JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

No. 62

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES

THE FEASIBILITY STUDY
ON
UPGRADING INTER-URBAN HIGHWAY SYSTEM ALONG THE PAN-PHILIPPINE HIGHWAY
(Sta. Rita, Plaridel - San Jose Section)

FINAL REPORT

EXECUTIVE SUMMARY

NOVEMBER 1999

KATAHIRA & ENGINEERS INTERNATIONAL
YACHIYO ENGINEERING CO.,LTD.

EXCHANGE RATE

July 26, 1999
1 US $ = P38.30
1 US $ = Yen 116.4
1 P = Yen 3.039

Source : Central Bank of the Philippines

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PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a Feasibility Study on Upgrading Inter-Urban Highway System along the Pan-Philippine Highway (Sta. Rita, Plaridel – San Jose Section) and entrusted the study to the Japan International Cooperation Agency (JICA).

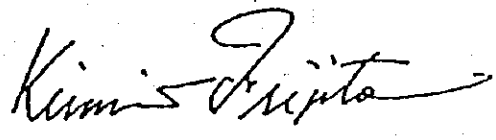
JICA selected and dispatched a study team headed by Mr. Tsuneo Bekki of Katahira & Engineers International, and consisting of Katahira & Engineers International and Yachiyo Engineering Co., Ltd. to the Philippines, two times between November 1998 and November 1999. In addition, JICA set up an advisory committee headed by Mr. Takahiro Hisano, Director of Road Division, Kyushu Regional Construction Bureau, the Ministry of Construction between November 1998 and November 1999, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of the Philippines and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

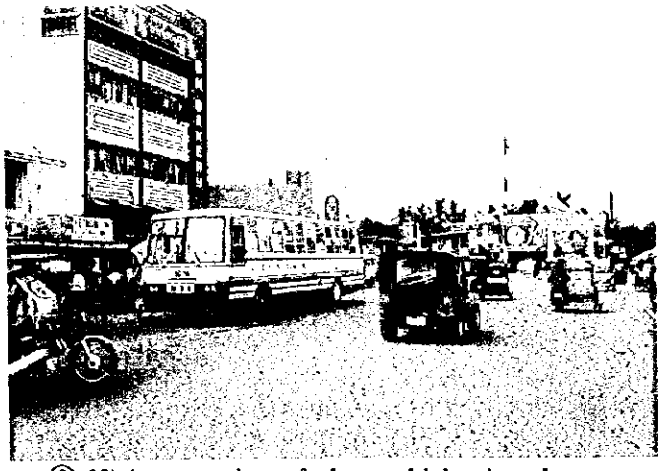
Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the Team.

November 1999



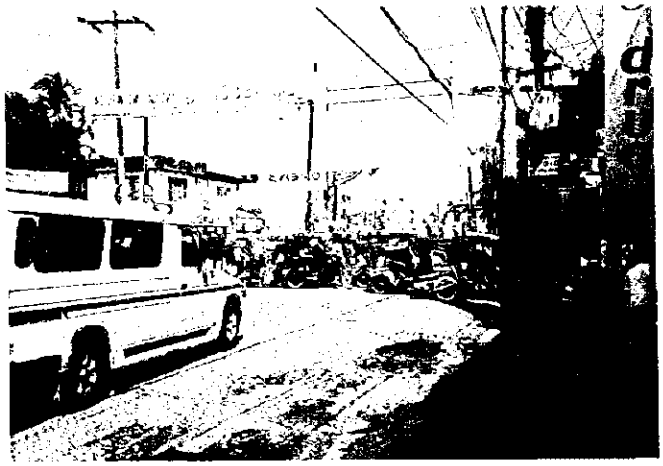
Kimio Fujita
President
Japan International Cooperation Agency

① Traffic congestion at Plaridel intersection



② High proportion of slow vehicles in urban section of Gapan

③ Traffic congestion in urban section of Sta. Rosa



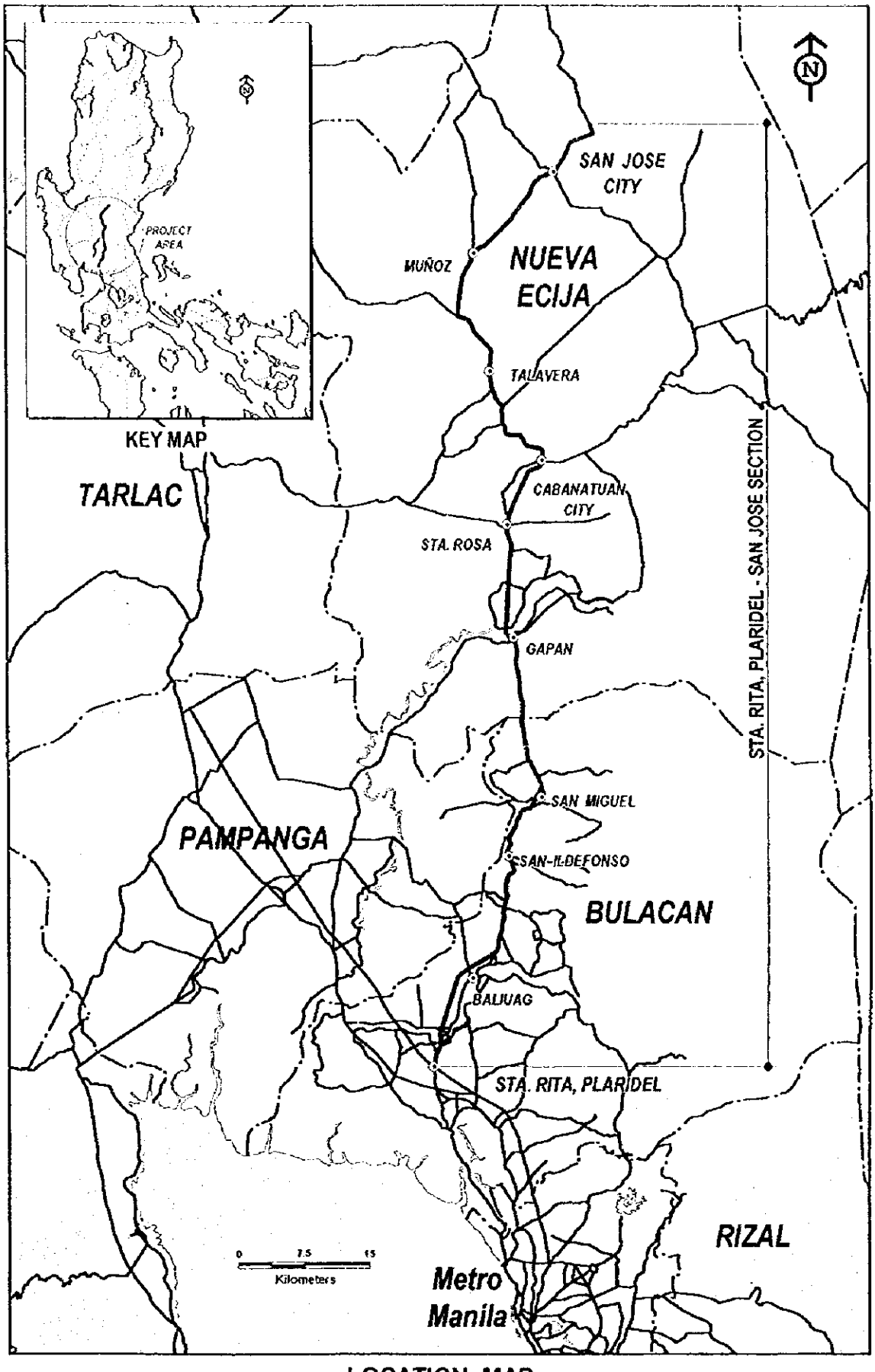
④ Many tricycles crossing the Pan - Philippine Highway at a intersection in Cabanatuan City

⑤ Traffic congestion in urban section of Cabanatuan City

⑥ Traffic congestion at a major intersection in San Jose City (4 - lane)

⑦ Many vehicles parking at roadside in urban area of Talavera

⑧ Inter - urban section where widening to 4 - lines is difficult



LOCATION MAP

SUMMARY

OBJECTIVE OF THE PROJECT

In recent years, economic growth has brought about a sharp increase of road traffic in and around Metro Manila and the regional growth pole cities. Both local and through traffic have increased, especially along the urban sections of the road. The traffic function of the arterial road has been seriously affected. The objective of the project is to upgrade the traffic function of the Sta. Rita, Plaridel and San Jose Section of the Pan-Philippine Highway.

TRAFFIC CONDITION AND LEVEL OF SERVICE (LOS)

The existing traffic volume (AADT) of 4-wheel or more vehicles ranges from 8,300 to 26,100. There is an additional tricycle traffic of between 9,200 and 27,500. This traffic is carried on a 2-lane road. The level of service (LOS) of the urban sections is E (approaching traffic capacity) and of major urban intersections is F (lowest level). The travel speed of between 40 and 60 km/hour on the inter-urban sections is reduced drastically to between 10 and 20 km/hour in the urban sections.

FACTORS AFFECTING TRAFFIC FLOW

- High mixture of slow speed vehicles such as jeepneys and tricycles
- Heavy side frictions due to narrow shoulders, too many intersections, irregular parking, no sidewalk, etc.
- Uncontrolled intersections (no traffic signals nor exclusive lanes for turning vehicles)
- Substandard horizontal and vertical alignment (only limited sections)

PROPOSED IMPROVEMENT MEASURES

Short Term (2000-2005)

1) Construction of Bypasses (2-lane)
2) Enforcement of Traffic Management
3) Widening of Existing Pan-Philippine Highway within the existing road right-of-way.
4) Installation of Traffic Signal at Major Intersections.

Medium Term (2006-2010)

- Widening of Bypasses (to 4-lane)
- Construction of an Expressway (2-lane)

Long Term (2011-2020)

- Widening of an Expressway (to 4-lane)

THE THREE BYPASS PROJECTS AND ESTIMATED TRAFFIC

Three bypass projects were proposed for heavily congested urban sections.

Bypass	Estimated Traffic on Bypass (PCU/day)	
	2005	2020
Plaridel-Baliuag Bypass	19,600	42,900
Cabanatuan Bypass	22,600	36,500
San Jose Bypass	16,200	22,500

PROJECT COST

Total project cost was estimated at 9,398.0 Million Pesos: 4,957.5 Million Pesos in Phase-1 and 4,440.5 Million Pesos in Phase-2.

(Unit: Million Pesos at 1999 Prices)

	Phase-1	Phase-2	Total
Detailed Design	240.40	57.83	298.23
ROW Acquisition	565.61	-	565.61
Construction	3,844.01	4,058.03	7,902.04
Const. Supervision	307.51	324.64	632.15
Total	4,957.53	4,440.50	9,398.03

MAJOR FEATURES OF BYPASSES

Major Features	Plaridel - Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
1) No. of lanes Phase 1	2-lane	2-lane	2-lane
Phase 2	4-lane divided	4-lane divided	2-lane
2) Total length	21.989 km	30.351 km	7.31 km
• Section with Frontage Road (*)	7.453 km	15.8 km	-
• Section w/o Frontage Road	13.129 km	12.406 km	-
- Roadway Section Sub-total	20.582 km	28.206 km	7.208 km
• Bridge length	1.407 km	2.145 km	0.102 km
- Long Bridge	n=1, L = 1,135m	n=2, L = 1,625m	-
- Medium / Short Bridges	n=10, L = 272m	n=15, L = 520m	n=2, L = 102m
3) Road ROW Width	45 m	52 m	32 m
4) Interchange	n = 1	-	-
5) Intersecting Roads			
• Major intersection	n = 8	n = 14	n = 7
• Underpass	n = 10	n = 3	n = 0
• Access to frontage road	n = 5	n = 6	-
6) Access roads	n = 7, L = 14.73 km	n = 5, L = 14.21 km	n = 2, L = 3.5 km
7) Cross drainage facilities (RCBC/RCPC)	n = 73	n = 93	n = 23

(*) Phase-2.

ECONOMIC EVALUATION

The project was evaluated economically as highly feasible.

	EIRR (%)
Plaridel -- Baliuag Bypass	24.6
Cabanatuan Bypass	20.2
San Jose Bypass	28.6
Total Project	22.0

IMPLEMENTATION SCHEDULE

Construction Stage	Plaridel-Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
Phase-1			
Detailed Design	Apr. 200-Sep.2001	Apr.2000-Sep.2001	Oct.2000-Sep.2001
ROW Acquisition	July 2001-Mar. 2003	July 2001-Dec.2002	Oct. 2000-Dec.2002
Tender	Jan. 2002-Dec.2002	Oct.2001-Sep.2002	Oct.2002-Sep.2003
Construction	Jan.2003-June 2005	Oct.2002-June 2005	Oct.2003-June 2005
Phase-2			
Review of D/D	July 2006-Dec.2006	July2006-Dec.2006	-
Tender	Jan.2007-Dec.2007	Jan.2007-Dec.2007	-
Construction	Jan.2008-Dec.2010	Jan.2008-Dec.2010	-

ANNUAL FUND REQUIREMENT

Maximum fund requirement in Phase-1 and Phase-2 will be 1,635 Million Pesos (2004) and 1,753 Million Pesos (2009), respectively, which are within the estimated fund allocation framework.

OVERALL EVALUATION

The three bypass projects were evaluated as highly feasible from every aspect.

Technical Feasibility: All proposed works can be carried out by construction methods commonly used in the Philippines.

Economic Feasibility: The economic return is good enough to justify the projects as proved by the economic evaluation.

Financial Feasibility: The projects can be implemented within the normal budgetary framework of DPWH.

Environmental Impacts: Overall, the negative impacts of the projects were assessed as being low and these could be mitigated. Overall, the positive impacts were assessed as being high.

Impacts on Regional and Local Development: The projects are expected to contribute greatly to both regional and local development by improving accessibility and the flow of traffic.

RECOMMENDATIONS

Early Implementation of Three Bypass Projects

The bypass projects are needed urgently and should be implemented at the earliest possible time. Possible factors which might affect the implementation of the projects are as follows:

- Securing ECC
- Road ROW Acquisition
- Resettlement of Project-affected People
- Fund Preparation

These matters should be given timely consideration.

Development Control Within the Road ROW of the Proposed Bypasses

As soon as the road ROW is determined, concerned LGUs should promulgate an ordinance which prohibits any development within the road ROW and it should be strictly implemented.

Review and Update of the Land Use Plan by LGUs

Concerned LGUs should review and update their Land Use Plans based on the alignment of the proposed bypasses and access roads.

Stage Construction

In view of the funding requirements and DPWH budgetary framework, stage construction is recommended for the Plaridel-Baliuag Bypass and the Cabanatuan Bypass. However, if the financial situation improves, these should be constructed in one stage as 4-lane bypasses.

Utilization of this Study for Other Similar Projects

In the Philippines, there are many urban sections along arterial roads which suffer from problems similar to those of this Study Road. Hence, this Study is applicable and can be used for the similar projects.

Inter-Urban Sections of the Study Road

Widening should be planned and implemented within the existing road ROW. Proper coordination with the concerned LGUs for relocation of affected houses and facilities is essential.

Other Urban Sections of the Study Road

Away from the proposed bypass, in other urban sections such as Gapan, San Ildefonso, etc., road improvements are required urgently. For example,

- Traffic management
- Paving of shoulders for use by slow moving vehicles
- Construction of sidewalks

TABLE OF CONTENTS

1. INTRODUCTION

BACKGROUND

In the Philippines, the systematic development of the road network began in the late 1960s. Initially the road development thrust was to expand the road network to provide basic access to the major regions. Since the middle of 1980s, the Government of the Philippines (GOP) has experienced premature deterioration of road pavements and bridges as well as road damage due to natural calamities. To cope with such situations, the GOP's emphasis for the road development, through its implementing agency, the Department of Public Works and Highways (DPWH) was changed to rehabilitate and convert existing roads to more durable roads that could also be less likely to be damaged by natural calamity. In line with this policy, various road projects have been implemented.

In recent years, economic growth has brought about a sharp increase of road traffic in and around Metro Manila and regional growth pole cities. Both local and through traffic have increased, especially along the urban sections of arterial roads. The arterial traffic function of these roads has been seriously affected. Upgrading the traffic function of arterial roads and proper sharing of road function with local roads are becoming vital issues to be addressed in road development policies.

The section of the Pan-Philippine Highway from Sta. Rita, Plaridel to San Jose (the Study Road) starts at about 40 km north of Metro Manila and extends for about 123.5 km. Along the Study Road, small and medium size urban centers are situated at about 10 km intervals and in between urbanization is expanding as ribbon type development. In these sections, the traffic function of the Pan-Philippine Highway is being affected seriously due to the high proportion of slow and disorderly moving traffic such as tricycles and jeepneys.

To cope with these issues, GOP through DPWH, sought technical assistance from the Government of Japan (GOJ) for the conduct of a **Feasibility Study on Upgrading Inter-urban Highway System Along the Pan-Philippine Highway (Sta. Rita, Plaridel – San Jose Section)** (the Study).

In response to the request of GOP, GOJ decided to conduct the Study through the Japan International Cooperation Agency ("JICA"), which is the official agency responsible for the implementation of the technical cooperation program of GOJ. JICA organized a Study Team for the Study.

The JICA Study Team, in close collaboration with the DPWH counterpart team, commenced its work in November 1998 and completed the Study in October 1999.

OBJECTIVES OF THE STUDY

- To carry out a feasibility study on improving the traffic capacity of the Sta. Rita (Plaridel) – San Jose Section of the Pan-Philippine Highway.
- To exercise the maximum technology transfer to the Philippine counterpart persons through conduct of the Study.

STUDY ROAD AND STUDY AREA

The Study Road is the Sta. Rita (Plaridel) – San Jose Section of the Pan-Philippine Highway. This section starts at Km. 38+500, at the junction with the North Luzon Expressway, to Km. 162+000. The Study Area includes adjacent areas within the zone of influence of the road.

REPORTS

The Final Report contains the following sections:

- Executive Summary
- Main Text
- Appendix
- Drawings

2 PHYSICAL AND SOCIO-ECONOMIC PROFILE

TOPOGRAPHY

The topography along the Study Road is generally flat with the ground elevation of about 8m and 110m above mean sea level at Plaridel and San Jose, respectively. The Study Road crosses four major rivers; the Angat, the Peñaranda, the Pampanga and the Talavera rivers. Numerous small scale streams and irrigation canals are crossed.

GEOLOGY

The dominant ground along the Study Road is Recent alluvial material. This material is formed by the rivers and streams depositing weathered rock materials.

CLIMATE

The climate of the Study Area is characterized by two pronounced seasons, the wet and dry. A well defined rainy season occurs in the months of June to September, while the dry season is experienced during the months of November to April.

Province	Annual Rainfall (mm)	Max. Monthly Rainfall (mm)	No. of Rainy Days	Temperature (°C) Max.	Min.
Bulacan	2,406	504 (Aug)	151	31.8	22.3
Nueva Ecija	1,893	379 (Aug)	125	32.7	22.3

POPULATION

The annual average population growth rate from 1990 to 1995 of the Provinces of Bulacan and Nueva Ecija were 3.46% and 2.78%, respectively. This is higher than the national average (2.48%). Among major cities and municipalities along the Study Road, high population growth rates were recorded at Plaridel, Cabanatuan City and San Jose City.

	Population (x 1,000)		Average Annual Growth Rate
	1990	1995	1990-1995
Philippines	60,703	68,617	2.48
Region III	6,199	6,933	2.26
Province			
Bulacan	1,505	1,784	3.46
Nueva Ecija	1,313	1,506	2.78
MajorCity/ Municipality			
Plaridel	53	66	4.62
Baliuag	90	103	2.81
Gapan	70	78	1.98
Cabanatuan City	173	201	3.04
San Jose City	83	97	3.18

ECONOMIC GROWTH AND STRUCTURE

During the past 10 years, the economic growth in Region III (4.2% per annum) was higher than that of the country (3.8%). In Region III, the industrial sector had the highest share of GRDP of 44.2%. This is significantly higher than the national average of 35.9%, and is the result of a growth of 5.0% per annum. The agriculture sector shared 22.1% of Region III GRDP and recorded high growth rate of 4.0% per annum. Again, this is significantly higher than the national average of 2.1%.

	Philippines	Region III
GDP/GRDP (BillionP): 1997 current	2,424	203
Per Capita GDP/GRDP(P): 1997	33,884	28,120
Annual Average Growth Rate: 1987-1997	3.8	4.2
Agriculture Sector	2.1	4.0
Industry Sector	4.2	5.0
Service Sector	4.4	3.4
Sectoral Share		
Agricultural Sector (%)	20.7	22.1
Industry Sector (%)	35.9	44.2
Service Sector (%)	43.4	33.7

PRESENT LAND USE

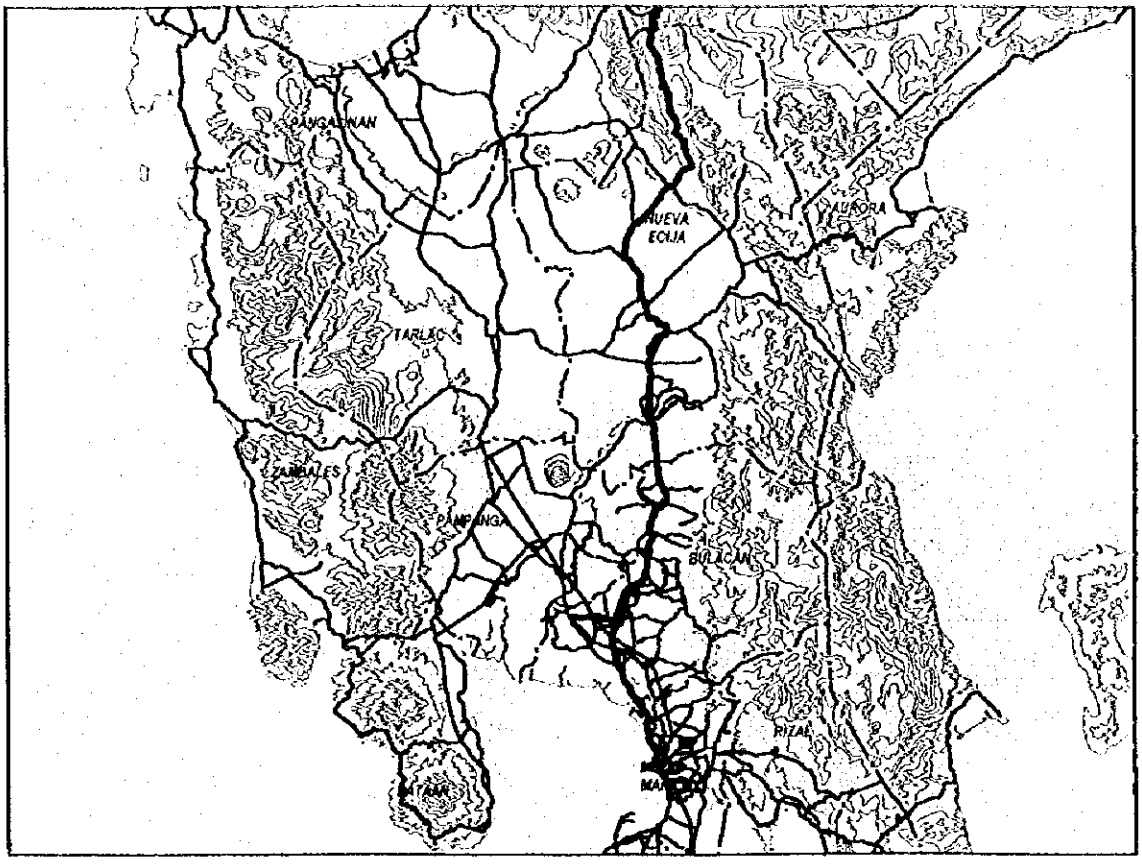
Over 60% of the land is in productive use. Crop lands are predominant and occupy 55% and 59% of total land area in Bulacan and Nueva Ecija Provinces, respectively.

Land Use	Bulacan (Km^2) Area	(%)	Nueva Ecija (Km^2) Area	(%)
Production Land Use	1,688	(64.3)	3,194	(60.4)
- Crop land	1,446	(55.1)	3,116	(59.0)
- Fishing ground	167	(6.3)	2	(0.0)
- Production forest	75	(2.9)	76	(1.4)
Protected Area	697	(26.5)	1,258	(23.8)
Built-up Area	240	(9.2)	832	(15.7)
Total	2,625	(100.0)	5,284	(100.0)

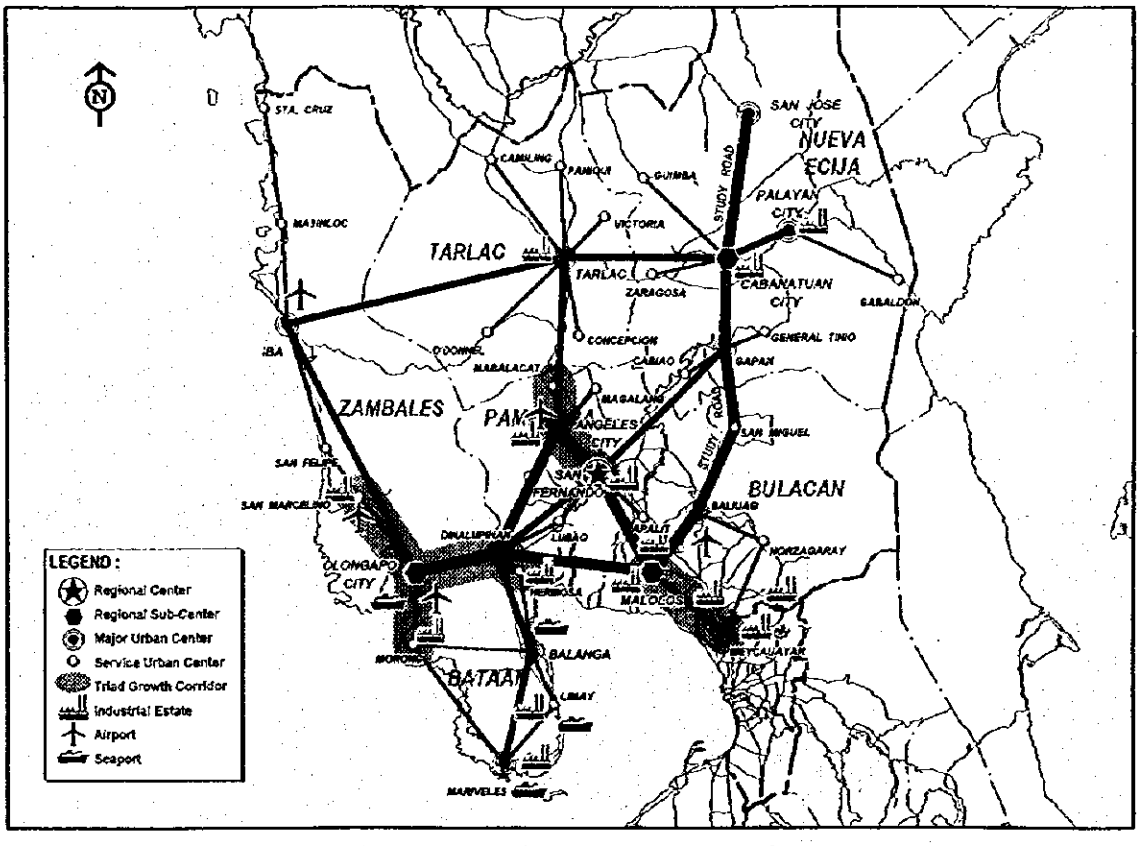
HIERARCHY OF URBAN CENTERS

Urban centers along the Study Road are classified as follows:

Regional Sub-center - Cabanatuan City
Major Urban Center - Baliuag, Gapan, San Jose City
Service Urban Center - San Miguel



TOPOGRAPHY OF REGION III



HIERARCHY OF URBAN CENTERS

3 PRESENT ROAD AND TRAFFIC CONDITION OF THE STUDY ROAD

EXISTING ROAD NETWORK

The Study Road constitutes the north-south backbone arterial road serving the eastern part of Region III and connects Region II with Metro Manila. Other important north-south backbone roads are the Manila North Road and the North Luzon Expressway. These roads serve the western parts of Region III. The north-south backbone roads are connected by the east-west lateral road (Iba-Tarlac-Cabanatuan-Palayan).

There are four major road projects proposed in Region III:

- Sierra Madre Highway / North Luzon Expressway East
- Rainbow Highway
- North Luzon Expressway Extension
- Dalton Pass Road

PRESENT ROAD CONDITION OF STUDY ROAD

- Horizontal alignment: generally acceptable except at six curve sections.
- Vertical alignment : generally acceptable except at five short sections.
- Carriageway width : 2x3.35 = 6.70m, except short section in San Jose City which has been widened to a 4-lane divided road.
- Shoulder width: varies from 1.5 to 4.0m. The shoulder is mainly gravel.
- Pavement : pavement is in fair condition, as its rehabilitation was completed in 1996.
- Road right-of-way : 15 ~ 20m

TRAFFIC VOLUME (AADT)

Except north of San Jose Section where the traffic volume is about 3,750, the AADT of 4-wheel or more vehicles varies from 8,300 (San Miguel Bypass) to 26,100 (Cabanatuan Urban Section).

Tricycle traffic is very heavy in all urban sections, particularly at Gapan (9,200 to 15,400), Cabanatuan (15,400 to 24,200), San Jose (25,200 to 27,500) and Talavera (12,300).

TRAVEL TIME AND SPEED

The average travel time for the 125.9km section was 3.26 hours (or an average 38.6 km/hour), while the longest was 3.43 hours (or an average of 36.7 km/hour). The travel speed is drastically reduced in the urban sections, particularly in Cabanatuan, Plaridel and Gapan, where the slowest travel speed was 10.2 km/hour, 13.3 km/hour, and 11.9 km/hour, respectively.

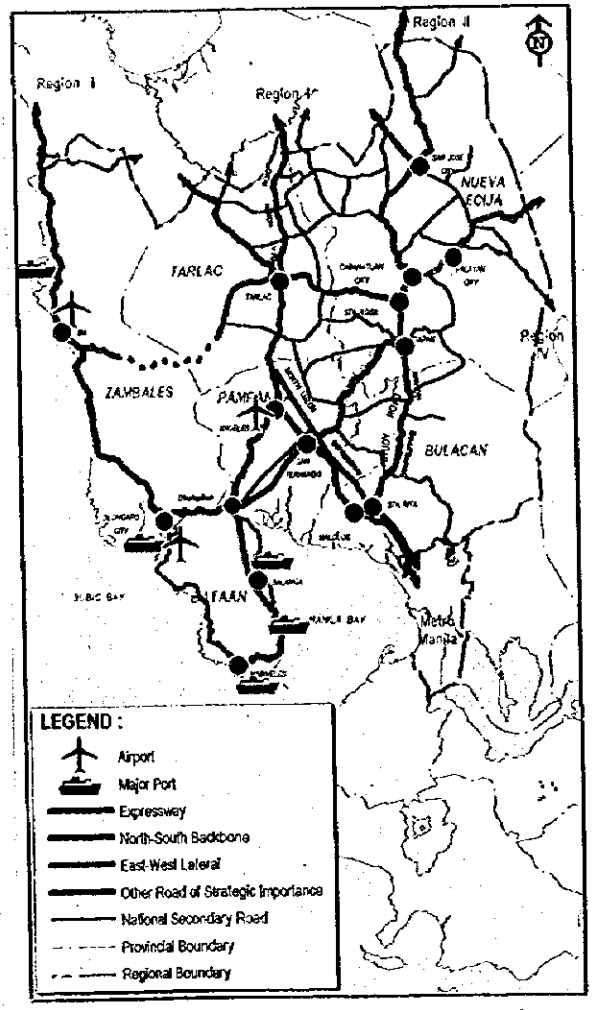
The inter-urban sections still enjoy relatively high travel speeds ranging from 40 to 60 km/hour.

LEVEL OF SERVICE (LOS)

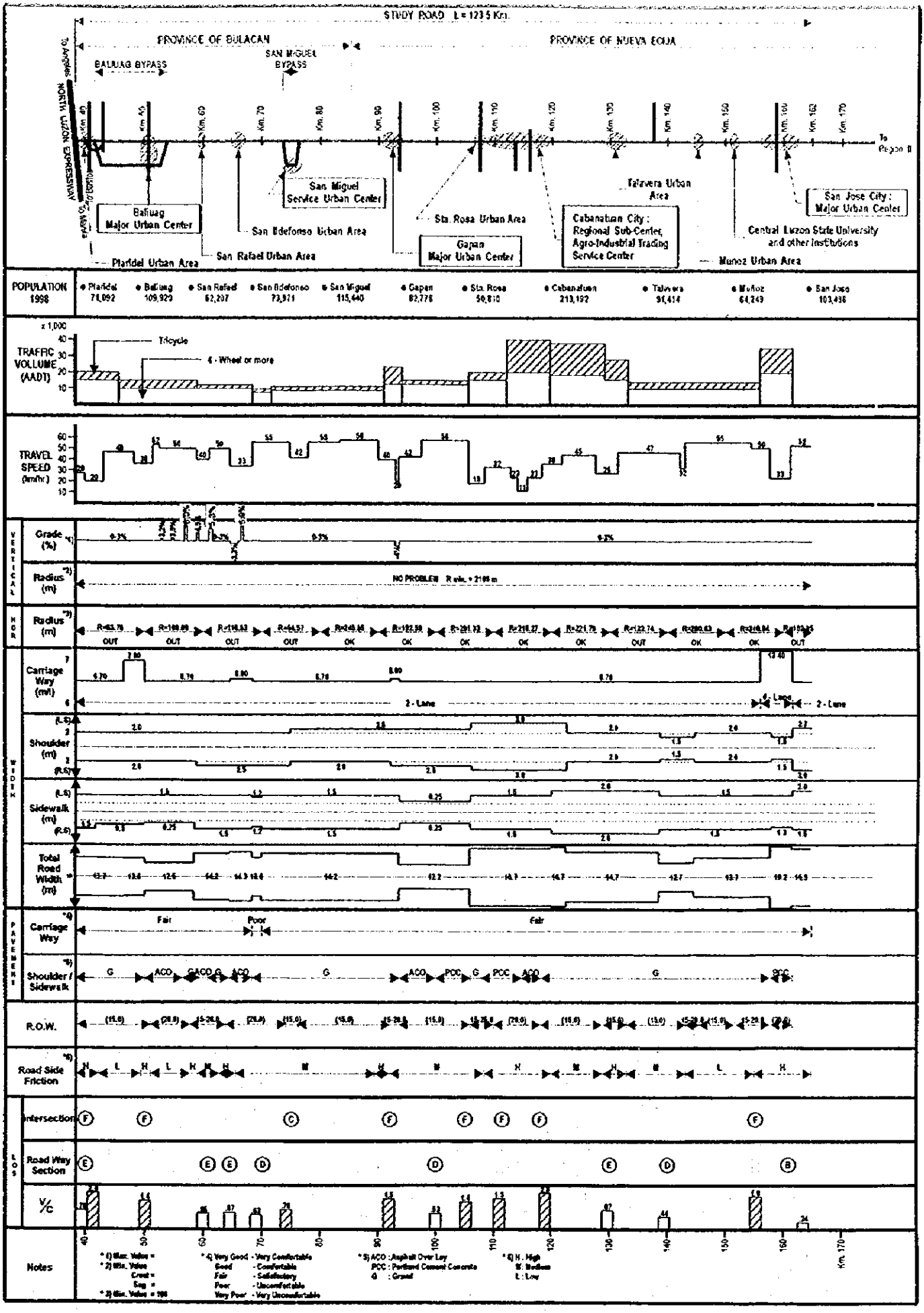
	LOS	
• All major intersections in urban sections	F	(Forced or breakdown flow)
• Most urban sections	E	(Unstable flow)
• Inter-urban sections	D	(Approaching unstable flow)

FACTORS AFFECTING TRAFFIC FLOW

- High proportion of slow speed vehicles such as jeepneys and tricycles
- Heavy side frictions due to narrow shoulders, too many intersections, irregular parking, no sidewalk, etc.
- Uncontrolled intersections (no traffic signals nor exclusive lanes for turning vehicles)
- Substandard horizontal and vertical alignment (only limited sections)
- Natural hazard such as flooding.



EXISTING ROAD NETWORK IN REGION III



SUMMARY OF EXISTING ROAD CONDITIONS AND TRAFFIC ANALYSIS

4. FUTURE SOCIO-ECONOMIC FRAMEWORK

FUTURE POPULATION

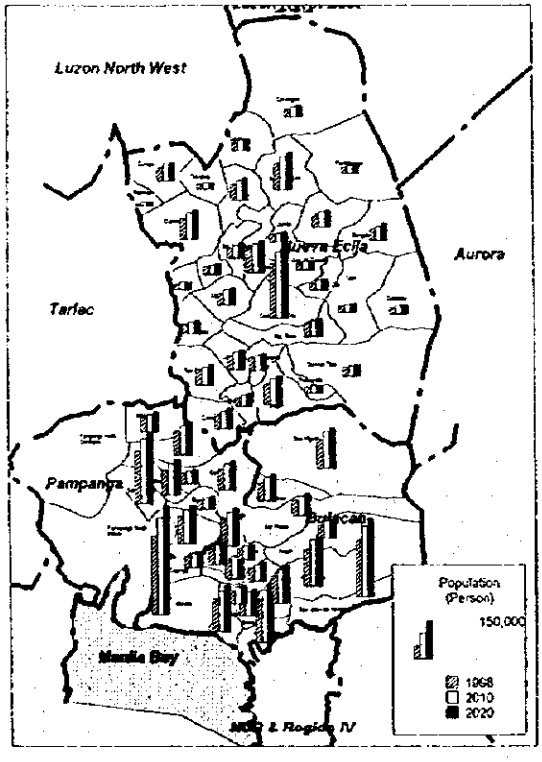
The GOP's official projection was adopted for the Study. This projection is published in the "1995-based National and Regional Population Projection" prepared by the Technical Advisory Group and the National Statistics Office.

Population of the Philippines is projected to increase from 73.1 million in 1998 to 105.5 million in 2020 with an average annual growth rate of 1.68%. The population of Region III is expected to grow at 1.48% per annum and the 7.4 million population in 1998 is estimated to be 10.2 million in 2020. The populations of Bulacan and Nueva Ecija Provinces are projected to grow at almost the same rate as Region III and will be 2.6 and 2.2 millions in 2020, respectively.

Among cities and municipalities along the Study Road, the population in 2020 of Cabanatuan City, San Jose City, Plaridel and Baliuag are estimated to be 288, 143, 99 and 152 thousand, respectively.

(1,000)

	Population				2020/1998
	1998	2005	2010	2020	
Philippines	73,131	84,215	91,851	105,503	1.44
Region III	7,375	8,427	9,101	10,194	1.38
Bulacan Province	1,892	2,166	2,340	2,620	1.38
Nueva Ecija Province	1,605	1,834	1,981	2,219	1.38
Plaridel	71	82	88	99	1.39
Baliuag	110	126	136	152	1.38
Gapan	83	94	102	114	1.37
Cabanatuan City	213	238	257	288	1.35
San Jose City	103	118	128	143	1.39



FUTURE ECONOMIC GROWTH

During the period of the Study, the official future economic framework was not available. The Study Team made economic growth estimates and presented them to the Technical Working Group. The following growth rates have been adopted and approved by the Steering Committee:

National Economic Growth Rate: 4.6% per annum
Region III Economic Growth Rate: 5.3% per annum

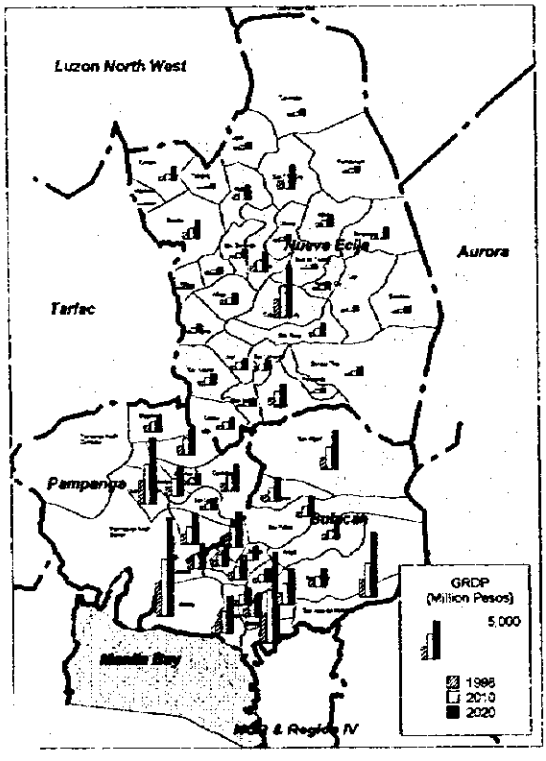
Based on the above Region III GRDP, GRDP of cities and municipalities as well as traffic zones were estimated. GRDP of Bulacan Province is estimated to grow from 26.1 billion pesos in 1998 to 81.0 billion pesos in 2020, Nueva Ecija Province from 16.3 billion pesos in 1998 to 48.9 billion pesos in 2020.

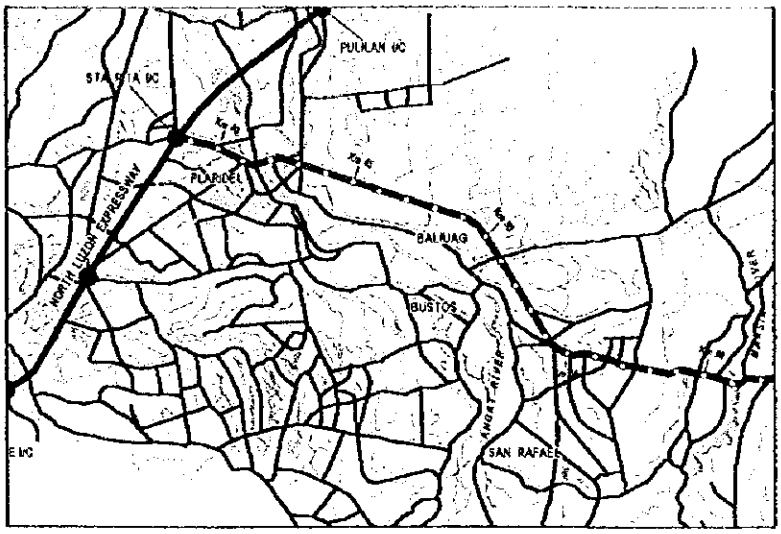
	GRDP (billion)				2020/1998
	1998	2005	2010	2020	
Philippines	2,737.9	3,750.9	4,696.8	7,364.0	2.69
Region III	230.5	330.9	428.4	718.0	3.11
Bulacan Province	26.1	36.0	46.6	81.0	3.10
Nueva Ecija Province	16.3	22.5	29.1	48.9	3.00
Plaridel	1.0	1.4	1.8	3.1	3.10
Baliuag	1.6	2.2	2.8	4.7	2.94
Gapan	0.9	1.3	1.6	2.7	3.00
Cabanatuan City	2.4	3.2	4.1	6.9	2.88
San Jose City	1.0	1.4	1.9	3.2	3.20

FUTURE LAND USE PLAN

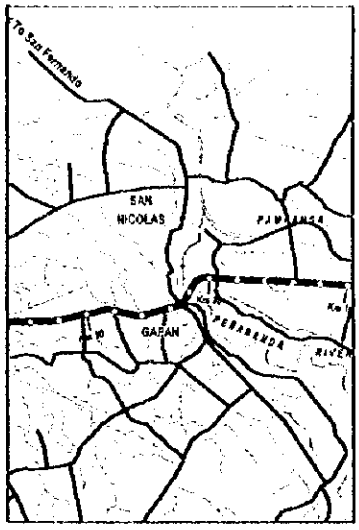
Future land use plans submitted by the concerned Provinces, Cities and Municipalities were reviewed and compiled. The future land use plan of the following areas are attached:

- Plaridel – Baliuag Area
- Gapan Area
- Sta. Rosa – Cabanatuan City – Talavera Area
- San Jose City Area

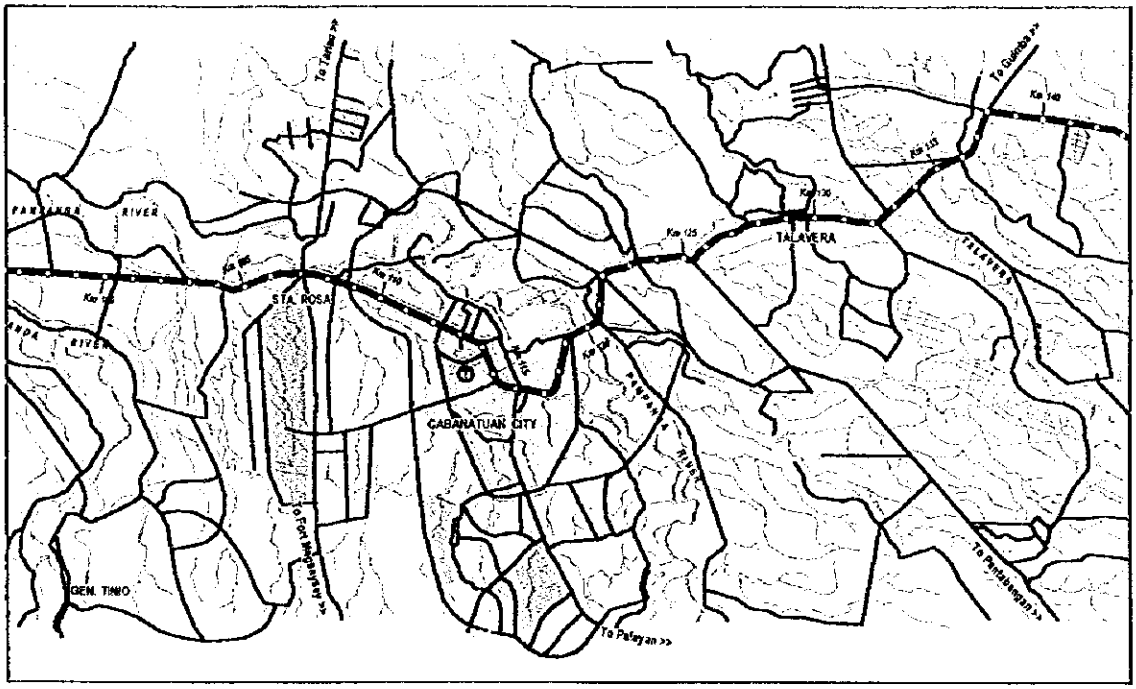




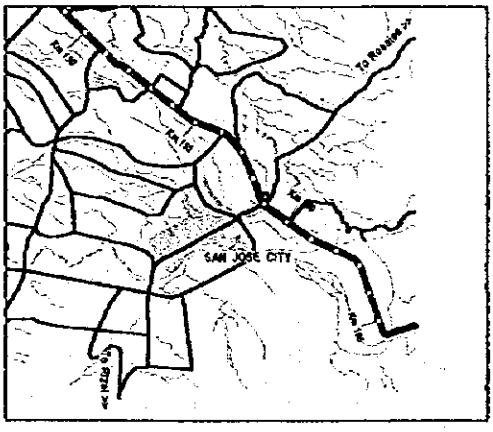
PLARIDEL - BALIUAG AREA



GAPAN AREA



STA. ROSA - CABANATUAN CITY - TALAVERA AREA



SAN JOSE CITY AREA

LEGEND :
- Commercial Area
- Residential Area
- Industrial Area
- Institutional Area

FUTURE LAND USE

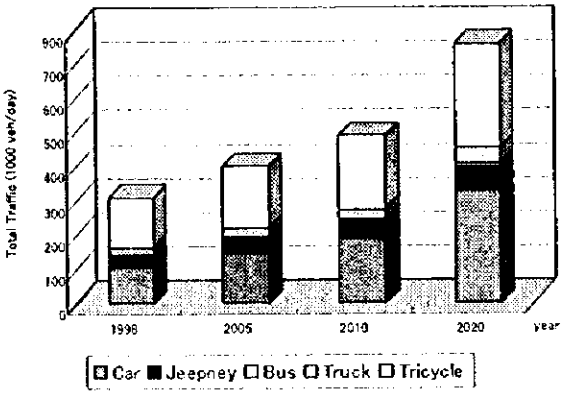
5 FUTURE TRAFFIC DEMAND FORECAST

METHODOLOGY

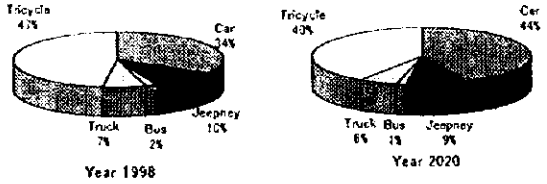
Generated/attracted traffic was forecast by zone, with linear models using population and gross regional product as the explanatory variables. As the present OD matrix was incomplete, it only includes trips passing along the Project Road, the models were used only to estimate the growth rate of trips. Trip distribution (OD trips) was forecast by the present pattern method. The forecast was made for five vehicle types; cars (inclusive of jeep, van, pick-up), jeepneys, buses, trucks and tricycles.

TOTAL GENERATED AND ATTRACTED TRIPS

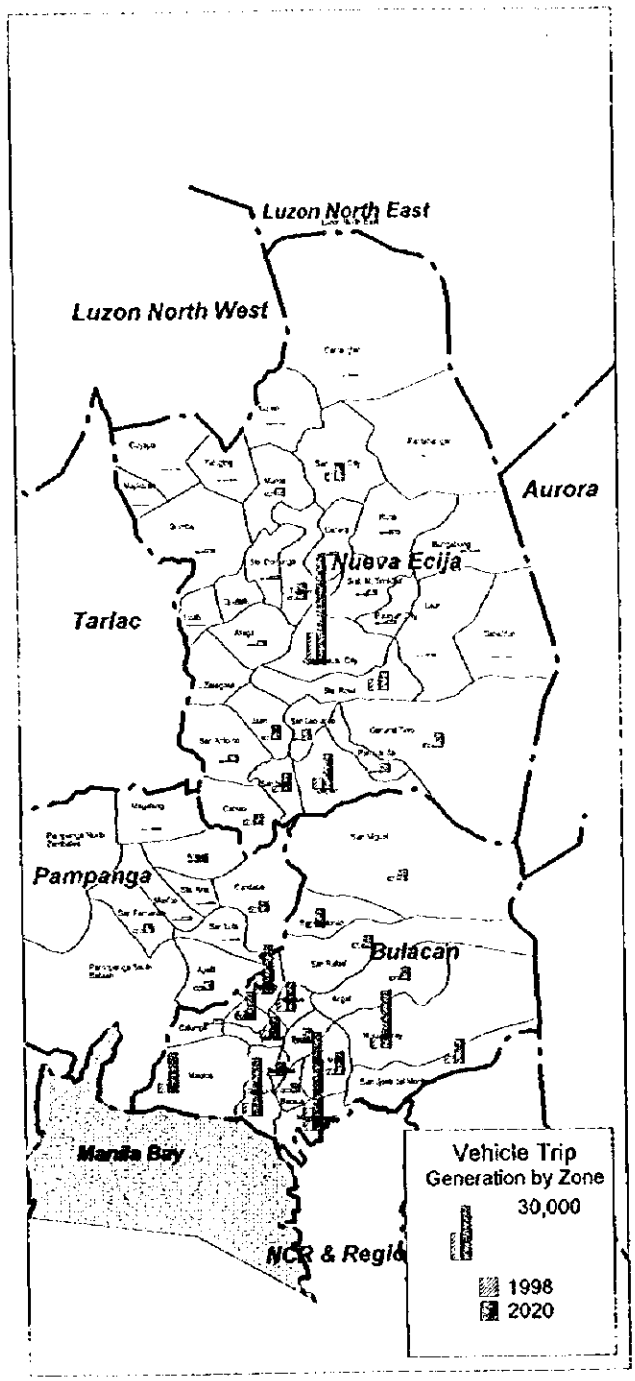
Currently, total demand for the Study Road was estimated at about 310,000 vehicle trips per day, excluding zone-internal trips. Of this total, 47% are trips by tricycles making short distance trips. Cars have a share of 34%, jeepneys of 10% and large vehicles of 9%. The trips will grow to 400,000 in 2005 and 760,000 in 2020, i.e. 2.4 times the present. Cars will show the highest growth rate of 3.1 times while other vehicle trips will more than double.



Increase of Vehicle Trips



Composition of Vehicle Type



Vehicle Trips generated by zone

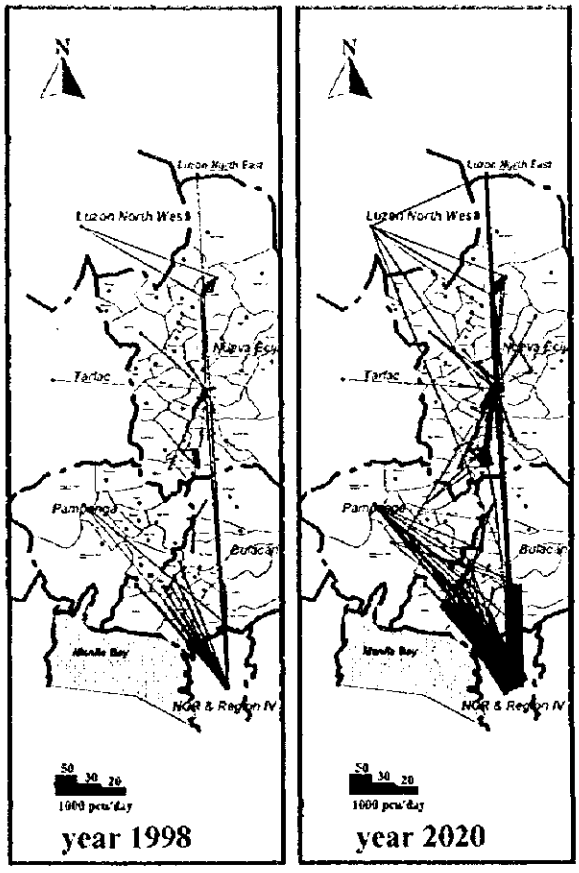
VEHICLE TRIPS BY ZONE

In the Study Road Corridor, both now and in the future, the largest vehicle trip generation and attraction is observed in Cabanatuan City. Excluding tricycle trips, its inter zonal trips are 17,000 in 1998 and 61,000 in 2020, followed by Gapan City (6,200 trips in 1998 and 19,000 in 2020) and Santa Rosa City and San Jose City (both cities has almost same trips of about 5,000 in 1998 and 9,000 in 2020). Present trips in other cities are less than 3,000. The highest traffic increase is 6.0 times in General M. Trinidad, followed by 5.6 times in Norzagaray. In other areas, the traffic increase is between 2.0 to 4.5 times the present traffic.

VEHICLE OD STRUCTURE

The desire on the right shows OD traffic volume in the Study Area in the form of desire lines. More than half of the total traffic is moving between NCR and the southern part of Bulacan Province without giving any burden on the Study Road. The urbanization of the Capital region will reach south Bulacan in the future.

The cities of Cabanatuan, Gapan and San Jose will expand and their characteristics as regional centers will become clearer. The major part of the traffic demand is due to local trips, and long distance trips passing through the whole of the Study Area are not significant.



Desire Line Chart of Study Road Traffic

AVERAGE TRIP LENGTH

As most of the traffic is local, average trip length is short. At present, the average length of inter-zonal trips is for cars 21 Km, buses 27Km, trucks 31Km. Jeepneys and tricycle serve mainly inside a city and their trip lengths are shorter at 16 Km for jeepney and 4 Km for tricycle, excluding intra-zonal trips. In the future, these trip lengths will tend to increase by 10 to 20 %.

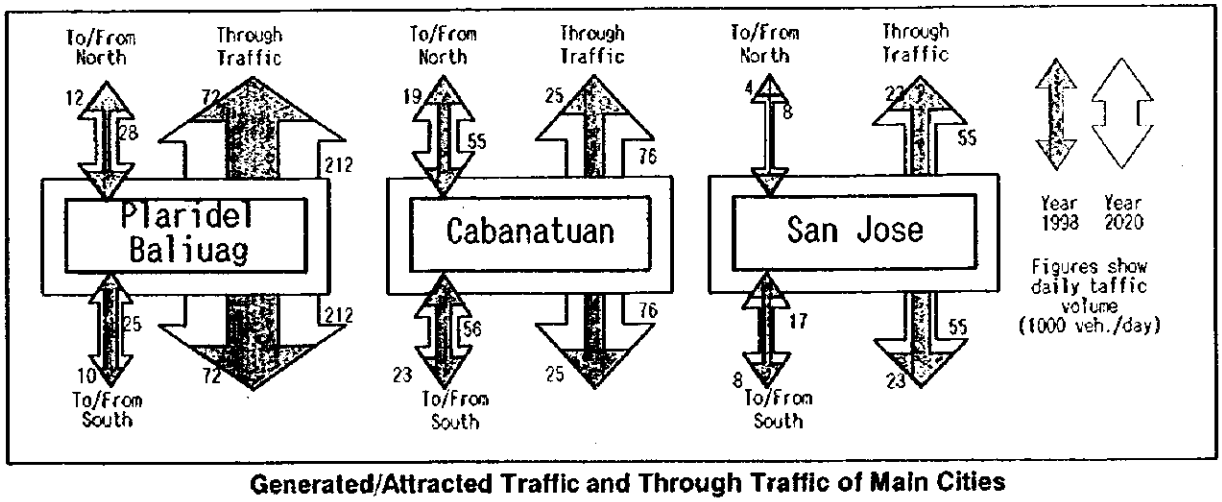
Average Trip Length (Km)

	1998	2020
Car	21.2	24.5
Jeepney	16.0	18.3
Bus	27.2	28.8
Truck	30.6	35.6
Tricycle	3.9	3.9

GENERATED, ATTRACTED AND THROUGH TRAFFIC

As this Study is mainly covered with urban by-passes, the analysis of the future traffic demand for bypasses around the main cities was based on the OD matrices. The results are shown the figure below. In the future as well as at present, Plaridel /Baliuag and San Jose have more through traffic than trips with their origin or destination in the city.

Especially in Plaridel/Baliuag which is located at the start of the Study Road Corridor, through traffic will be more than three times the traffic to or from the cities. Even in the largest city in the Study Area, Cabanatuan, through traffic will be more than half of traffic to or from the city. Through traffic will increase more than three times the present level by the year 2020. From this viewpoint, the importance of bypass construction is apparent.



Generated/Attracted Traffic and Through Traffic of Main Cities

ESTIMATED TRAFFIC ON BYPASSES

Future traffic demand forecasted in a form of OD distribution was assigned on a road link network to estimate traffic volume on each bypass.

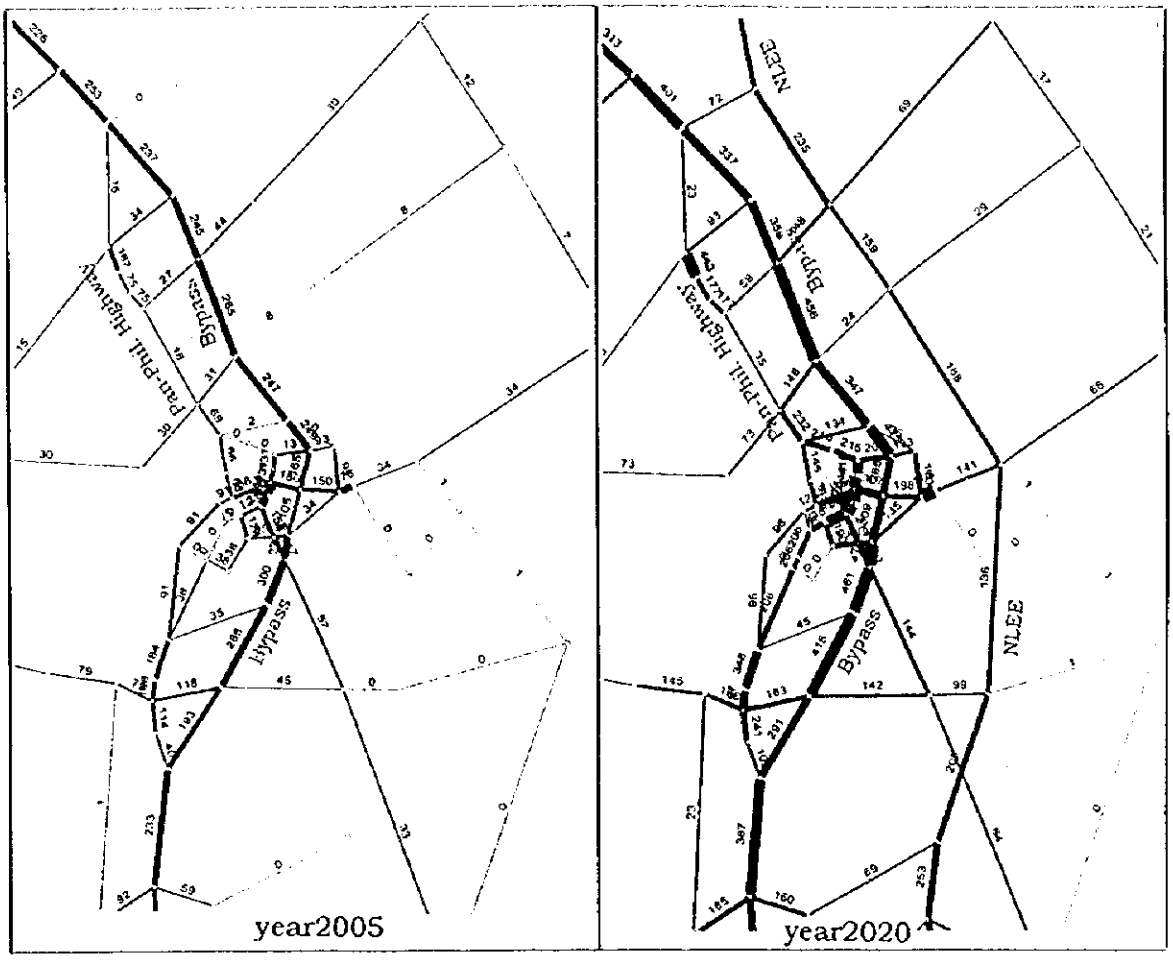
Cabanatuan Bypass is expected to attract the highest traffic volume from 2005 to 2010. In year 2020, it is predicted that Plaridel – Baliuag Bypass will attract the highest traffic volume. San Jose Bypass is expected to be most sensitive to the cases of with and without an expressway.

ESTIMATED BYPASS TRAFFIC (PCU/day)

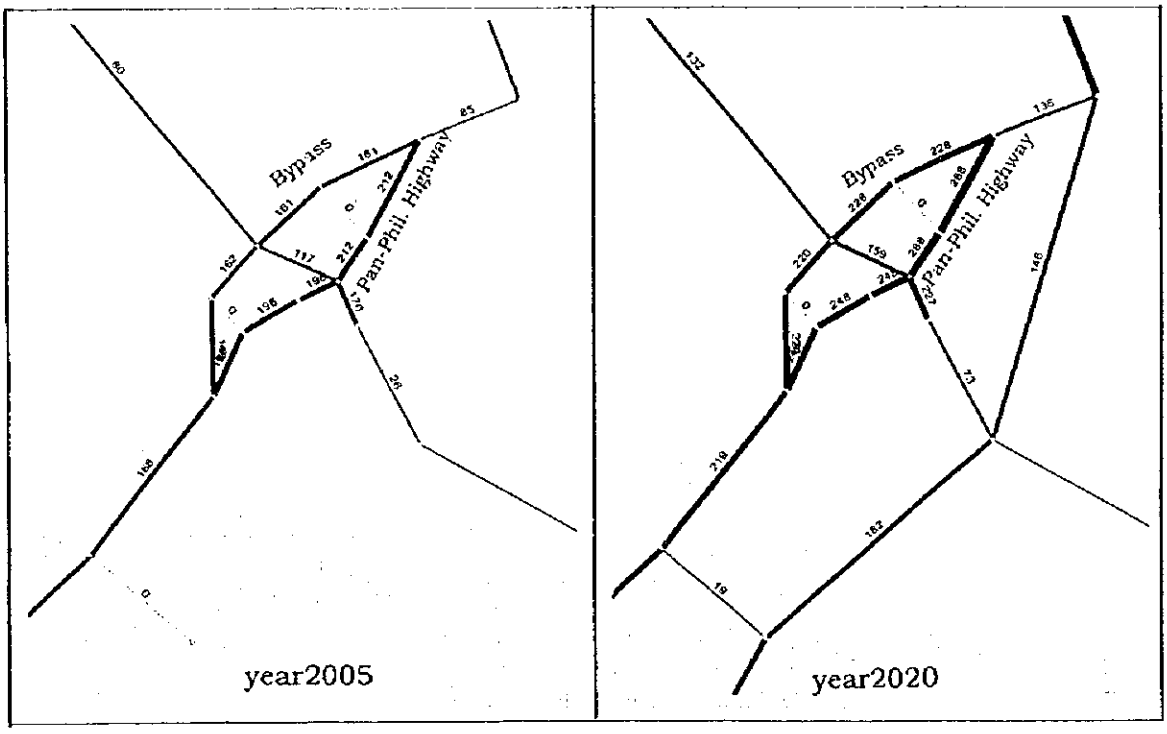
Year	Major Link Condition		Plaridel-Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
2005	2-lane bypass, w/o Expressway	Max.	31,771	32,022	17,534
		Min.	12,584	10,504	14,784
		Average	19,555	22,606	16,157
2010	2-lane bypass, w/o Expressway	Max.	34,936	34,016	22,282
		Min.	15,958	11,097	18,811
		Average	22,587	24,120	20,558
2010	4-lane bypass except San Jose Bypass, w/ Expressway	Max.	35,712	35,344	17,753
		Min.	10,715	10,396	13,709
		Average	20,922	22,298	15,761
2020	4-lane bypass except San Jose Bypass, w/ Expressway	Max.	68,567	53,288	25,152
		Min.	19,877	25,126	19,376
		Average	42,922	36,531	22,457

Note: Max. = Maximum link traffic volume among links of a bypass.
Min. = Minimum link volume among links of a bypass.
Ave. = Average traffic volume of all links of a bypass

ESTIMATED TRAFFIC VOLUME ON PLARIDEL-BALIUAG BYPASS
(Unit:100pcu/day)



ESTIMATED TRAFFIC VOLUME ON CABANATUAN BYPASS
(Unit:100pcu/day)

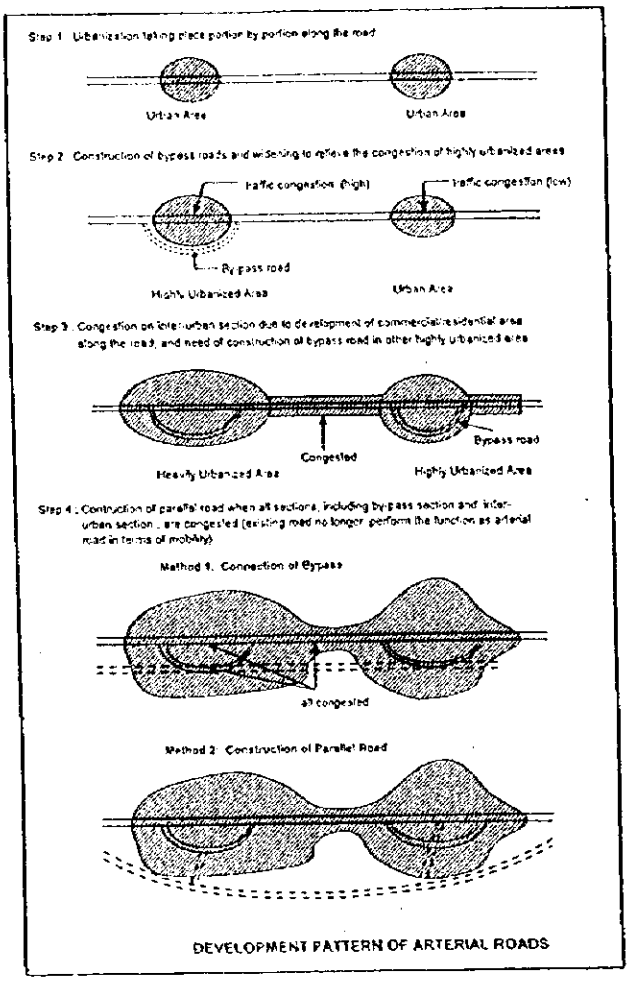


ESTIMATED TRAFFIC VOLUME ON SAN JOSE BYPASS
(Unit:100pcu/day)

6. BASIC ROAD DEVELOPMENT PLAN

DEVELOPMENT PATTERN OF ARTERIAL ROADS

Urbanization in the country has been expanding along major arterial roads, particularly along the Pan-Philippine Highway with no development regulations or control. Hence, urbanization occurs as a natural growth of ribbon type of development along arterial roads. To cope with this urbanization, arterial roads must be developed accordingly. Many of the arterial roads in the country are in the stage of Step-3 shown in the illustration below.



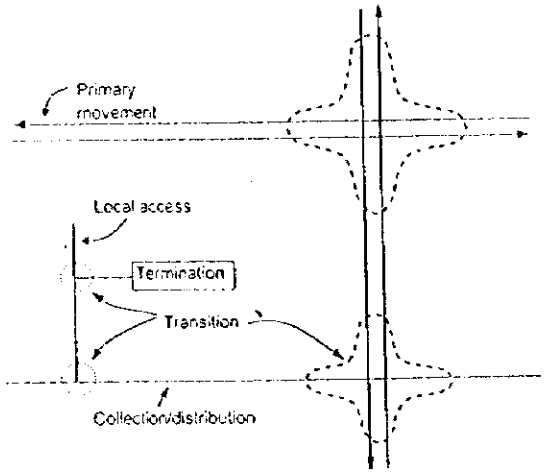
DEVELOPMENT PATTERN OF ARTERIAL ROADS

In the future many of the arterial roads will need to be upgraded. It can be said that road development in the Philippines is now entering a new era, from 2-lane road extension, improvement and rehabilitation, to upgrading of arterial roads. The basic concepts of upgrading are discussed hereunder.

HIGHWAY FUNCTIONS AND CLASSIFICATIONS

Hierarchy of Movement

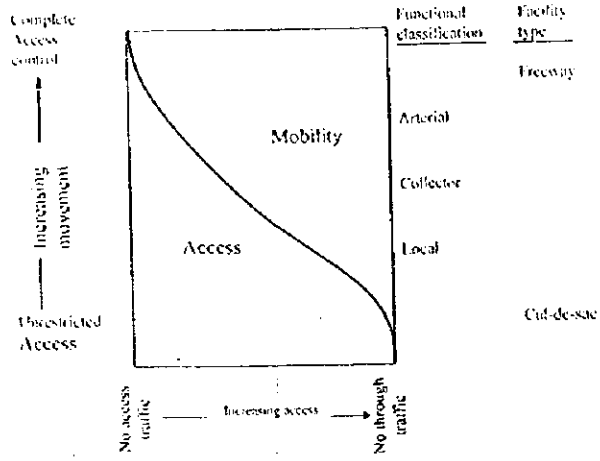
The road network should be planned and constructed that hierarchy of movement, that is primary movement, transition, collection and distribution, access and termination, is achieved.



HIERARCHY OF MOVEMENT IN A FUNCTIONAL CIRCULATION SYSTEM

Functional Classification

A functional system of highways must provide for a gradation of traffic flow from the mobility function to the access function. Arterial roads must be mobility function oriented and the access function needs to be controlled as much as possible.



FUNCTIONAL CLASSIFICATION

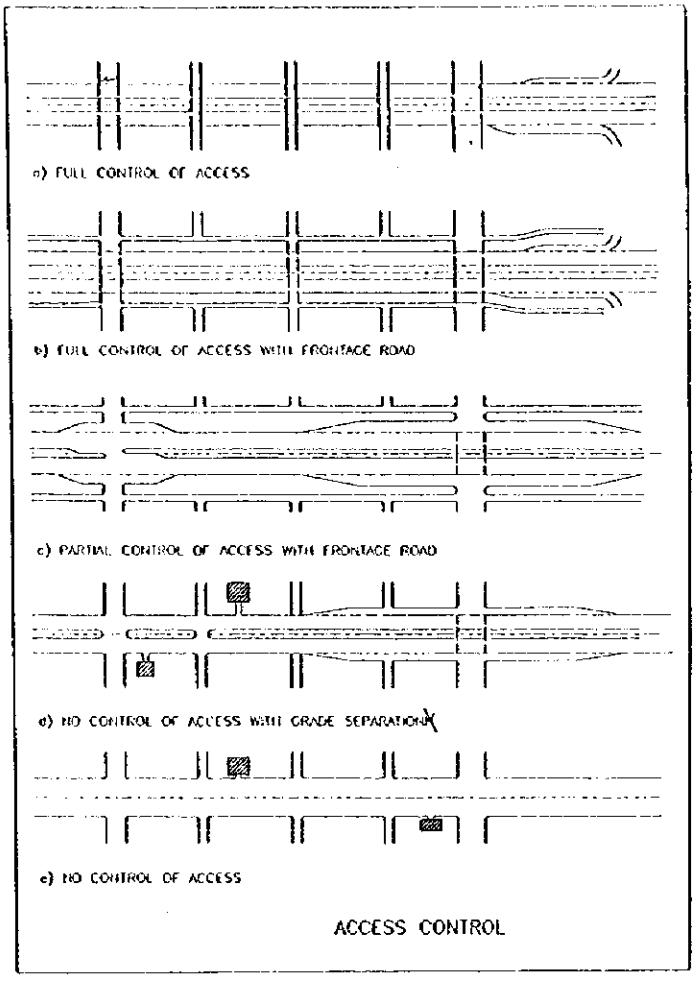
HIGHWAY SYSTEM AND FACILITIES

The transportation system is the basic infrastructure element which influences the pattern of regional and urban development. Throughout history, transportation and land development have been closely bound. Therefore, the development of the future highway system should be planned in such a way that it will support both the specific objectives of the transport sector as well as the general development objectives which include the

regional development and land use development in the influence area.

Access Control

The degree of access control is classified into full control of access, partial control of access and no control of access. Partial control of access is highly desirable on an arterial road.



ACCESS CONTROL

Frontage Road

In order to provide for the two conflicting functions of mobility and accessibility, it is highly recommended that frontage roads should be provided wherever possible.

Main road : To provide mobility for through traffic.

Frontage road: To control access to a main road.
To function as a local street serving adjoining property.

Intersecting Roads

When developing a route as an arterial or expressway, it must determined whether each intersecting road should be terminated or rerouted, or provided with an at-grade intersection, a grade separation or interchange. The chief concern is the continuous flow on the major road. For those cross roads that cannot be terminated, some crossing facilities should be provided. Crossing facilities are important parts of a highway. To a great extent, the efficiency, safety, speed, cost of operation and capacity of the road depend on the location and design of the crossings.

The following lists some of the alternative arrangements for intersecting roads:

- Termination of cross road
- Provision of right turn movement both from arterial and cross road
- Intersection at grade
- Grade separation without ramp
- Interchange

TRAFFIC SAFETY

Improving roads without applying appropriate safety measures is likely to result in a significant increase in both accident rates and accident severity. It is a fact that improved roads encourage drivers to increase their driving speeds thereby increasing the chances of a traffic accident. For upgraded highways, especially in urban areas, the need to separate people from motor traffic becomes essential.

Traffic control devices such as traffic signs, markings and signals should be well designed and placed at proper locations.

ENVIRONMENTAL CONSIDERATIONS

The main environmental problems associated with highways are i) impairment of scenic values / environmental aesthetics, ii) pollution, noise and vibrations, and iii) inadequate maintenance. To cope with these problems, to provide an environmental protection zone is recommended within which tree and plant species can grow successfully in roadside environment.

7 MEASURES FOR UPGRADING HIGHWAY SYSTEM

SECTIONS WHERE URGENT MEASURES REQUIRED

LOS analysis indicated that the following sections require urgent improvement measures:

- Plaridel Urban Section
- Gapan Urban Section
- Cabanatuan Urban Section
- San Jose Urban Section

LOS of inter-urban sections are as follows:

LOS E: Between Baliuag and Gapan
Between Cabanatuan and Talavera

LOS D: Between Gapan and Sta. Rosa
Between Talavera and San Jose

LOS B: North of San Jose Urban Section

Sections with LOS E need urgent improvement measures. Sections with LOS D will require improvement measures in the near future.

PROPOSED HIGHWAY PROJECTS TO BE CONSIDERED

Two highway projects have been proposed in the Study Area. They have almost same alignment.

- Sierra Madre Highway
- North Luzon Expressway East

DEVELOPMENT OPTIONS

After consideration of the urgent improvement requirements and the proposed highway projects, the following two development options were prepared:

Option-1: 2nd Pan-Philippine Highway Development

- Stage 1 : Construction of bypasses at highly urbanized areas.
- Stage 2 : Construction of 2nd Pan-Philippine Highway (4-lane), connecting bypasses constructed under Stage 1. An alignment of 2nd Highway will be close to and almost parallel to the existing Pan-Philippine Highway.

Option-2: Expressway Development

- Stage 1 : Same as Option-1.
- Stage 2 : Construction of an expressway (4-lane). An alignment of an expressway will be far from, but almost parallel to the existing Pan-Philippine Highway.

It is noted that both options may require construction of a local road along the foot of Sierra Madre Mountain Range to boost development in the eastern part of Region III.

It was concluded through a series of discussions with the technical working group, and agreed by the Steering Committee for the Study, that Option-2 was preferable.

Option 2 is consist with the policy of the Philippine Government to enhance the involvement of the private sector and to develop toll systems for road development.

PROPOSED IMPROVEMENT MEASURES

Short Term (2000 – 2005)

1) Construction of bypasses (2-lane)
   - Plaridel-Baliuag Bypass
   - Cabanatuan Bypass
   - San Jose Bypass
2) Enforcement of traffic management
   - Gapan Urban Section
3) Widening of existing Pan-Philippine Highway within the existing road right-of-way
   - Existing road ROW of 15m
     - Addition of exclusive lane for Slow speed vehicles (2x2.65m)
     - Addition of sidewalk (2x1.5m) for urban section or shoulder (2x1.5) for rural section
   - Existing road ROW of 20m
     - Addition of 2 lanes (2x3.35m)
     - Addition of shoulder (2x2.0m)
     - Addition of sidewalk (2x1.3m)
4) Installation of traffic signals at major intersections

Medium Term (2006-2010)

- Widening of bypasses to 4-lanes
- Construction of an expressway (2-lane)

Long Term (2011-2020)

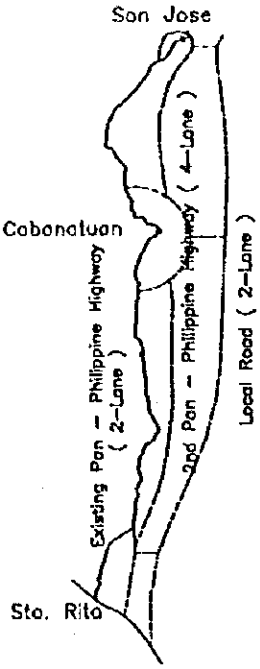
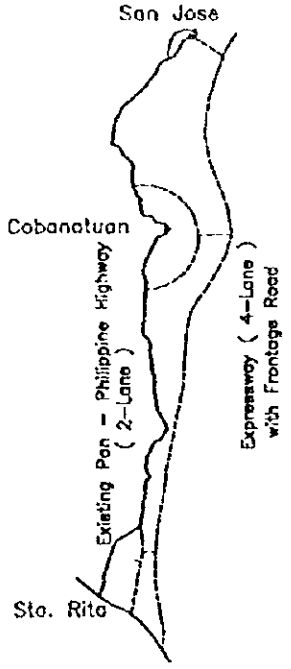
- Widening of an expressway to 4-lanes

Through discussions with the Government officials concerned, it was agreed that the Study should focus on the short term measures, except the widening of the existing Pan-Philippine Highway and installation of traffic signals. This is because acquisition of the road right-of-way and relocation of houses and establishments required for road widening are too sensitive for Central Government to undertake without the positive involvement of LGUs.

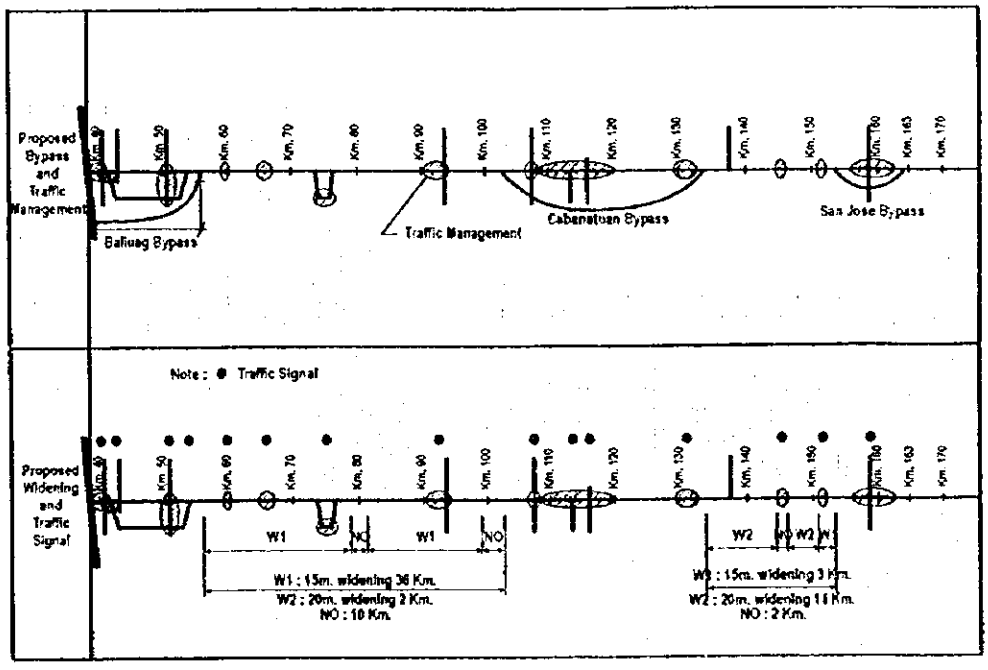
TRAFFIC MANAGEMENT IN GAPAN URBAN SECTION

The following traffic regulation should be enforced:

- Designate direction of traffic in the area
- No parking along Pan-Philippine Highway
- Loading and unloading only in designated areas
- Traffic violation and corresponding penalty

Option	Option 1 2nd Pan – Philipine Highway (Traffic and Regional Development Oriented)	Option 2 Expressway (Traffic and Regional Development Oriented)
Schematic Diagram		
Desired Implementation Schedule	• • Bypass ; 2005 • 2nd Pan – Philippine Highway – 2–Lane ; 2010 – Widening to 4–Lane ; 2020 Local Road (2–Lane) ; Depending on Regional Development	• Bypass ; 2005 • Expressway – 2–Lane ; 2010 – Widening to 4–Lane ; 2020

DEVELOPMENT OPTIONS



RECOMMENDED SHORT TERM IMPROVEMENT MEASURES

8 ALTERNATIVE BYPASS ROUTES AND SELECTION OF THE BEST ROUTE

ALTERNATIVE BYPASS ROUTES

Using the following planning concepts, several alternative routes were selected for each bypass.

Plaridel – Baliuag Bypass

Route-1: (22.5 km)
- New interchange between Bocaue I/C and Wawa Junction.
- Shortest linkage with Metro Manila.
- To provide direct access to proposed Guiguinto Industrial area.

Route-2: (22.0 km)
- Existing Wawa Junction is to be converted to an interchange.
- Second shortest linkage with Metro Manila.
- To provide better access to proposed Plaridel industrial area and Baliuag Urban Center.

Route-3: (20.3 km)
- Almost the same concept as Route-2, except that a new interchange is provided between Wawa Junction and Sta. Rita I/C.

Route-4: (16.8 km)
- The only route considered that is west of the existing Pan-Philippine Highway.
- To use the existing Pulilan I/C.
- Though this route provides the longest link to Metro Manila, a bridge over the Angat River can be avoided.

Cabanatuan Bypass

Route-1: (35.0 km)
- To be provided at the outer most area of future urban development, thus avoiding the proposed urban area.
- To follow the proposed outer circumferential road proposed by the City Government of Cabanatuan, thus Talavera Urban Center is not bypassed.
- Future connection with Sierra Madre Highway (or NLEE).

Route-2: (29.5 km)
- To bypass three urban centers, Sta. Rosa, Cabanatuan and Talavera.
- To be provided on the outside existing urban area, but pass through the middle portion of the future urban area.
- To follow the inner circumferential road proposed by the City Government.
- Accessibility to the Cabanatuan Urban Center.

Route-3: (24.0 km)
- Almost the same concept as Route-2, except that it ends before Talavera Urban Center.

Route-4: (19.5 km)
- To be provided on the western side of Cabanatuan Urban Center and Pampanga River.
- The route is intended for mainly Cabanatuan City through traffic.
- Due to Pampanga River and the heavily built-up Urban Centers, access from the Bypass to Cabanatuan Urban Center is difficult.

San Jose Bypass

Route-1: (9.0 km)
- To be located on the eastern side of the existing Pan-Philippine Highway.
- To provide direct access to the proposed industrial area.

Route-2: (6.5 km)
- To be located on the western side of the existing Pan-Philippine Highway.
- The route will delineate the border of the future urban center.

EVALUATION AND SELECTION OF BEST ROUTE

All alternative routes were evaluated from the following viewpoints:

Technical Evaluation
- Interchange location
- Geometry
- Efficiency of bypass
- Accessibility to urban centers
- Harmony with existing road network
- Construction difficulty

Developmental Evaluation
- Compatibility with City Development Plan
- Compatibility with Provincial Development Plan
- Services to Private Development Plans

Environmental Evaluation
- Existing natural environment
- Socio-economic environment
- Number of houses affected
- ROW acquisition

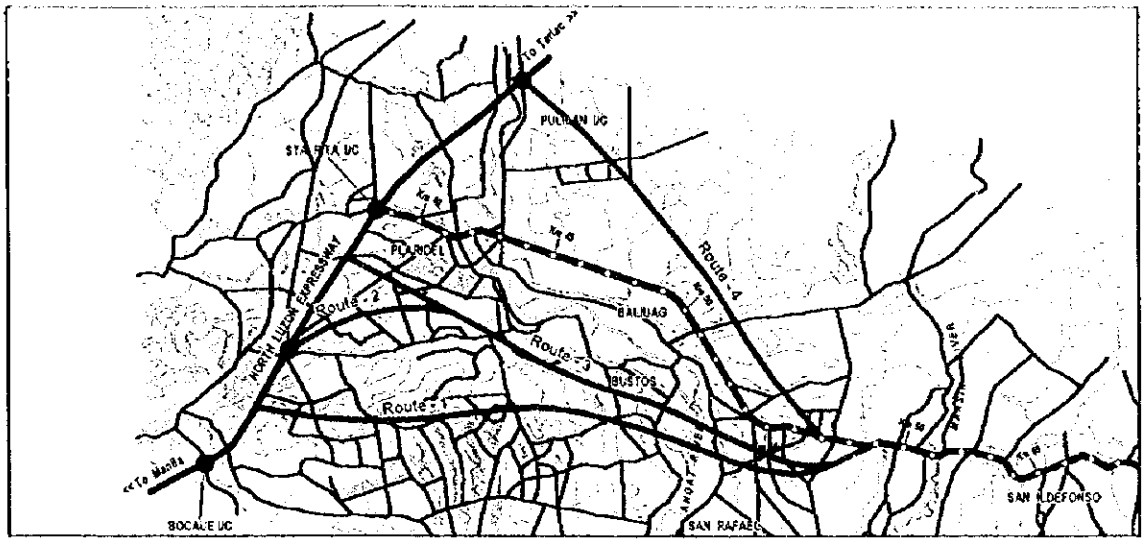
Economic and Financial Evaluation
- Financial aspect
- Social aspect
- Economic aspect

Results of evaluation were as follows:

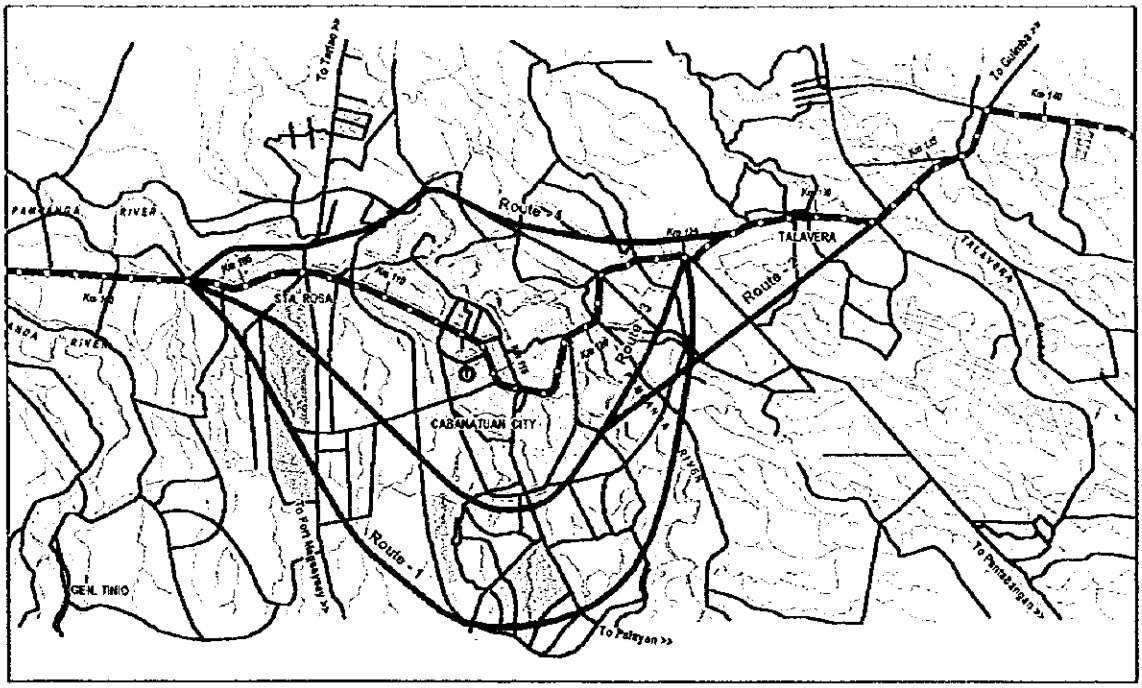
Rank	Plaridel-Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
1	Route-2	Route-2	Route-2
2	Route-3	Route-3	Route-1
2	Route-4	Route-4	-
4	Route-1	Route-1	-

Note: Routes 3 and 4 were evaluated to be equal and ranked 2nd.

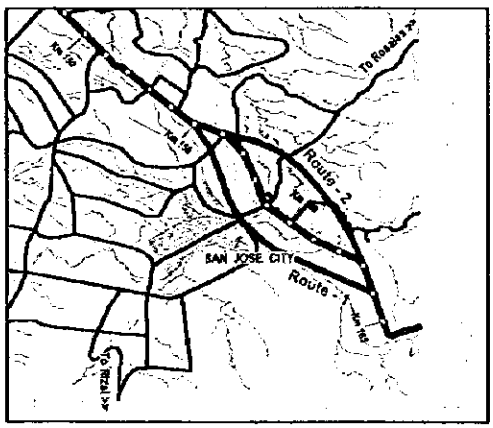
Route-2 was selected as the best for all bypasses.



PLARIDEL - BALIUAG BYPASS ALTERNATIVE ROUTES



CABANATUAN BYPASS ALTERNATIVE ROUTES



SAN JOSE BYPASS ALTERNATIVE ROUTES

LEGEND :

- Existing Pan-Philippine Highway
- Existing Expressway
- Existing Road
- Proposed Bypass Route Alternatives

Future Land Use

- Commercial Area
- Residential Area
- Industrial Area
- Institutional Area

9 PRELIMINARY ENGINEERING DESIGN

DESIGN CONCEPT

The mobility oriented highway design was developed with due consideration for the expected urbanization, attraction of traffic to the bypass, harmony with local traffic, provision for divided communities and agricultural lands by the bypass, environment, traffic safety and minimization of adverse social impacts.

DESIGN STANDARDS

Highway Geometric Design Standards

Design Element	Geometric Design Standards	
Design Speed	80 km/ hour	
Cross-sectional Elements		
Lane width	3.5m	
Shoulder width	2.5m	
Cross Fall – Carriageway	1.5%	
- Shoulder	2.0%	(Plaridel-Baliuag Bypass)
Center median width	2.0m	Bypass)
	5.0m	(Cabanatuan
Frontage road width (one way)	5.5m	Bypass)
Sidewalk	3.0m	
Design Elements		
Minimum horizontal radius	280m	
Minimum horizontal curve length	140m	
Maximum super-elevation	10%	
Maximum vertical grade	4%	
Non-passing sight distance	115m	
Passing sight distance	560m	

Bridge Design Standards

Standards adopted : AASHTO Standard Specification for Highway Bridges, 16th Edition.
Live Load : MS 20-44
Free Board : Minimum 1.5m

Pavement Design

Standards adopted : AASHTO Guide for Design of Pavement Structures, 1993.
Type of Pavement : Determined based on the Life-Cycle Cost Analysis

Standard Cross-Section

Plaridel – Baliuag Bypass

Most of the areas along the Bypass are designated as agricultural land under the future land use plan. In limited areas, the road passes through existing and future residential land that is mostly located at the intersections with the existing roads. Thus, the bypass can be divided into the populated area and the non-populated area. The frontage road was proposed for the populated areas. A 45 meter wide road right-of-way was proposed.

Cabanatuan Bypass

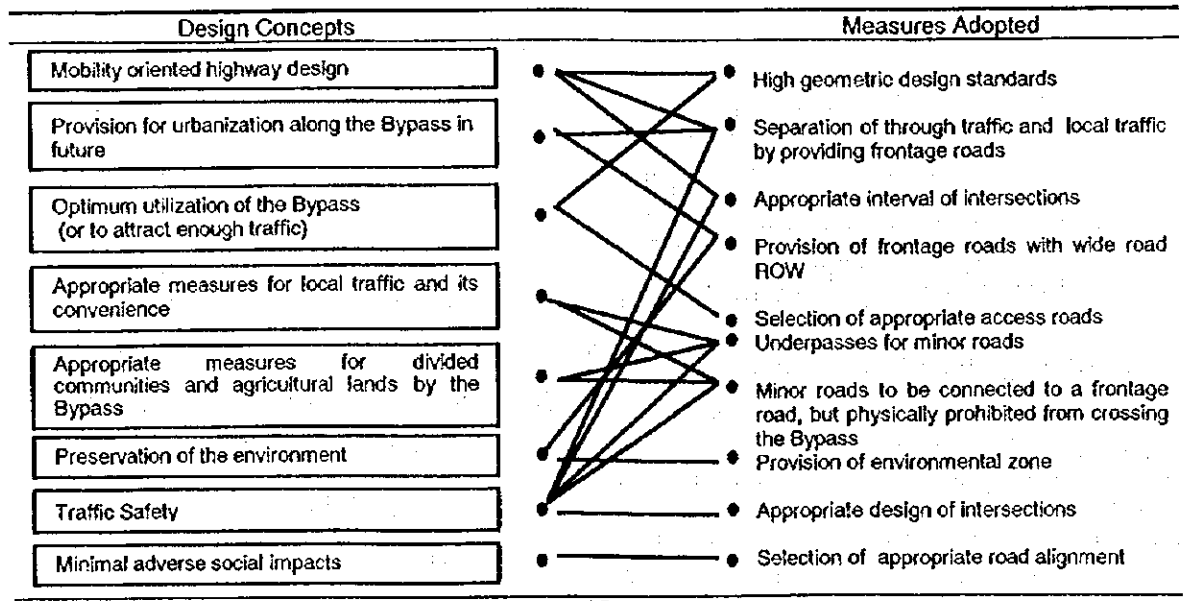
The Bypass is planned to lie along the fringe of future residential areas, but industrial areas and institutional area are planned outside the bypass route. Thus, the bypass is located within the planned urban area of Cabanatuan City, where the frontage road was planned to be provided.

The section between Cabanatuan City and Talavera (on the northern side of the Pampanga River) is located on the outskirsts of the planned urban area and the area is designated as agricultural land, thus, a frontage road is not needed yet. A 52 meter wide road right-of-way was proposed.

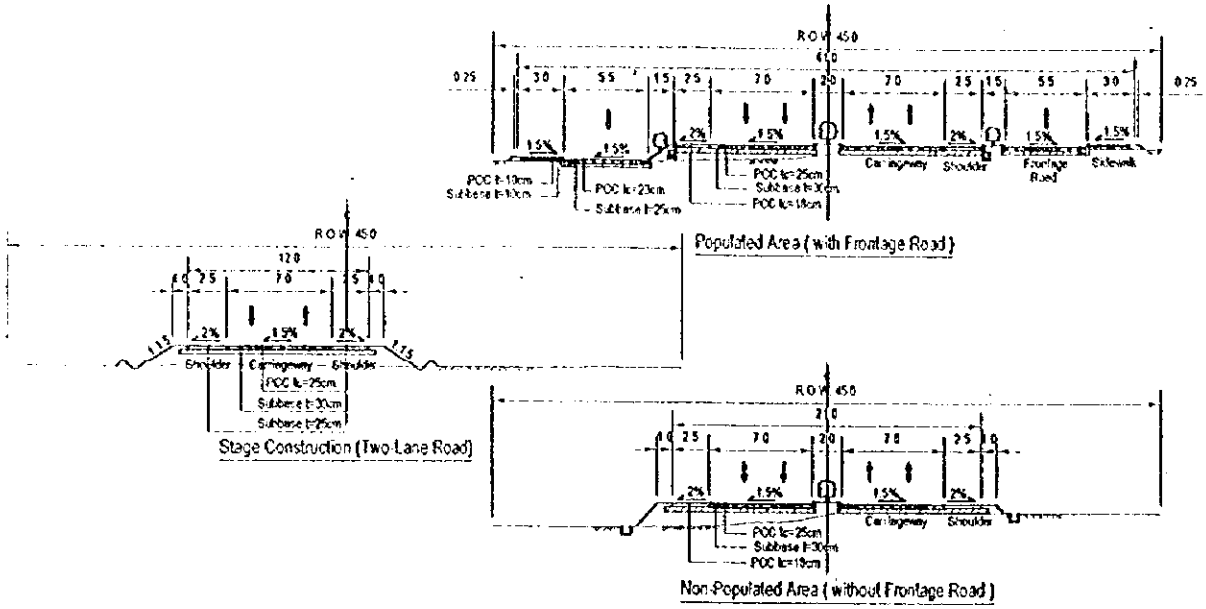
San Jose Bypass

The Bypass is planned to lie along the fringe of future residential areas and passes along the foot of the mountains, thus a frontage road is not necessary, instead a bike is required.

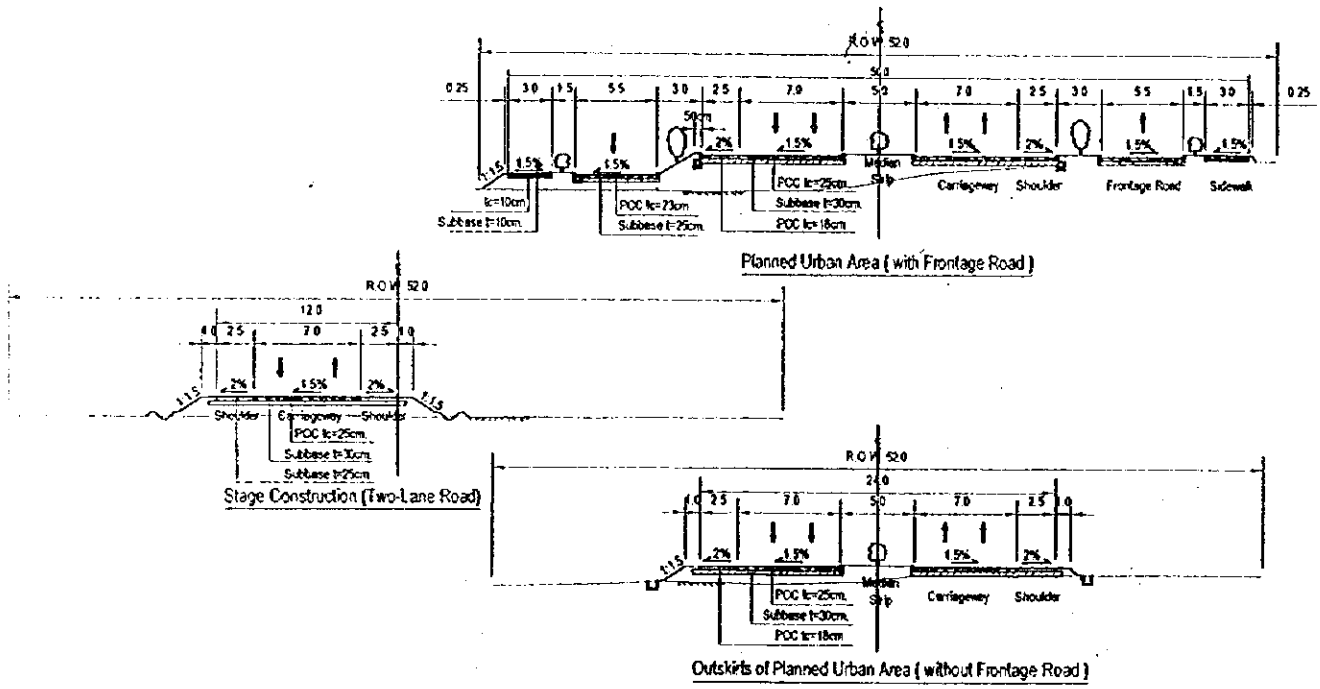
HIGHWAY DESIGN



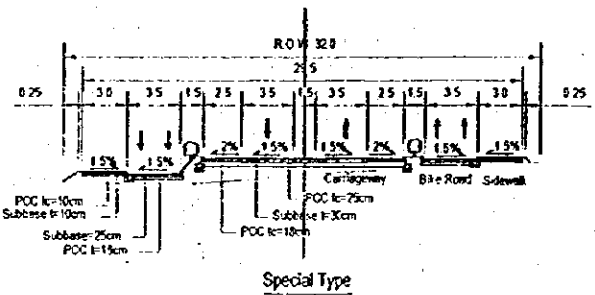
PHASE 1 CONSTRUCTION	PHASE 2 CONSTRUCTION



PLARIDEL-BALIUAG BYPASS



CABANATUAN BYPASS



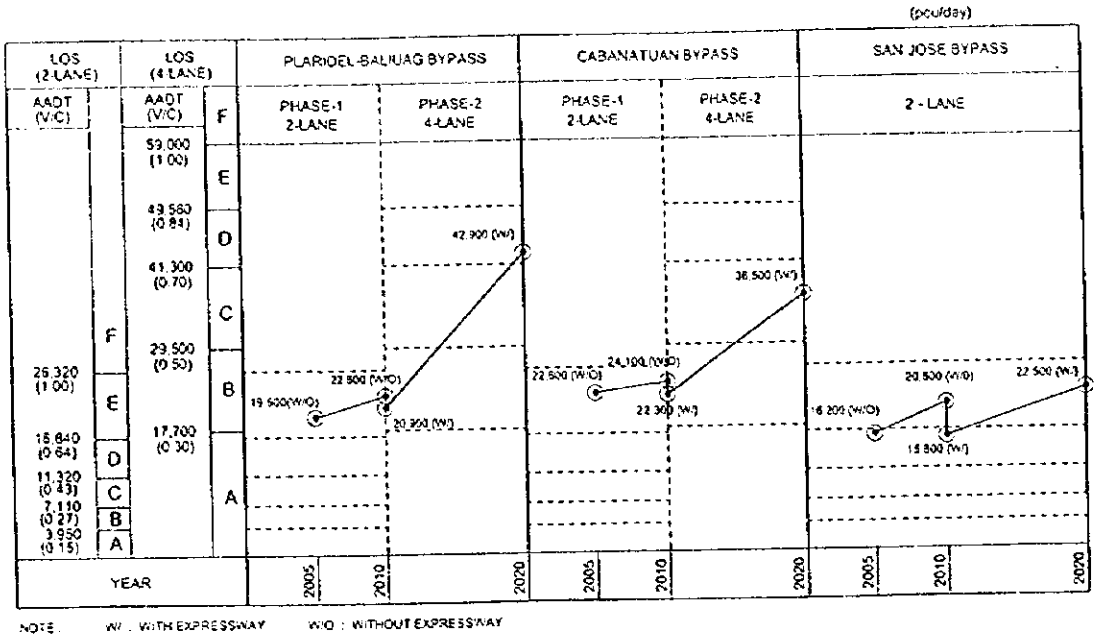
SAN JOSE BYPASS

STANDARD CROSS SECTION OF EACH BYPASS

NUMBER OF LANES

Based on the estimated traffic volume on the bypass, the number of lanes was estimated. Preferably, the Plaridel – Baliuag Bypass and the Cabanatuan Bypass should be 4 lanes from the initial stage. However, due to financial constraints both have been proposed as 2 lanes in Phase-1, to be widened to 4 lanes in Phase-2.

	No. of Lanes	
	Phase-1 (2005-2010)	Phase-2 (2011-2020)
Plaridel-Baliuag Bypass	2-lane	4-lane
Cabanatuan Bypass	2-lane	4-lane
San Jose Bypass	2-lane	2-lane

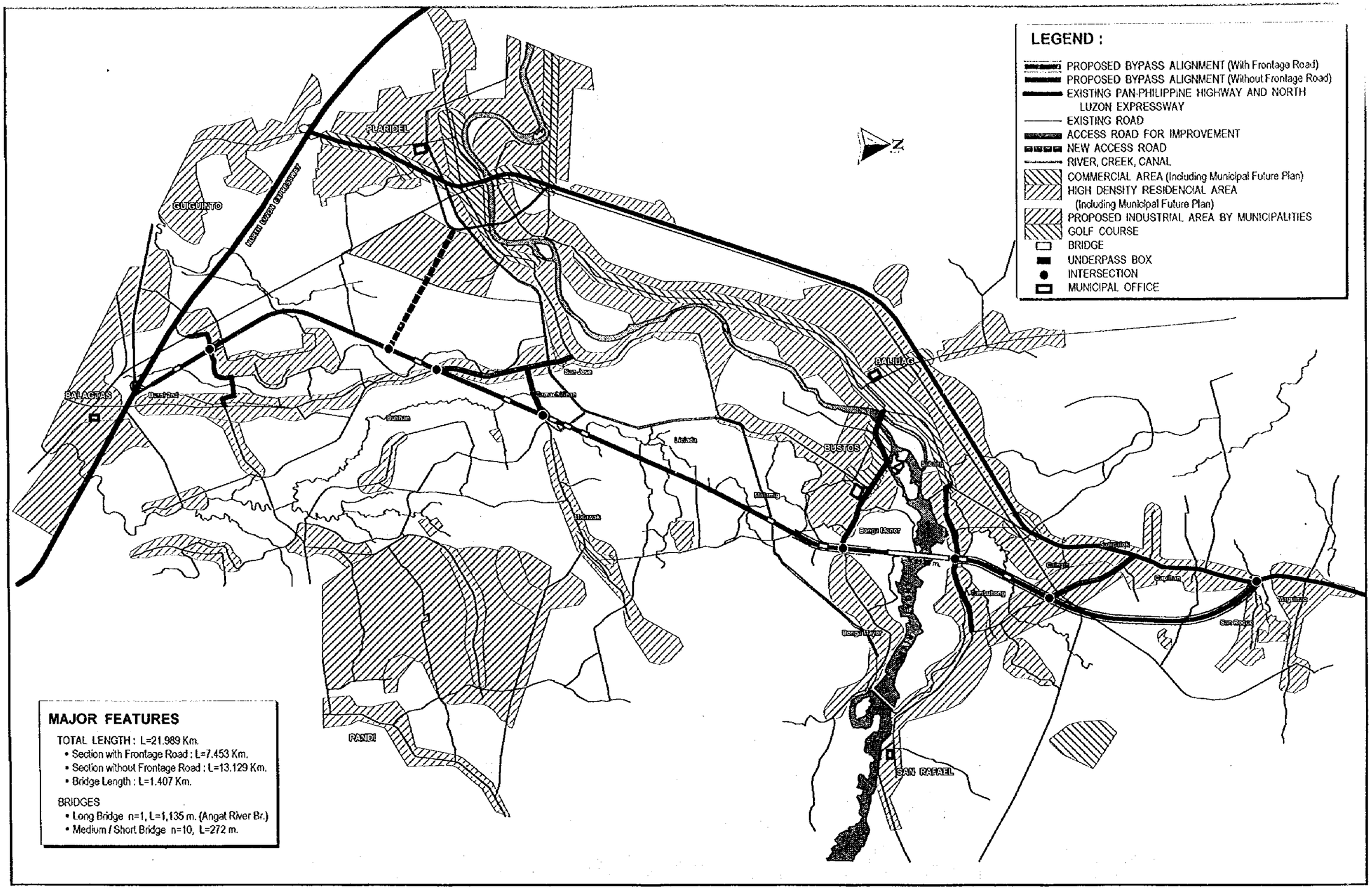


ESTIMATED BYPASS TRAFFIC AND LEVEL OF SERVICE

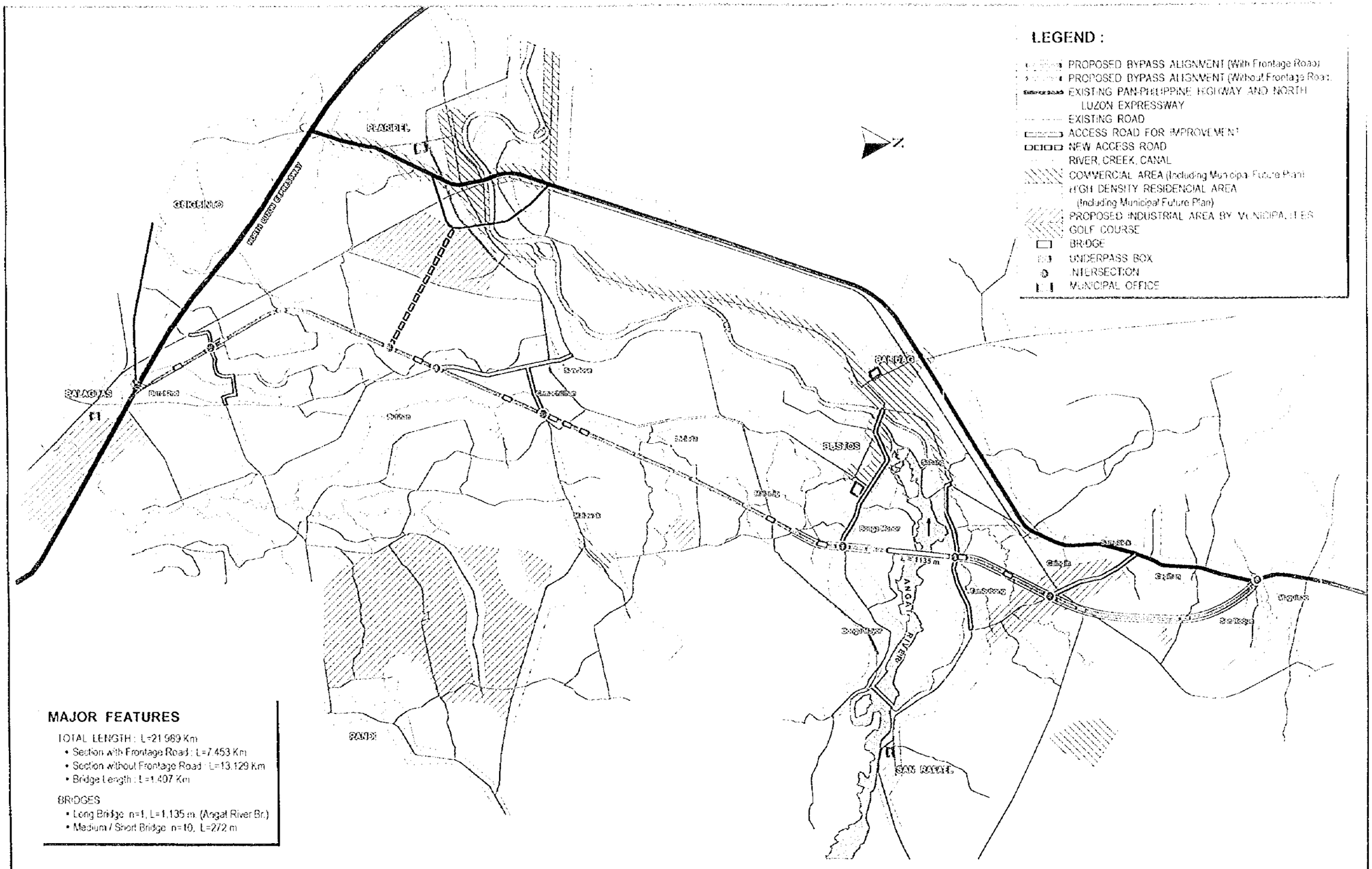
MAJOR FEATURES OF BYPASSES

Major Features	Plaridel - Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
1) No. of lanes Phase 1	2-lane	2-lane	2-lane
Phase 2	4-lane divided	4-lane divided	2-lane
2) Total length	21.989 km	30.351 km	7.31 km
• Section with Frontage Road (*)	7.453 km	15.8 km	-
• Section w/o Frontage Road	13.129 km	12.406 km	-
- Roadway Section Sub-total	20.582 km	28.206 km	7.208 km
• Bridge length	1.407 km	2.145 km	0.102 km
- Long Bridge	n=1, L = 1,135m	n=2, L = 1,625m	-
- Medium / Short Bridges	n=10, L = 272m	n=15, L = 520m	n=2, L = 102m
3) Road ROW Width	45 m	52 m	32 m
4) Interchange	n = 1	-	-
5) Intersecting Roads			
• Major intersection	n = 8	n = 14	n = 7
• Underpass	n = 10	n = 3	n = 0
• Access to frontage road	n = 5	n = 6	-
6) Access roads	n = 7, L = 14.73 km	n = 5, L = 13.23 km	n = 2, L = 3.5 km
7) Cross drainage facilities (RCBC/RCPC)	n = 73	n = 93	n = 23

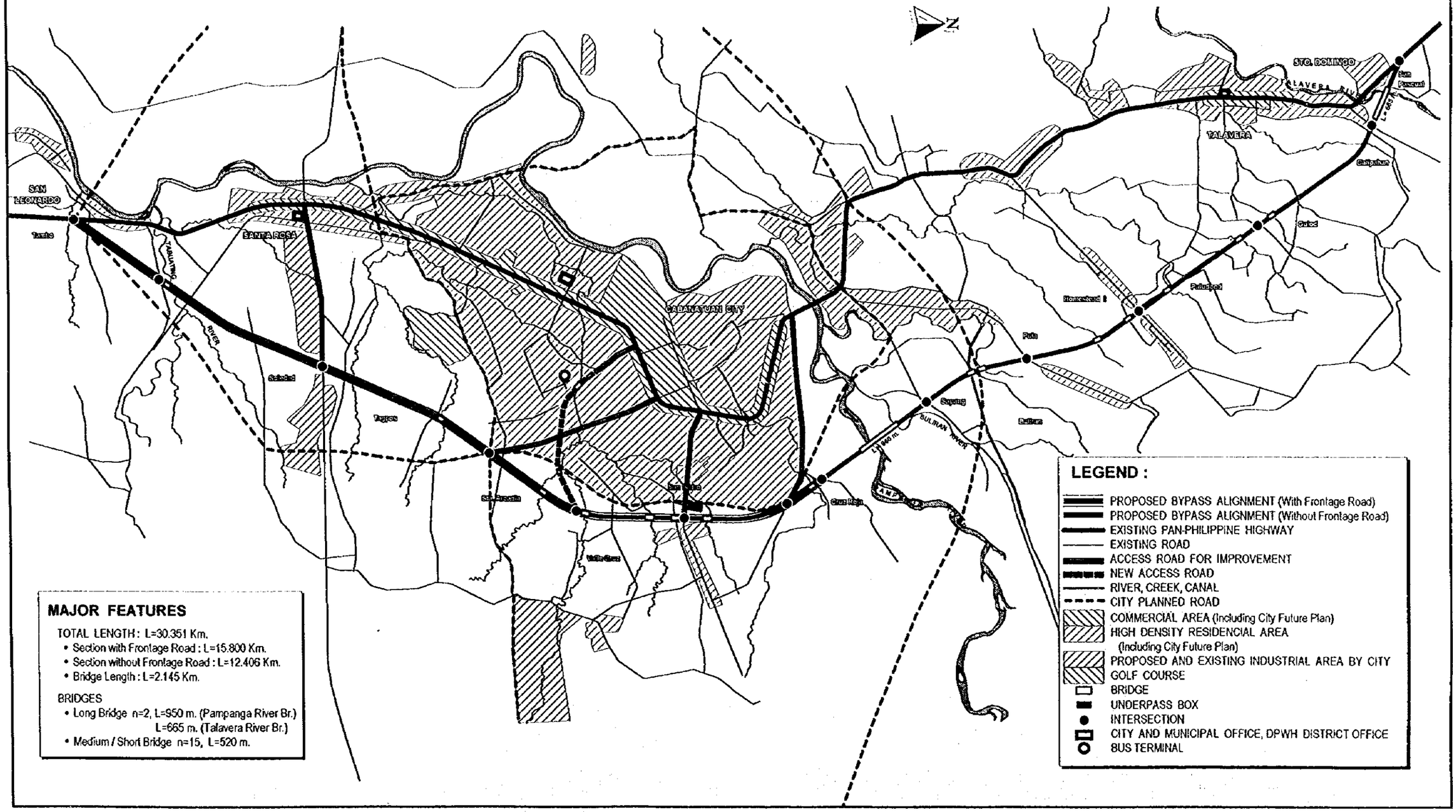
(*) Phase-2.



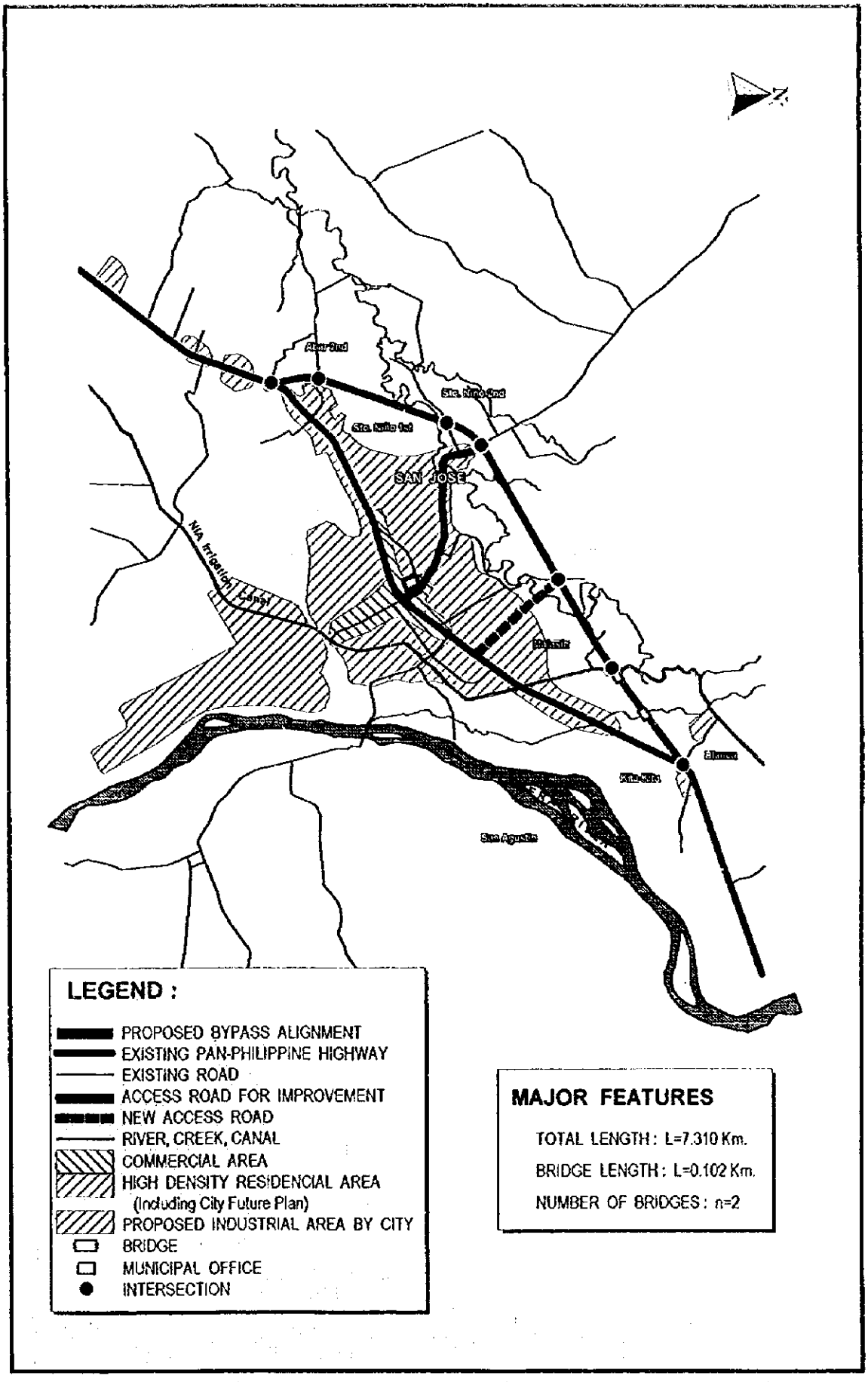
PROPOSED PLARIDEL-BALIUAG BYPASS



PROPOSED PLARIDEL-BALIUAG BYPASS



PROPOSED CABANATUAN BYPASS



PROPOSED SAN JOSE BYPASS

10. PROJECT COST ESTIMATE

The total project cost was estimated at 9,398 million pesos made up of 4,957.5 million pesos for Phase-1 and 4,440 million pesos for Phase-2.

The construction cost was high when compared with an ordinary road due to the long bridges required. For Plaridel-Baliuag Bypass, the bridge construction cost in Phase-1 and Phase-2 was 48% and 49% respectively. For Cabanatuan Bypass, the share was 52% in Phase-1 and 39% in Phase-2.

The road right-of-way acquisition and compensation cost was estimated from the current prevailing market prices. All road right-of-way should be acquired in Phase-1.

In order to determine the exact road right-of-way, the detailed engineering design of the entire project should be undertaken at the beginning of the Project (or in Phase-1). At the beginning of Phase-2, it should be reviewed and updated.

Plaridel-Baliuag Bypass

(Unit: Million Pesos at 1999 Prices)

	Phase-1	Phase-2	Total
Detailed Design	101.04	24.54	125.58
ROW Acquisition	380.62	-	380.62
Construction	1,680.17	1,669.55	3,349.72
Const. Supervision	134.40	133.56	267.96
Total	2,296.23	1,827.65	4,123.88

Cabanatuan Bypass

(Unit: Million Pesos at 1999 Prices)

	Phase-1	Phase-2	Total
Detailed Design	122.52	33.29	155.81
ROW Acquisition	156.95	-	156.95
Construction	1,742.98	2,388.48	4,131.46
Const. Supervision	139.44	191.08	330.52
Total	2,161.89	2,612.85	4,774.74

San Jose Bypass

(Unit: Million Pesos at 1999 Prices)

	Phase-1	Phase-2	Total
Detailed Design	16.84	-	16.84
ROW Acquisition	28.04	-	28.04
Construction	420.86	-	420.86
Const. Supervision	33.67	-	33.67
Total	499.41	-	499.41

TOTAL PROJECT

(Unit: Million Pesos at 1999 Prices)

	Phase-1	Phase-2	Total
Detailed Design	240.40	57.83	298.23
ROW Acquisition	565.61	-	565.61
Construction	3,844.01	4,058.03	7,902.04
Const. Supervision	307.51	324.64	632.15
Total	4,957.53	4,440.50	9,398.03

UNIT COST OF LAND ACQUISITION AND COMPENSATION

	Item		Praridel-Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
UNIT	Land Acquisition				
	Agricultural Land	(P/m^2)	150 – 350	40 – 45	40
	Residential Land	(P/m^2)	540 – 2,000	300 – 800	550 - 800
	Compensation				
	Piggery	(P/ha)	1,910	1,910	-
	Poultry	(P/m^2)	1,910	1,910	-
	Concrete House	(P/m^2)	5,400	4,535	4,535
	Semi Concrete House	(P/m^2)	4,760	3,485	3,485
	Light Material House	(P/m^2)	2,300	2,375	2,370
AREA OF ROAD	Each Bypass		L = 20.582km B = 45.0m A = 92.62ha	L = 28.206km B = 52.0m A = 146.67ha	L = 7.208km B = 32.0m A = 23.07 ha
	New Access Road		L = 2.48km B = 30.0m A = 7.44ha	L = 2.95km B = 30.0m A = 8.85ha	L = 1.25km B = 30.0m A = 3.75 ha

Source: Municipal/City Assessor's Office in the Study area

11. ECONOMIC EVALUATION

METHODOLOGY

Cost-benefit analysis was used to evaluate the economics of the bypass project. Benefit is defined as the savings in total transport cost (VOC +TTC) accrued by the Project. The economic project life is taken as 30 years and 15% is used for the economic discount rate.

IMPACT ON TRAFFIC

In 2005, the average running speed for all trips assigned on the road network will be 16.2 Km/hr at peak times and 41.5 Km/hr or other times. These speeds will be improved by the bypasses to 18.0 Km/hr and 44.7 Km/hr, respectively. Without the project, increasing traffic congestion will reduce the speed in 2020 to 12.3 Km/hr during peak times. The bypass project will recover the average speed to 14.5 Km/hr. If the bypasses are implemented individually, Cabanatuan bypass will contribute more to travel speed recovery than the others.

Improvement of Average Speed

(km/hr)

Bypass	2005		2020	
	Peak	Average	Peak	Average
Without Project	16.2	41.5	12.3	40.3
Plaridel-Baliuag	17.3	42.7	13.1	42.1
Cabanatuan	17.4	43.4	13.8	42.7
San Jose	16.9	42.0	12.6	41.2
Entire Project	18.0	44.7	14.5	43.5

ECONOMIC COST OF THE PROJECT

The financial cost stated in the previous section was converted to the economic cost by deducting tax and applying the shadow wage rate (85% of market price) to the unskilled labor cost within the project. The total financial cost of 9.4 billion pesos is equivalent to 8.0 billion pesos in economic cost. The ratio of economic to financial cost is 85.3%. Annual maintenance cost will be increased by 15 million pesos due to the implementation of the three bypasses.

Financial and Economic Cost of Project

(million pesos at 1999 price)

Project Component	Financial Cost	Economic Cost
Plaridel-Baliuag Bypass	4,123.9	3,539.9
Cabanatuan Bypass	4,774.7	4,054.2
San Jose Bypass	499.4	426.6
Total	9,398.0	8,020.7

ECONOMIC BENEFIT

The economic benefit of the three bypasses is estimated at 244 million pesos in 2005 (half of the amount is accounted in the cash flow because the opening of the bypasses is scheduled for mid- 2005). Thereafter, it will increase rapidly, reaching 5.3 billion pesos in 2020. Approximately, 20 to 25% of the benefit is savings of vehicle operating cost (VOC) and the rest is savings in passengers' travel time cost (TTC).

Economic Benefit

(million pesos p.a.)

year	Savings in		Total Benefit
	VOC	TTC	
2005	65	179	244
2010	417	1,266	1,683
2020	1,030	4,277	5,307

EVALUATION RESULT

The bottom figure on the next page shows the cash flow of cost and benefit. Calculating evaluation indicators based on this cash flow, the IRR of the project is estimated at 22%, NPV at 2.37 billion pesos and B/C ratio at 1.7, all of which show a very high economic return. Each bypass was evaluated individually by assuming that only one bypass is implemented and that the other two are never completed. On this basis, the IRR of Plaridel-Baliuag bypass is 25%, Cabanatuan bypass 20% and San Jose bypass 29%. All the component bypasses are highly feasible economically.

The expressway has a major impact on the benefits to be obtained from bypass project. For evaluation purposes, the expressway is assumed to open in 2010. If it is never realized, the benefit of the bypass will increase enormously and the IRR of the bypass project will be extraordinarily high at 38%.

Summary of Evaluation Result

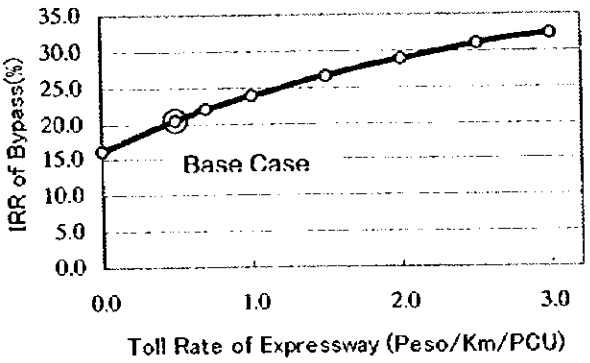
Project Component	IRR (%)	NPV (Mill. Peso)	B/C -
Entire Project (w/Expwy)	22.0	2372.1	1.7
Entire Project (w/o Expwy)	37.6	18739.8	6.4
Plaridel-Baliuag Bypass	24.6	1479.4	1.9
Cabanatuan Bypass	20.2	962.8	1.6
San Jose Bypass	28.6	392.2	2.5

TOLL RATE AND IRR OF BYPASS

Because of its high speed service, construction of the expressway parallel to the bypass affects economic feasibility of the bypass more than it affects the traffic volume on the bypass. Due to toll resistance, traffic volume on the expressway is less than that on the bypass. However, the reduction in total travel time is much larger on the expressway than on the bypass.

In this Study, a toll rate of 0.7 peso/Km per pcu has been assumed. By changing this rate, demand for the expressway and hence demand for the bypass will be varied. Thus, the economic feasibility of the bypass is affected by the toll rate.

The figure below shows the relation between the toll rate and IRR of the bypass. If the expressway is free of charge, demand for the bypass is lowest and the IRR reduces to 16.2%. As the toll rate rises, demand for the expressway decreases and bypass IRR rises. If the toll is infinite, no one will use the expressway and the bypass IRR will reach 37.6% as in the previous table.



Toll Rate of Expressway and IRR of Bypass

Although the bypass IRR is affected by the expressway toll rate, it should be noted that even if the expressway were free of charge, the bypass project would be still economically feasible.

FUND PROCUREMENT

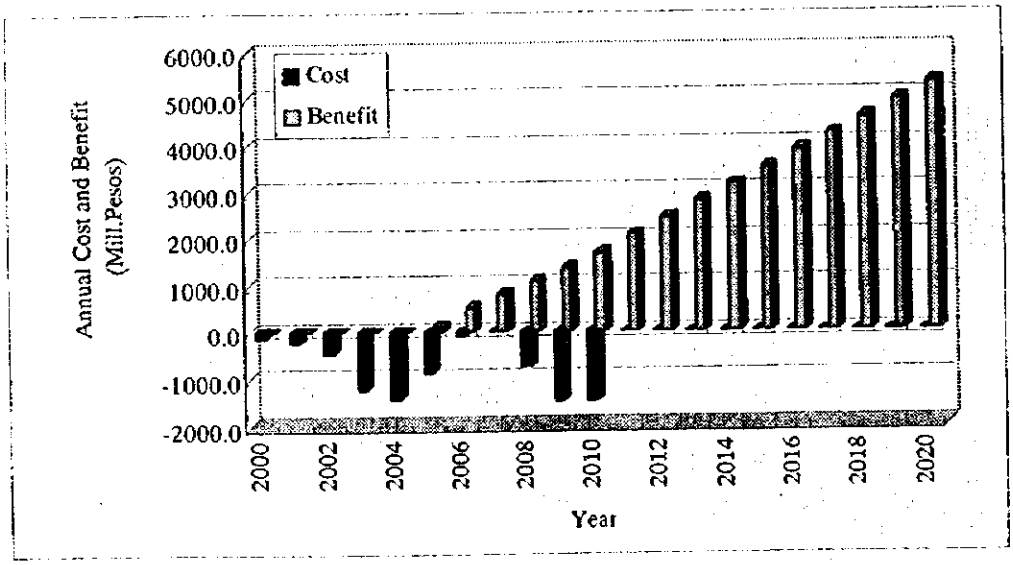
One of the basic policies of the current Philippine Government is the "Beneficiaries Pay". The following funding measures apply this principle.

(1) Toll Bypass

If, for a certain period, a toll is charged to use the bypass and the toll revenue can be used for amortization as well as for maintenance of the road. If users are charged, for example, 5 pesos/ pcu for the first fifteen years, the accumulation of toll revenue would be 1.6 billion pesos for Plaridel-Baliuag bypass, 1.4 billion pesos for Cabanatuan bypass and 0.7 billion pesos for San Jose bypass.

(2) Development Tax along Bypass

The bypasses will boost nearby urban development. If a development tax is charged, part of the development benefit can be used to pay for part of construction cost of a bypass. If a special tax of 100 pesos per square meter was imposed on all urban development within the area of 500m each side of the bypass, the maximum tax revenue of 2.0 billion pesos is expected to Plaridel-Baliuag bypass, 2.8 billion pesos to Cabanatuan bypass and 0.5 billion pesos to San Jose bypass.



Cash Flow of Cost and Benefit of the Bypass Project

12. ENVIRONMENTAL IMPACT ASSESSMENT

PROJECT CLASSIFICATION

The proposed bypasses are to be built on newly acquired lands, thus the Projects are classified as "Environmentally Critical Projects". An EIA must be undertaken and an ECC must be obtained.

SOCIO-ECONOMIC ENVIRONMENTAL IMPACTS

The following factors were assessed as moderate negative impacts:

- Displacement of communities
- Loss of and/or damages to means of livelihood.

Displacement of Communities

Number of affected families were estimated as follows:

	Number of Houses (Families)	
	Legal Occupants	Informal Settlers
Plaridel-Baliuag Bypass	70 (107)	4 (8)
Cabanatuan Bypass	43 (60)	none
San Jose Bypass	6 (14)	none
Total	119 (181)	4 (8)

For affected legal occupants, the Government must ensure that they are properly compensated for loss of land and improvements. If they wish to be provided with a resettlement site, the Government should do its utmost effort to comply with their request.

For affected informal settlers, the Government through the help of concerned LGUs must provide a sustainable resettlement site with all basic social services. Also, the Government must implement a sound Social Development Program (SDP) so as to assure that their livelihood can be sustainable.

Two possible resettlement sites were identified. One is located at Barrio Matictic, Norzagaray in Bulacan Province. The other is located at Bakod Bayan in Cabanatuan City.

Loss of and/or Damages to Means of Livelihood

Most of farmers along the proposed bypasses rely on rice production as their means of livelihood. Loss of and/or damage to these agricultural lands will hamper their capacity to support their families. Tenant-farmers are most affected.

A parcellary survey must be undertaken during the detailed engineering design stage to identify the number of legal occupant farmers and tenant-farmers.

For legal occupant farmers, the Government must ensure that they are properly compensated at replacement cost.

For tenant-farmers, the Government must ensure that they are paid disturbance compensation equivalent to five times the average of the last five-year gross harvests. The Government should also implement a sound SDP for them.

The following factors were assessed to be high positive impacts during the operation phase:

- Improved accessibility to basic social services such as schools, hospitals, public markets, etc.
- Reduction of transport costs due to improved traffic flow.
- Better flow of agricultural and agro-industrial commodities from the farm to market.
- Sound urbanization and commercial development of non-agricultural and non-prime agricultural areas.
- Increase in land values of area traversed by and in the vicinity of a bypass.
- Increase in employment opportunities as a result of commercial and industrial development.

NATURAL ENVIRONMENTAL IMPACTS

No significant negative impact on the natural environment was assessed, since the bypasses traverse cultivated or developed areas. The proposed alignments were selected to avoid a historical site (there is one in Bustos) and religious institutions. All protected areas such as watershed forest reserves and national parks are located far away from the proposed bypasses.

POLLUTION

No significant negative impacts on air quality, vibration and water quality were assessed. During the operation stage, high positive impacts were assessed along the existing Pan-Philippine Highway due to the reduced traffic.

ENVIRONMENTAL MANAGEMENT PLAN

The environmental management plan should contain the following:

- Institutional Plan
- Information, Education and Communication Program
- Environmental Monitoring Program

13. MAINTENANCE AND MANAGEMENT STRATEGY

MAIN OBJECTIVES OF ROAD MAINTENANCE

- To provide comfortable, safe, efficient and reliable facilities for road users.
- To prevent premature deterioration and to prolong the life of the road structure, thus protecting the road from costly renovation or reconstruction.

IMPORTANCE OF ROAD INSPECTION

One of the most important aspects of road maintenance is:

- To identify deficiencies and damage at an early stage, and
- To undertake repair works as soon as they are required in order to prevent progress of the deficiencies or damage.

A careful and thorough inspection should be carried out at least once a month. Identified deficiencies and damage should be properly recorded on the field inspection sheet.

Identified deficiencies and damage should be prioritized for timely treatment and reflected in the Quincenal Schedule (MBA) and/or the Quarterly Schedule (MBC).

MAINTENANCE COST

All pavements deteriorate with the passage of traffic loads. Accordingly maintenance cost will increase as the pavement deteriorates.

The maintenance cost for the 4-lane divided Cabanatuan Bypass with a frontage road was estimated as follows:

Pavement Condition	Maintenance Cost Per Km Per Year (₱)
Good	160,000
Fair	235,000
Bad	382,000

In comparison, the maintenance budget allocation based on the EMK system was estimated at 166,200 pesos. While the pavement is in good condition, the EMK allocated maintenance budget would be sufficient. However, it would not be sufficient when the pavement deteriorates. Expenditure of the maintenance budget should be planned strategically within DEO to cope with pavement deterioration.

MAINTENANCE ACTIVITY LIST AND FREQUENCY

Element	Type	Maintenance Activity	Frequency	Demarcation
Carriageway	PCC	Crack and Joint Sealing	As soon as identified.	MBA
		Patching	When crack sealing is no longer effective.	MBC
		Replacement of Concrete Slab	When wide cracks are found.	MBC
		Resurfacing with AC (overlay)	When PSI or RRI becomes 2.5	MBC
Shoulder	PCC	"Same" as Carriageway PCC pavement".		
	Gravel	Patching	As soon as a depressed portion identified.	MBA
		Grading	At least 3 times a year	MBC
		Regravelling	Once in 5 years	
Drainage	Side Ditches (all types)	Ditch Cleaning (regular)	3 times a year	MBC
		Ditch cleaning (as needed)	every after heavy rain / typhoon	MBA
	RCPC / RCBC	Culvert cleaning (regular)	3 times a year	MBC
		Ditch cleaning (as needed)	every after heavy rain / typhoon	MBA
		Digging inlet / outlet sides canal within ROW (regular)	2 times a year	MBC
		Digging inlet / outlet sides canal within ROW (as needed)	every after heavy rain / typhoon	MBA
		Digging inlet / outlet sides canal outside ROW	as required	MBC
Traffic	Pavement Markers	Centerline and lane line repainting	2 times a year	MBC
		Repainting channelization curbs and other markings at intersection	2 times a year	MBC
	Traffic Signs, Warning Signs, Guide Signs	Cleaning Signs	As needed	MBA
		Repainting / Replacement of signs	As needed	MBC
	Traffic Signal Light	Maintenance of traffic signal light	As needed	MBC
	Guardrail	Repainting / replacement of guardrail	As needed	MBC
Roadside Features		Vegetation control	4 times a year	MBC
		Erosion repair and control on roadside	As needed	MBA
		Maintenance of trees, plants, flowers, etc. in environmental zone	4 times a year	MBC
		Road cleaning	As needed	MBC/MBA
		Sodding slopes	As needed	MBC/MBA

14. PROJECT IMPLEMENTATION

MAXIMUM FUND ALLOCATION

The maximum possible fund allocation available for this project was estimated to be about 5% of the total highway sector capital investment budget.

Estimated Max. Fund Allocation To This Project

Year	Amount (Million P)	Year	Amount (Million P)
2003	1,560	2008	2,400
2004	1,740	2009	2,520
2005	1,920	2010	2,710

IMPLEMENTATION PRIORITY OF BYPASS

All the bypasses are needed urgently. Among the three bypasses, the relative priority based on the present traffic condition, estimated bypass traffic and economic return is in the following order:

- Cabanatuan Bypass
- Plaridel – Baliuag Bypass
- San Jose Bypass

STAGE CONSTRUCTION

Considering the funding capacity and fund requirements of the Project, Stage Construction was recommended for Plaridel – Baliuag Bypass and Cabanatuan Bypass. Under Phase-1 (by 2005), a 2-lane road is proposed for all three bypasses. Under Phase-2 (by 2010), two of the bypasses should be widened to a 4-lane divided road with a frontage road in strategic sections.

IMPLEMENTATION SCHEDULE

Construction Stage	Plaridel-Baliuag Bypass	Cabanatuan Bypass	San Jose Bypass
Phase-1			
Detailed Design	Apr. 200-Sep.2001	Apr.2000-Sep.2001	Oct.2000-Sep.2001
ROW Acquisition	July 2001-Mar. 2003	July 2001-Dec.2002	Oct. 2000-Dec 2002
Tender	Jan. 2002-Dec.2002	Oct 2001-Sep.2002	Oct 2002-Sep.2003
Construction	Jan.2003-June 2005	Oct 2002-June 2005	Oct 2003-June 2005
Phase-2			
Review of Detailed Design	July 2006-Dec 2006	July2006-Dec.2006	-
ROW Acquisition	-	-	-
Tender	Jan.2007-Dec 2007	Jan.2007-Dec.2007	-
Construction	Jan.2008-Dec 2010	Jan.2008-Dec.2010	-

ANNUAL FUND REQUIREMENT

Maximum fund requirement in Phase-1 and Phase-2 will be 1,635 Million Pesos (2004) and 1,753 Million Pesos (2009), respectively. These amounts are within the estimated fund allocation framework.

IMPLEMENTATION SCHEDULE AND ANNUAL FUND REQUIREMENT

Unit: Million Pesos at 1999 Prices

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	TOTAL
CONSTRUCTION STAGE			Phase - 1						Phase - 2					
Implementation Schedule	Plaridel - Baliuag Bypass	Detailed Design												
		ROW Acquisition												
		Tender												
		Construction												
	Cabanatuan Bypass	Detailed Design												
		ROW Acquisition												
		Tender												
		Construction												
	San Jose Bypass	Detailed Design												
		ROW Acquisition												
		Tender												
		Construction												
Annual Fund Requirement (Million Pesos at 1999 Prices)	Plaridel - Baliuag Bypass	Detailed Design	50.52	50.52	-	-	-	-	24.54	-	-	-	-	125.58
		ROW Acquisition	-	76.12	228.37	76.13	-	-	-	-	-	-	-	380.62
		Construction	-	-	-	504.05	672.07	504.05	-	-	333.91	667.82	667.82	3,349.72
		Const. Supervision	-	-	-	40.32	53.76	40.32	-	-	26.71	53.42	53.43	267.96
		Total	50.52	126.64	228.37	620.50	725.83	544.37	24.54	-	360.62	721.24	721.25	4,123.88
	Cabanatuan Bypass	Detailed Design	61.26	61.26	-	-	-	-	33.29	-	-	-	-	155.81
		ROW Acquisition	-	47.09	109.86	-	-	-	-	-	-	-	-	156.95
		Construction	-	-	87.15	610.04	610.04	435.75	-	-	477.70	955.39	955.39	4,131.45
		Const. Supervision	-	-	6.97	48.80	48.81	34.86	-	-	38.22	76.43	76.43	330.52
		Total	61.26	108.35	203.98	658.84	658.85	470.61	33.29	-	515.92	1,031.82	1,031.82	4,774.74
	San Jose Bypass	Detailed Design	6.74	10.10	-	-	-	-	-	-	-	-	-	16.84
		ROW Acquisition	-	-	28.04	-	-	-	-	-	-	-	-	28.04
		Construction	-	-	-	42.09	231.47	147.30	-	-	-	-	-	420.86
		Const. Supervision	-	-	-	3.37	18.52	11.78	-	-	-	-	-	33.67
		Total	6.74	10.10	28.04	45.46	249.99	159.08	-	-	-	-	-	499.41
	Total	Detailed Design	118.52	121.88	-	-	-	-	57.83	-	-	-	-	298.23
		ROW Acquisition	-	123.21	366.27	76.13	-	-	-	-	-	-	-	565.61
		Construction	-	-	87.15	1,156.18	1,513.58	1,087.10	-	-	811.61	1,623.21	1,623.21	7,902.04
		Const. Supervision	-	-	6.97	92.49	121.09	86.96	-	-	64.93	129.85	129.86	632.15
		Total	118.52	246.09	460.39	1,324.80	1,634.67	1,174.06	57.83	-	876.54	1,753.06	1,753.07	9,398.03

Total of Each Phase					
Phase - 1	Detailed Design	240.40	Phase - 2	Detailed Design	57.83
	ROW Acquisition	565.61		ROW Acquisition	-
	Construction	3,844.01		Construction	4,058.03
	Construction Supervision	307.51		Construction Supervision	324.64
	Total	4,957.53		Total	4,440.50

15. OVERALL EVALUATION AND RECOMMENDATIONS

OVERALL EVALUATION

The three bypass projects were evaluated highly feasible from every aspect.

Technical Feasibility: All proposed works can be carried out by construction methods commonly used in the Philippines. No technical problems are expected during project implementation.

Economic Feasibility: Sufficient economic return is expected to justify the projects as shown by the economic evaluation.

Financial Feasibility: The projects can be implemented within the budgetary framework of DPWH.

Environmental Impacts: Overall the negative impacts of the projects were assessed as low and these could be mitigated. Overall positive impacts were assessed as high.

Impacts on Regional and Local Development: The projects are expected to contribute greatly to both regional and local development through improved accessibility and smooth flow of traffic.

RECOMMENDATIONS

Early Implementation of Three Bypass Projects

The projects are urgently needed and should be implemented at the earliest possible time. Possible factors which might affect the implementation of the projects are as follows:

- Securing ECC
- Road ROW Acquisition
- Resettlement of Project-affected People
- Fund Preparation

The above matters should be given timely consideration.

Development Control Within the Road ROW of the Proposed Bypasses

As soon as the road ROW is determined, concerned LGUs should promulgate an ordinance which prohibits all development within the road ROW and it should be strictly implemented.

Review and Update of the Land Use Plan by LGUs

Concerned LGUs should review and update their Land Use Plans based on the alignment of the proposed bypasses and their access roads.

Stage Construction

In view of the funding requirements and DPWH budgetary framework, stage construction has been recommended for the Plaridel-Baliuag Bypass and the Cabanatuan Bypass. However, if the financial situation improves, these bypasses should be constructed in one stage as a 4-lane bypass.

Utilization of this Study for Other Similar Projects

There are many urban sections along arterial roads in the country which suffer from problems similar to those of the Study Road. Hence, this Study is applicable and can be used for similar projects.

Inter-Urban Sections of the Study Road

For most of the inter-urban sections, the existing road ROW is limited to 15 to 20m. Ribbon type urbanization is widespread and, therefore, widening should be planned and implemented within the existing road ROW.

Even within the existing road ROW, removal of houses, trees and public utilities will be required. Proper coordination should be made with the concerned LGUs for the relocation of affected houses and facilities.

Other Urban Sections of the Study Road

Other shorter urban sections such as at Gapan, San Ildefonso, San Rafael, etc. suffer from similar problems. However, urgent measures should be implemented as follows:

- Traffic management
  - Installation of traffic signals and exclusive left turn lanes at major intersections.
  - Strict enforcement of roadside parking ban.
  - Loading and unloading only in designated areas.
- Paving of shoulders for use by slow moving vehicles
- Construction of sidewalks

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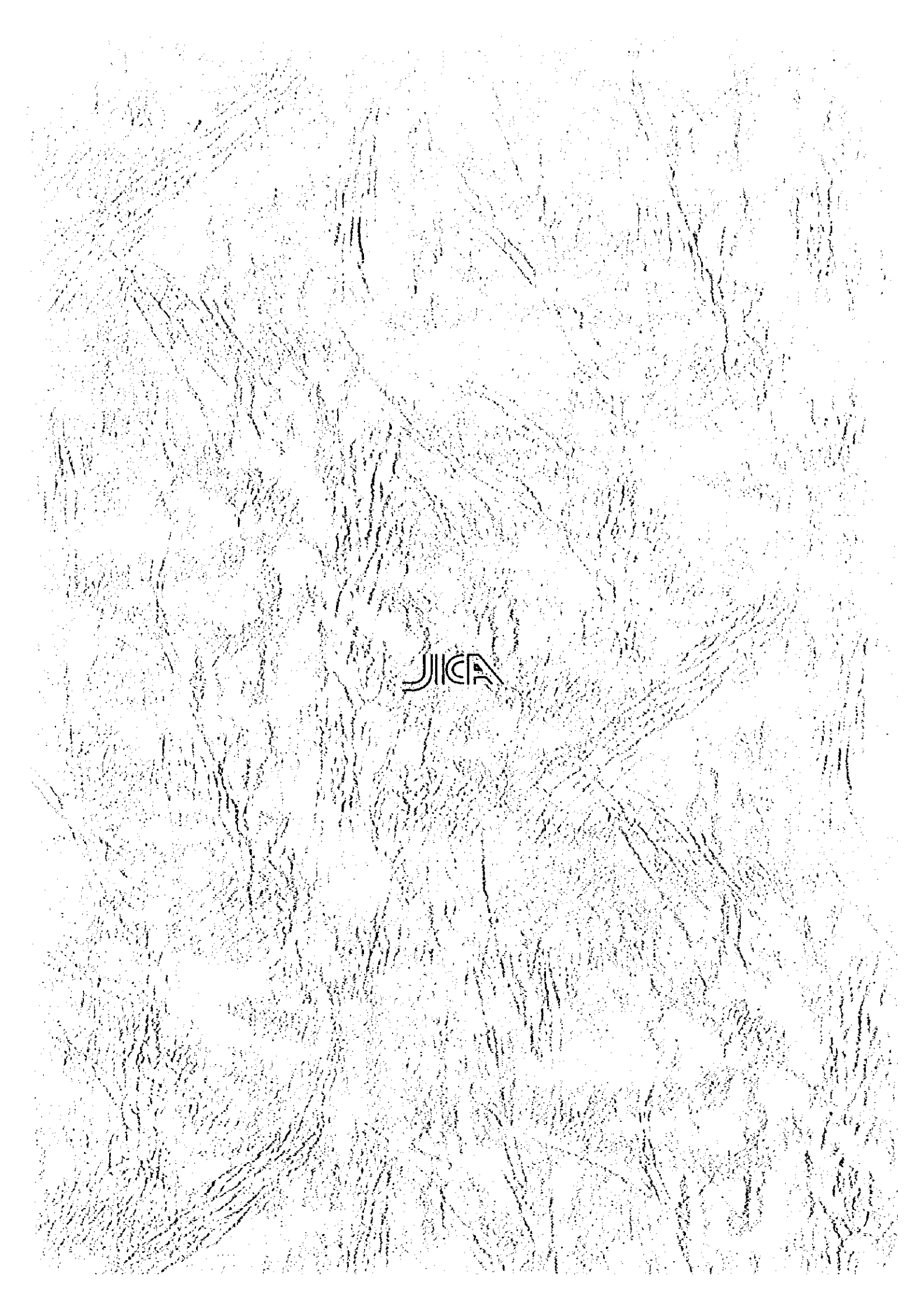
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