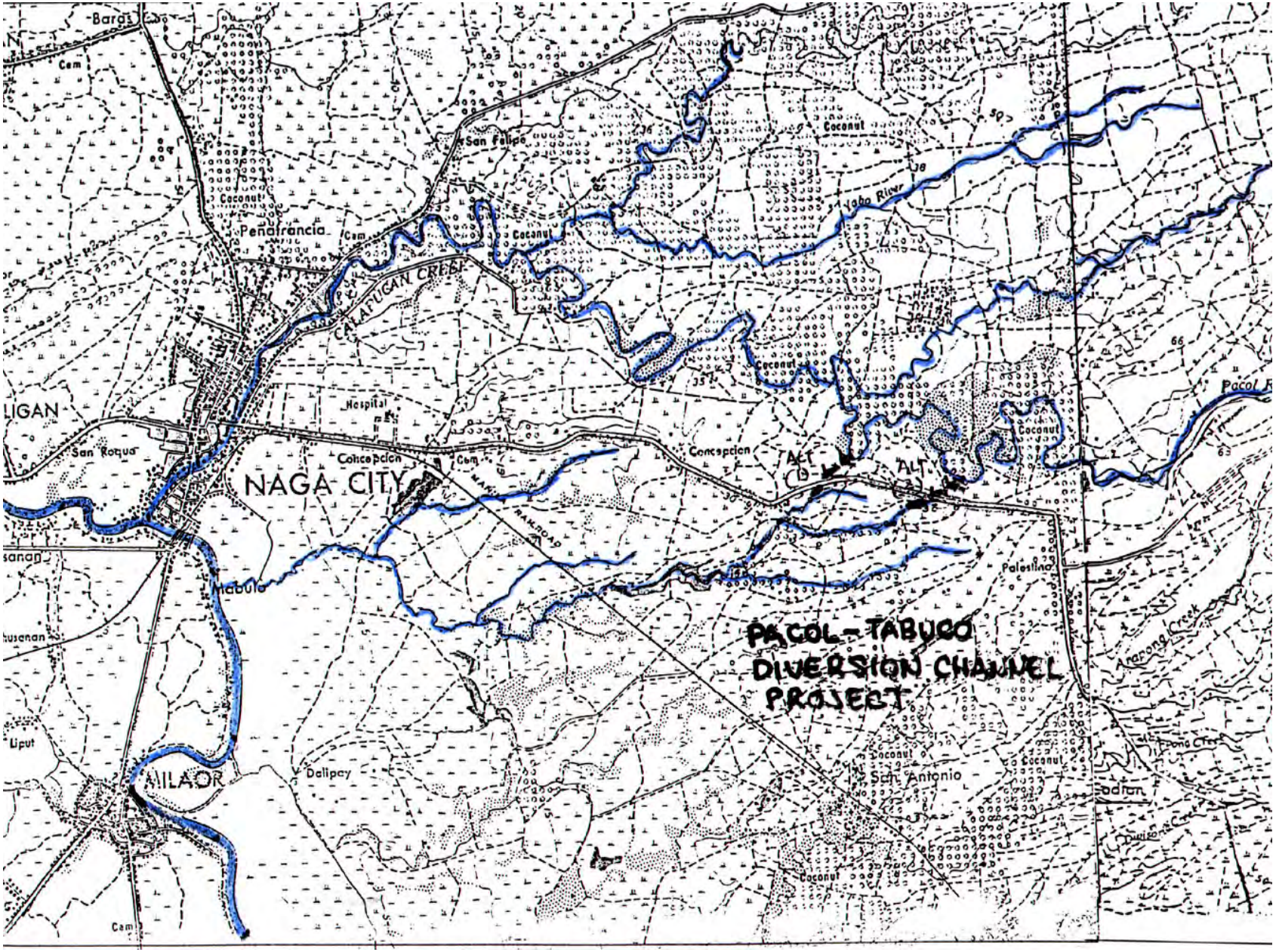
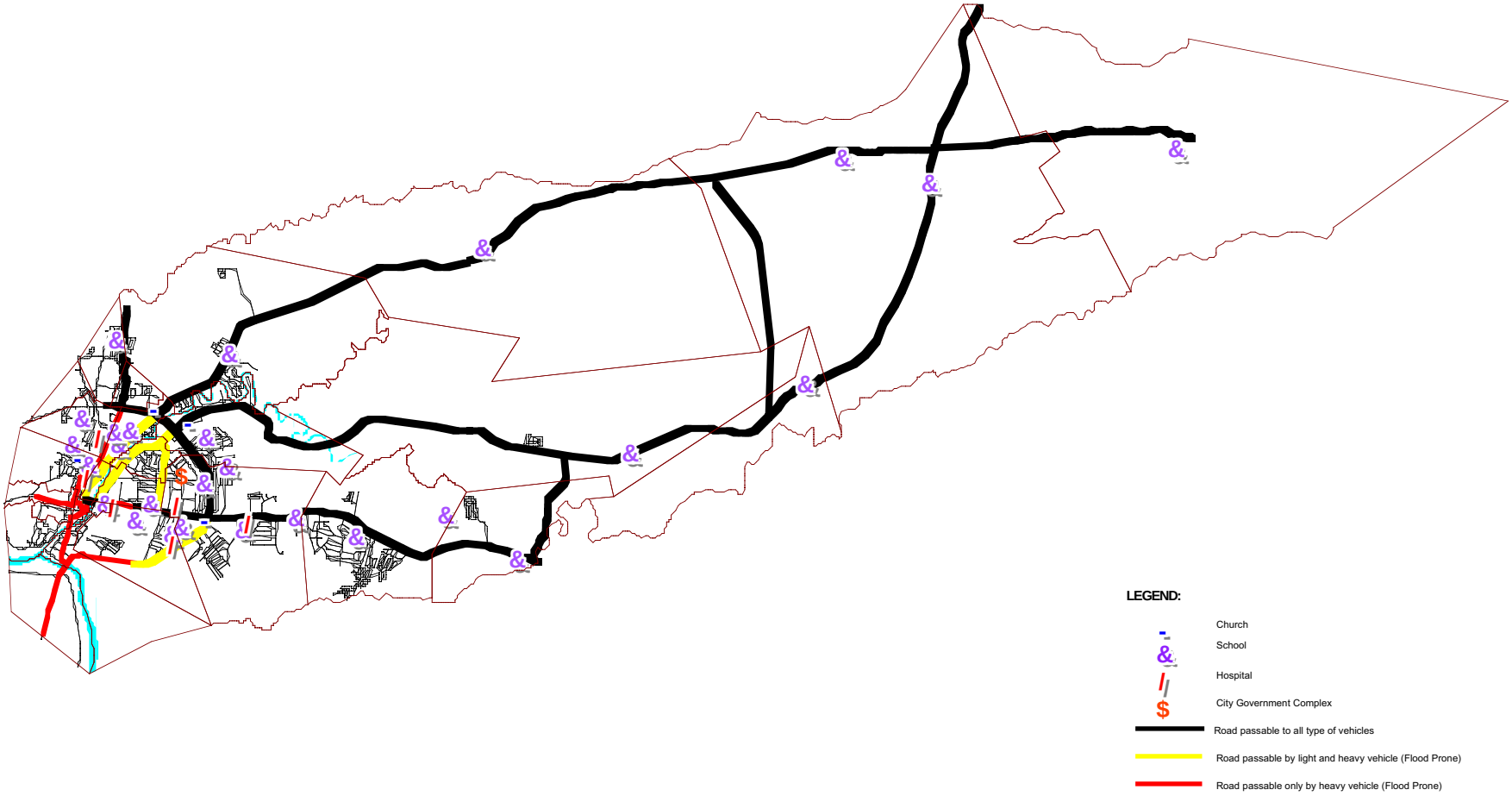


Figure 24: Figure Lifeline Facilities



Source: City Government of Naga

Figure 25: Naga City, Flood Hazard Zone

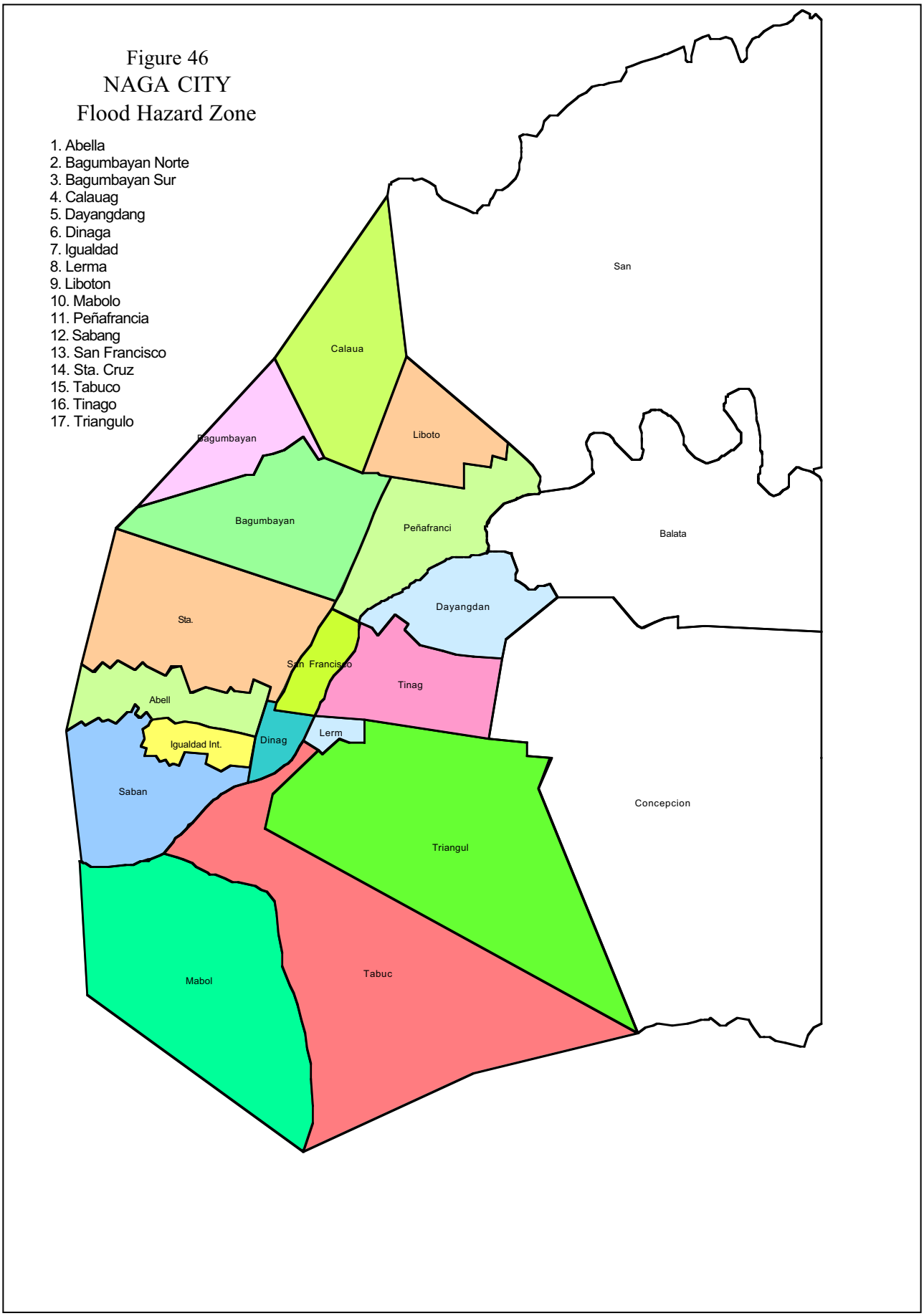


Figure 26: Naga City, Most Vulnerable Areas

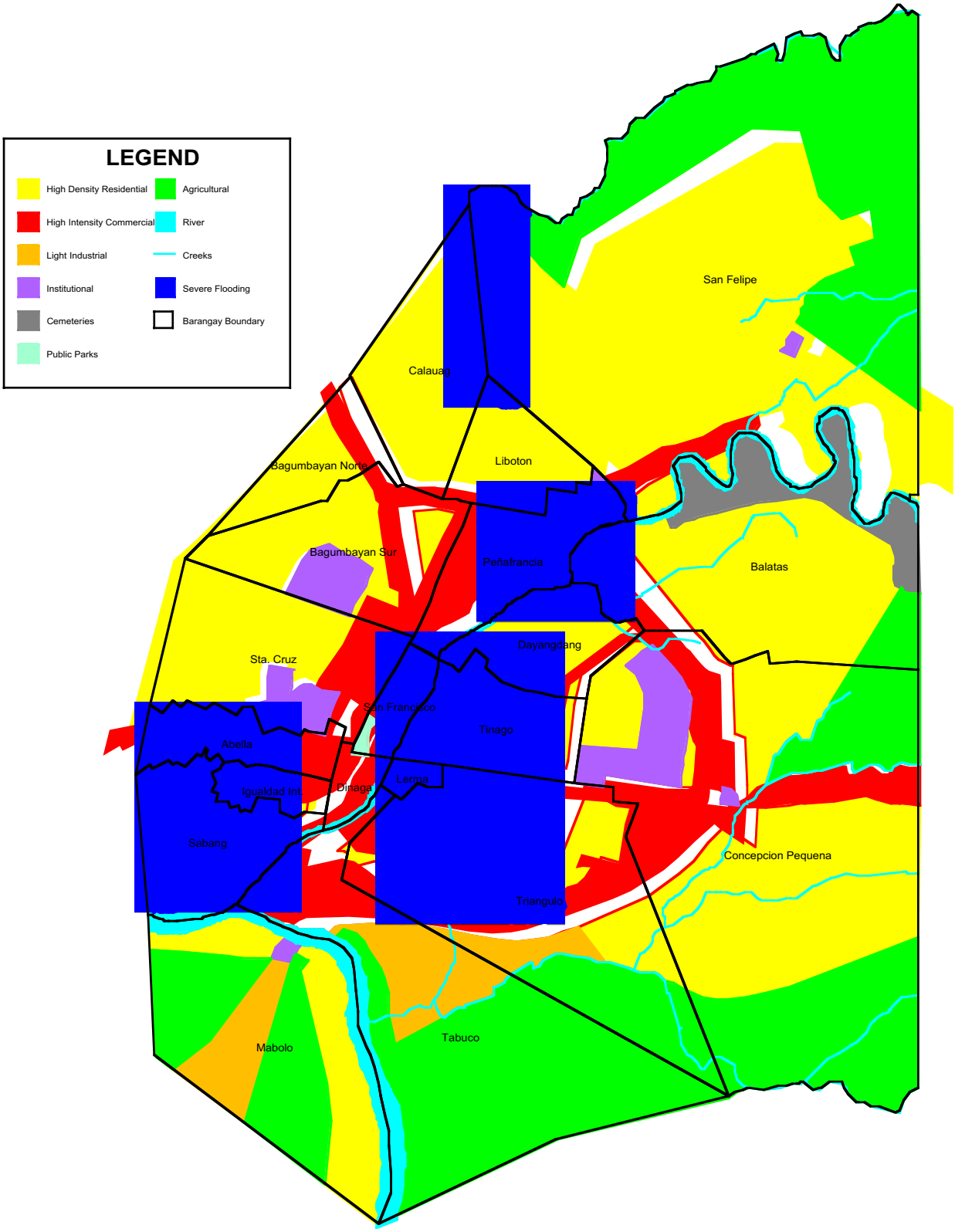


Figure 27: Naga City Built Up Area

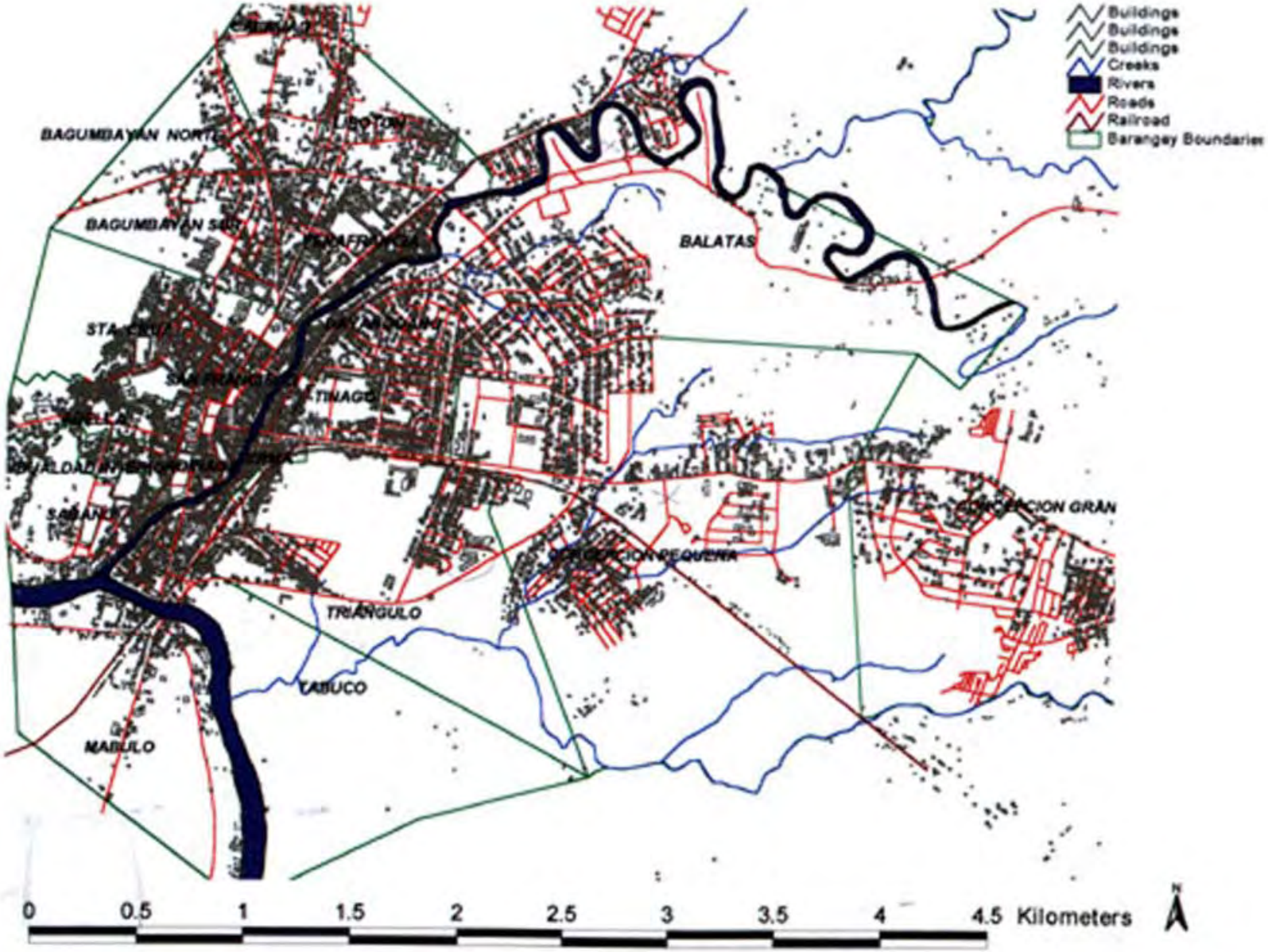


Table 21. Profile of Naga Hospitals for Emergency/Rescue Operations

NAME	OWNERSHIP/ Location	VULNERABILITY		Program For Diasaster Mitigation	FACILITIES/SERVICES					
		Flood	Typhoon		No. of Technical/Med. Staff	Trained Personnel for Rescue/ First Aid	AMBU-LANCES	Mode of Communication	Number of Beds	Other Facilities for Rescue/ Emergency
1. Dr. Roa Memorial Foundation	Private/ Dimasalang St.	M	L	None	18	None	None	• Phone	20	• 1 Generator
2. Naga City Hospital	Local Gov't./ Peñafrancia Ave.	L	L	ERN Host	40	90% of Staff and 400 Volunteers	3	• Phone • Command & Communica-tion Vehicle • VHF		• Rubber Boat • Tents • Trauma Van • 1 Generator • 3 Vehicle
3. Bicol Medical Center	National Gov't./ Concepcion Pegueña	N	L	DOH STOP D.E.A.T.H Program	346	20	10	• Phone • VHF	500	• 3 Generators • 14 Units Vehicles
4. Mother Seton	Private - Religious/ Triangulo	L	L	ERN Coope-rating Hospital	100	None	1	• Phone • VHF	100	• 2 Units Generator • 2 Vehicles
5. St. John	Private/ Panganiban Drive	H	L	ERN Coope-rating Hospital	89	None	1	• Phone • VHF	68	• 1 Generator • 1 Vehicle
6. AGO Medical	Private/ Concepcion Grande	N	L	ERN Coope-rating Hospital	95	None	None	• Phone	60	• 1 Generator

Legend:

H - HIGH RISK **L - LOW RISK**

N - Nill Risk *M - Moderate Risk*

Figure 28: Naga City Disaster Mitigation Project Organizational Functional Chart

Figure 55. Naga City Disaster Mitigation Project Organizational Functional Chart

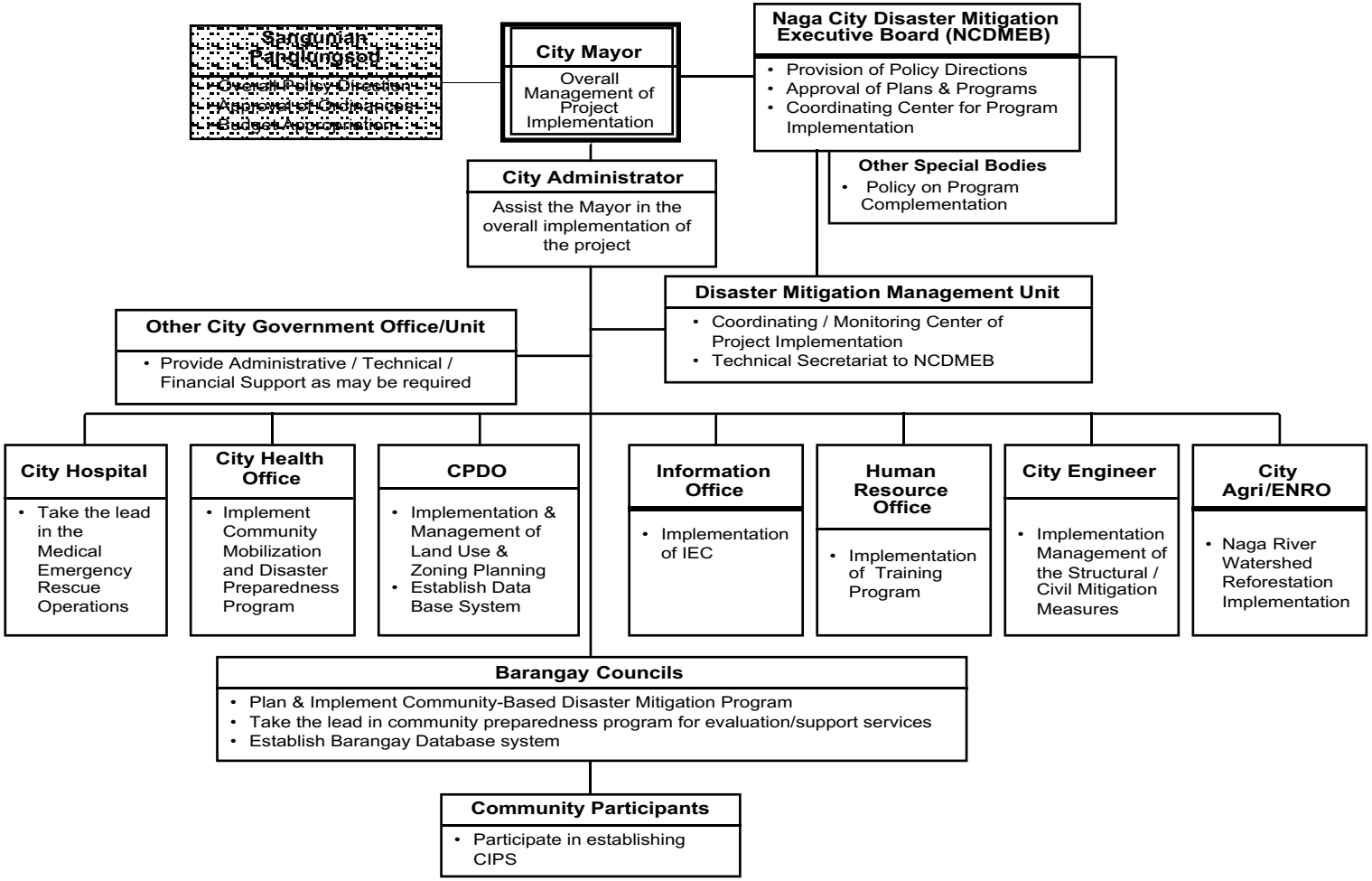


Table 22. Summary Implementation Plan of Institutional Development Program and Cost

ACTIVITY	SCOPE	COST (P Million)	DURATION	Remarks
1. **Organizational Strengthening**	1. Establishment of operating center and provision of equipment facilities.	4.50	1 year	● Office space of 50 sq.m. to be provided by the City Government
	2. Naga City Hospital equipment support	2.50	1 year	● Augment existing equipment for emergency rescue
	3. Training of 6,000 TPDs of Paramedics	12.00	3 years	● To be undertaken by the ERN Foundation, Inc.
	Sub-total	**19.00**		
2. **Establishment of Flood Database System**	1. Technical Data Base			
	● Naga City Flood Forecasting System	5.00	1 year	● To be implemented by PAGASA
	● Community-Based Flood Monitoring System	0.20	1 year	● Installation of Staff Gauges and Training of 17 barangay gauge keepers
	2. Flood/Wind Damaged Database			
	● Equipment support to CPDO	1.00	1 year	● Additional computer/vehicle for CPDO
	● Installation/training	1.70	2 years	● Training of CPDO Staff and selected barangay volunteers/ officials
	● Conduct of survey	3.00	5 years	● Estimated at P600,000.00 per year
	Sub-total	**10.90**		
3. **IEC Program**	1. Training/Information needs assessment/organizing works	1.00	1 year	● Additional cost at the P10 of Naga
	2. IEC Implementation	7.50	5 years	● Estimated at P1.5 M per year.
	Sub-total	**8.50**		
4. **Community Mobilization and Preparedness Program**	1. Install CIPS/Disaster Preparedness per Barangay	8.10	3 years	● Additional cost for the City Health Offices for Training of BHAs to conduct Community Development Works and actual community mobilization
	Sub-total	**8.10**		
	GRAND TOTAL	**46.50**		

Table 23. Summary Implementation Plan of Land Use Planning and Monitoring Capability Building

ACTIVITY	SCOPE	COST (P Million)	DURATION	Remarks
1. **Revision of Existing Land Use and Zoning Ordinance**	1. Evaluate options adaptable to current situation and minimize effect of Flood/wind Hazard	2.00	1 year	● Provision of Technical Assistance to CPDO to undertake the activity
2. **Revision/ Improvement of Ordinances**	1. Review existing ordinances and the proposed revision ● Conduct Public hearing	1.50	1 year	● Provision of Technical Assistance to City Legal Office in formulating revision of existing ordinance relevant to Disaster Mitigation
3. **HRD**	● Training needs analysis ● Orientation briefing/seminar for Sangunian and Executive Officer of Naga, CPDO, etc. ● Certificate Course Training on Land Use Planning	1.50	2 years	● Establish planning and monitoring capacity for updating of land use and zoning plans
4. **Citywide awareness campaign on zoning and flood mitigation**	● Included the IEC Program			
	GRAND TOTAL	**5.00**		

Table 24. Summary Implementation Plan of Structural/Civil Works Counter Measures

PHASE	SCOPE	PROJECT COST (P Million)	DURATION	Remarks
Phase I	1. Magsaysay Bridge redesign	-	-	● Cost charge to other project
	2. Naga River Easement Recovery Improvement Project to include redesigns to increase full bank capacity of Naga River	44.00	5 years	● Cost for civil works and A&E for the increasing full bank capacity of Naga River from Magsaysay Bridge to Sabang Tidal Structure
	3. Naga River Watershed Refo		9 years	● Cost charge to other project
	4. Study of Naga Tidal Structure	2.00	1 year	● Cost for DPWH to study and design only.
	5. Inventory and Evaluation of lifeline facilities	3.00	1 year	● Cost of Rehab/Improvement to be charge to concerned agencies
Phase II	1. Design/Study of comprehensive storm drainage master plan to include waterway, restoration, drainage interceptor canals, and Pacol-Tabuco Diversion Channel	4.00	1.5 years	● Consultancy Assistance to CEO
	2. A & E of viable projects	5.00	1.5 years	● Consultancy Assistance to CEO
Phase III	1. Construction of new drainage system and upgrading of existing drainage facilities	400.00	10 years	● External assistance source
	2. Waterway restoration and improvement	4.50	2 years	● External assistance source
	3. Construction of drainage inteceptor canals and extension of major waterways	8.00	3 years	● External assistance source
	4. Pacol-Tabuco Diversion Channel	6.00	2 years	● External assistance source
	5. Maintenance of Drainage System	40.00	5 years	● Continuing from Naga regular budget at P4.00 million/year
	GRAND TOTAL	**516.50**		

Table 25: SCHEDULE OF ACTIVITIES/CASH FLOW REQUIREMENTS

ACTIVITIES	CASH FLOW BY YEAR (P Million)						
	1	2	3	4	5	6 -10	Total
I Institutional Development							
1. Organizational Development	4.50	4.50	5.00	5.00	-	-	19.00
2. Establishment of Database System	2.90	5.00	1.20	1.20	0.60	-	10.90
3. IEC Program	2.50	1.50	1.50	1.50	1.50	-	8.50
4. Community Mobilization	1.00	1.70	2.70	2.70	-	-	8.10
II Structural Civil Works							
1. Phase I Naga River Improvement	5.00	11.00	11.00	11.00	11.00	-	49.00
2. Phase II Comprehensive Storm Drainage Master Planning and A & E	3.00	3.00	3.00	-	-	-	9.00
3. Phase III Implementation of Storm Drainage	-	40.00	40.00	40.00	40.00	258.50	418.50
III Land Use & Capability Building							
1. Revision of land use and zoning ordinance	1.00	1.00	-	-	-	-	2.00
2. Revision/Improvement of ordinances	0.50	1.00	-	-	-	-	1.50
3. HRD	0.50	1.00	-	-	-	-	1.50
Sub-total	**20.90**	**69.70**	**64.40**	**61.40**	**53.10**	**258.50**	**528.00**
IV Management/Supervision @ 5%	1.54	3.48	3.22	3.07	2.65	12.92	26.88
V Physical Contingencies @ 10%	2.09	6.97	6.44	6.14	5.31	25.85	52.80
GRAND TOTAL	**24.53**	**80.15**	**74.06**	**70.61**	**61.06**	**297.27**	**607.68**

Table 26. Economic Analysis: Option 1 - Full Costs

Year	Costs	Benefits	Netben
1	24.04	0.00	-24.04
2	80.16	8.00	-72.16
3	74.06	12.90	-61.16
4	70.61	21.50	-49.11
5	61.07	30.10	-30.97
6	59.46	43.00	-16.46
7	59.46	48.00	-11.46
8	59.46	48.00	-11.46
9	59.46	52.00	-7.46
10	59.46	53.00	-6.46
11	6.00	55.90	49.90
12	6.00	60.20	54.20
13	6.00	60.20	54.20
14	6.00	60.20	54.20
15	6.00	60.20	54.20
16	6.00	60.20	54.20
17	6.00	60.20	54.20
18	6.00	60.20	54.20
19	6.00	60.20	54.20
20	6.00	60.20	54.20
21	6.00	60.20	54.20
22	6.00	60.20	54.20
23	6.00	60.20	54.20
24	6.00	60.20	54.20
25	6.00	60.20	54.20
TOTAL	697.24	1,215.20	517.96
NPV	308.72	208.09	-100.63
IRR			8%

Table 27. Economic Analysis: Option 2 - Only Structural Works

Year	Costs	Benefits	Netben
1	5.75	0.00	-5.75
2	51.77	5.00	-46.77
3	51.77	8.00	-43.77
4	51.77	12.00	-39.77
5	51.77	25.00	-26.77
6	51.77	32.00	-19.77
7	51.77	43.00	-8.77
8	51.77	47.30	-4.47
9	51.77	47.30	-4.47
10	51.77	47.30	-4.47
11	6.00	53.00	47.00
12	6.00	58.00	52.00
13	6.00	58.00	52.00
14	6.00	58.00	52.00
15	6.00	58.00	52.00
16	6.00	58.00	52.00
17	6.00	58.00	52.00
18	6.00	58.00	52.00
19	6.00	58.00	52.00
20	6.00	58.00	52.00
21	6.00	58.00	52.00
22	6.00	58.00	52.00
23	6.00	58.00	52.00
24	6.00	58.00	52.00
25	6.00	58.00	52.00
TOTAL	561.68	1,131.90	570.22
NPV	228.48	181.69	-46.79
IRR			11%

Table 28. Economic Analysis: Option 3 - Without Drainage Rehab

Year	Costs	Benefits	Netben
1	24.04	0.00	-24.04
2	80.16	8.00	-72.16
3	74.06	12.90	-61.16
4	70.61	21.50	-49.11
5	61.07	30.10	-30.97
6	6.00	43.00	37.00
7	6.00	45.00	39.00
8	6.00	45.00	39.00
9	6.00	47.30	41.30
10	6.00	47.30	41.30
11	6.00	47.30	41.30
12	6.00	47.30	41.30
13	6.00	47.30	41.30
14	6.00	47.30	41.30
15	6.00	47.30	41.30
16	6.00	47.30	41.30
17	6.00	47.30	41.30
18	6.00	47.30	41.30
19	6.00	47.30	41.30
20	6.00	47.30	41.30
21	6.00	47.30	41.30
22	6.00	47.30	41.30
23	6.00	47.30	41.30
24	6.00	47.30	41.30
25	6.00	47.30	41.30
TOTAL	429.94	1,009.60	579.66
NPV	219.62	185.51	-34.11
IRR			12%

Table 29. Economic Analysis: Option 4 - Structural Works w/o Drainage Rehab

Year	Costs	Benefits	Netben
1	5.00	0.00	-5.00
2	52.00	5.00	-47.00
3	52.00	8.00	-44.00
4	52.00	12.00	-40.00
5	52.00	32.00	-20.00
6	6.00	43.00	37.00
7	6.00	47.30	41.30
8	6.00	47.30	41.30
9	6.00	47.30	41.30
10	6.00	47.30	41.30
11	6.00	47.30	41.30
12	6.00	47.30	41.30
13	6.00	47.30	41.30
14	6.00	47.30	41.30
15	6.00	47.30	41.30
16	6.00	47.30	41.30
17	6.00	47.30	41.30
18	6.00	47.30	41.30
19	6.00	47.30	41.30
20	6.00	47.30	41.30
21	6.00	47.30	41.30
22	6.00	47.30	41.30
23	6.00	47.30	41.30
24	6.00	47.30	41.30
25	6.00	47.30	41.30
TOTAL	333.00	998.70	665.70
NPV	152.11	177.15	25.04
IRR			18%

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The **Asian Urban Disaster Mitigation Program (AUDMP)**, launched in 1995, is the largest regional program of ADPC. The program, with core funding from the Office of Foreign Disaster Assistance of the United States Agency for International Development, will ultimately work in ten or more countries of the region. The program was designed to make cities safer from disasters. The goal of the AUDMP is to reduce the disaster vulnerability of urban populations, infrastructure, critical facilities and shelter in targeted cities in Asia, and to promote replication and adaptation of successful mitigation measures throughout the region. Towards this end, the program develops and supports national demonstration projects, information dissemination and networking activities, and policy seminars and professional training in the target countries of Bangladesh, Cambodia, India, Indonesia, Lao PDR, Nepal, Philippines, Sri Lanka, Thailand and Vietnam.

The **Asian Disaster Preparedness Center (ADPC)** is a regional resource center dedicated to disaster reduction for safer communities and sustainable development in Asia and the Pacific. Established in 1986 in Bangkok, Thailand, ADPC is recognized as an important focal point for promoting disaster awareness and developing capabilities to foster institutionalized disaster management and mitigation policies.

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