社会開発調査部報告書

No. 22

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume 7)

PROJECT EVALUATION
IN
THE PROVINCE OF RIZAL

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

S S F
90-112(7/30)

REPUBLIC OF THE PHILIPPINES Feasibility Study on the Rural Road Network Development Project FINAL REPORT (Volume 7) PROJECT EVALUATION IN THE

JICA LIBRARY
1086469[2]
21930

REPUBLIC OF THE PHILIPPINES

DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

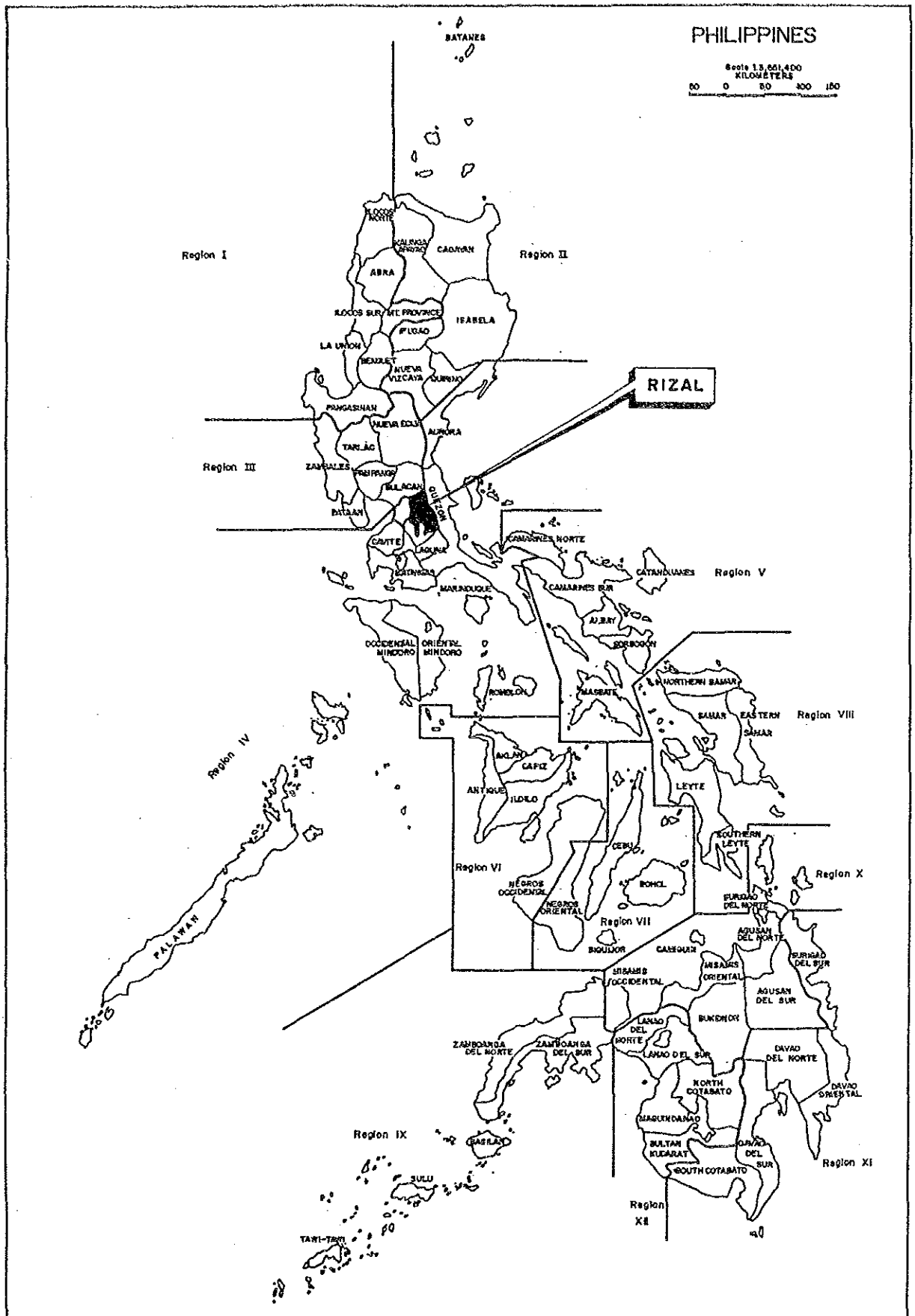
FINAL REPORT (Volume 7)

PROJECT EVALUATION
IN
THE PROVINCE OF RIZAL

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団
21930



FEASIBILITY STUDY ON THE RURAL ROAD NETWORK DEVELOPMENT PROJECT	LOCATION MAP

VOLUME - 7
PROVINCE OF RIZAL

TABLE OF CONTENTS

CHAPTER 1
SOCIO-ECONOMIC PROFILE OF THE PROVINCE

1.1 GENERAL

The Province of Rizal was selected as one of the Study Provinces which represents the province of the following characteristics:

- Economically less developed
- High level in road development
- Topographically flat and mountainous

1.2 GEOGRAPHY AND TOPOGRAPHY

The province is located in the central part of Luzon, bounded on the north by Bulacan Province, on the east by Quezon Province, on the south by Laguna Province and Laguna de Bay and on the west by Metro Manila.

Areas of more than one half of the Province in the north and east are mountainous where the Southern Sierra Madre Ranges are situated. The area facing Laguna de Bay is low and flat land. The western area adjacent to Metro Manila is also low and flat land.

Slope map of the province is shown in Figure 1.2-1.

1.3 POPULATION

The province is composed of fourteen (14) municipalities.

Population in 1990 is estimated at 792,000. The average annual population growth rate for the period of 10 years from 1980 to 1990 was estimated 3.4% which is higher than the national average of 2.4%. Population density of the province in 1990 is 605.1 persons per square kilometer which is higher by 2.9 times than the national average of 205 persons per sq. km.

Population, the average annual population growth rate and population density by municipality are presented in Table 1.3-1. Distribution of municipal towns together with their population is shown in Figure 1.3-1.

As the province is located adjacent to Metro Manila, about one fourth (1/4) of the Province in the western and southern areas are highly urbanized and residential and industrial areas were developed. Municipal towns are developed in the western area and along Laguna de Bay low land area.

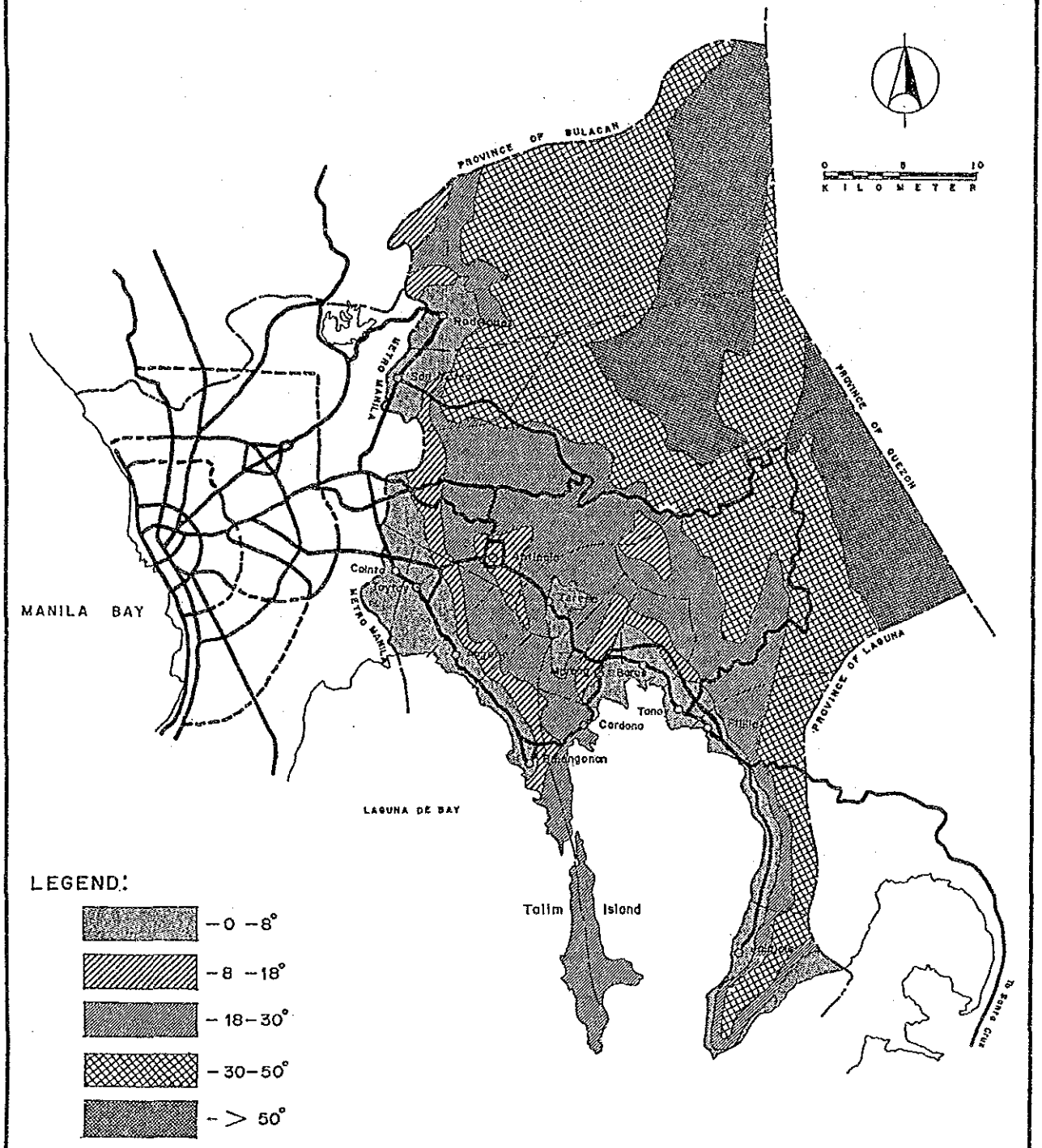


FIGURE 1.2 - 1 SLOPE MAP

Table 1.3-1

POPULATION, LAND AREA AND DENSITY (1990)
Province of Rizal

City/Municipality	Projected Population (1990)	Annual Growth Rate (%)	Land Area (km^2)	Density (p/km^2)
1. Angono	41,514	4.3	26.0	1,596.7
2. Antipolo	120,827	5.6	306.1	394.7
3. Baras	15,325	3.0	23.4	654.9
4. Binangonan	105,382	2.5	72.7	1,449.5
5. Cainta	110,817	6.3	10.2	10,864.4
6. Cardona	29,580	1.7	31.2	948.1
7. Jala-Jala	15,164	2.2	49.3	307.6
8. Montalban	57,407	3.0	312.8	183.5
9. Morong	27,132	0.7	37.6	721.6
10. Pililla	30,159	2.4	74.0	407.6
11. San Mateo	70,206	2.9	64.9	1,081.8
12. Tanay	55,356	3.0	243.4	227.4
13. Taytay	96,304	2.3	38.8	2,482.1
14. Teresa	16,876	1.1	18.6	907.3
T O T A L	792,049	3.4	1,309.0	605.1

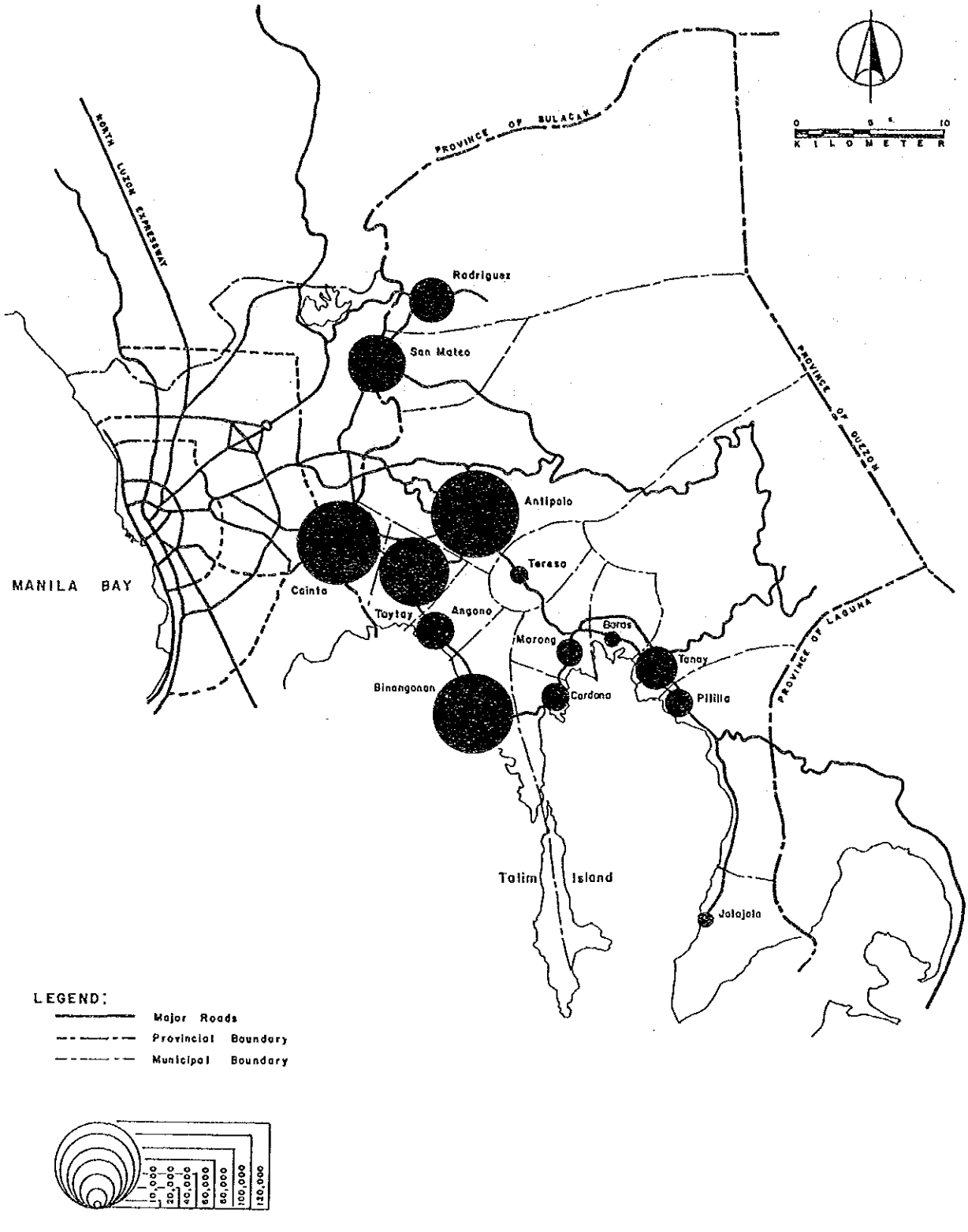


FIGURE 1.3-1 POPULATION BY MUNICIPALITY (1990)

1.4 SOCIO-ECONOMIC PROFILE

Table 1.4-1 shows major socio-economic data of the province in comparison with the national value.

Gross Regional Domestic Product which shows economic output of the province shares 1.7% of the total national output. In view of land area and population share of the province to the country, the province's economic output is slightly higher than the national average.

Per capita income of the province is higher by 1.24 times than the national average. Incidence of poverty shows lower level than the national average. Unemployment and underemployment rates are lower than the national average.

Influenced by socio-economic activities of Metro Manila, industry (secondary industry) shares the highest in terms of number of workers. Agricultural industry shares only 19%.

Table 1.4-1
MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF RIZAL

	Rizal (A)	Philippines (B)	(A)/(B)
1. Total Land Area (sq.km.)	1,309	300,000	0.004
2. Population in 1990 (1000 persons)	792	61,483	0.013
3. Population Density (persons/sq.km.)	605	205	2.95
4. GRDP (Million ₱ at 1000 prices)	10,875	623,051	0.017
5. Per Capita Income in 1985 (₱/person)	6,974	5,593	1.24
6. Number of Workers by Industrial Sector in 1980 (1000 persons)			
* Agricultural	33.3 (19%)	7,303 (51%)	0.005
* Industry	69.9 (41%)	2,177 (15%)	0.032
* Service	65.6 (38%)	4,552 (32%)	0.014
* Total 1/	171.3 (100%)	14,197 (100%)	0.012
7. Incidence of Poverty in 1985 (%)	49.7	59.3	-
8. Unemployment Rate in 1988 (%)	7.3	8.3	-
9. Underemployment Rate in 1988 (%)	8.2	11.6	-

Note: 1/ Includes other workers who cannot be classified as any one of three (3) sectors.

1.5 AGRICULTURAL LAND USE AND MAJOR CROPS

Rizal has a total land area of 1,309 square kilometers, representing 0.4% of the total land area of the Philippines. Table 1.5-1 shows general land use of the province. Grass land shares about 54% and agricultural land areas only 14.3%. Shares of built-up area is quite high and shares about 13%.

Figure 1.5-1 illustrates the agricultural land use of the province. Table 1.5-2 shows major crops produced in the province. Five (5) major crops of the province are palay, corn, mango, camote and cassava. However, none of them contribute substantially to the region's crop production.

Table 1.5-1
LAND USE OF RIZAL

Land Use	Area in sq.km.	%
Agricultural Land	187.2	14.3
Grass Land	700.3	53.5
Shrub Land	77.2	5.9
Forest	168.9	12.9
Built-up Area	175.4	13.4
Total	1,309.0	100.0

Source: Bureau of Soil

Table 1.5-2
MAJOR CROPS OF PROVINCE OF RIZAL

Major Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Palay	6,610	6,670	24,395	21,140
Corn	2,440	2,470	2,020	1,595
Mango	700	700	5,320	4,641
Camote	171	173	1,642	1,661
Cassava	115	116	943	928

Source: Bureau of Agricultural Statistics

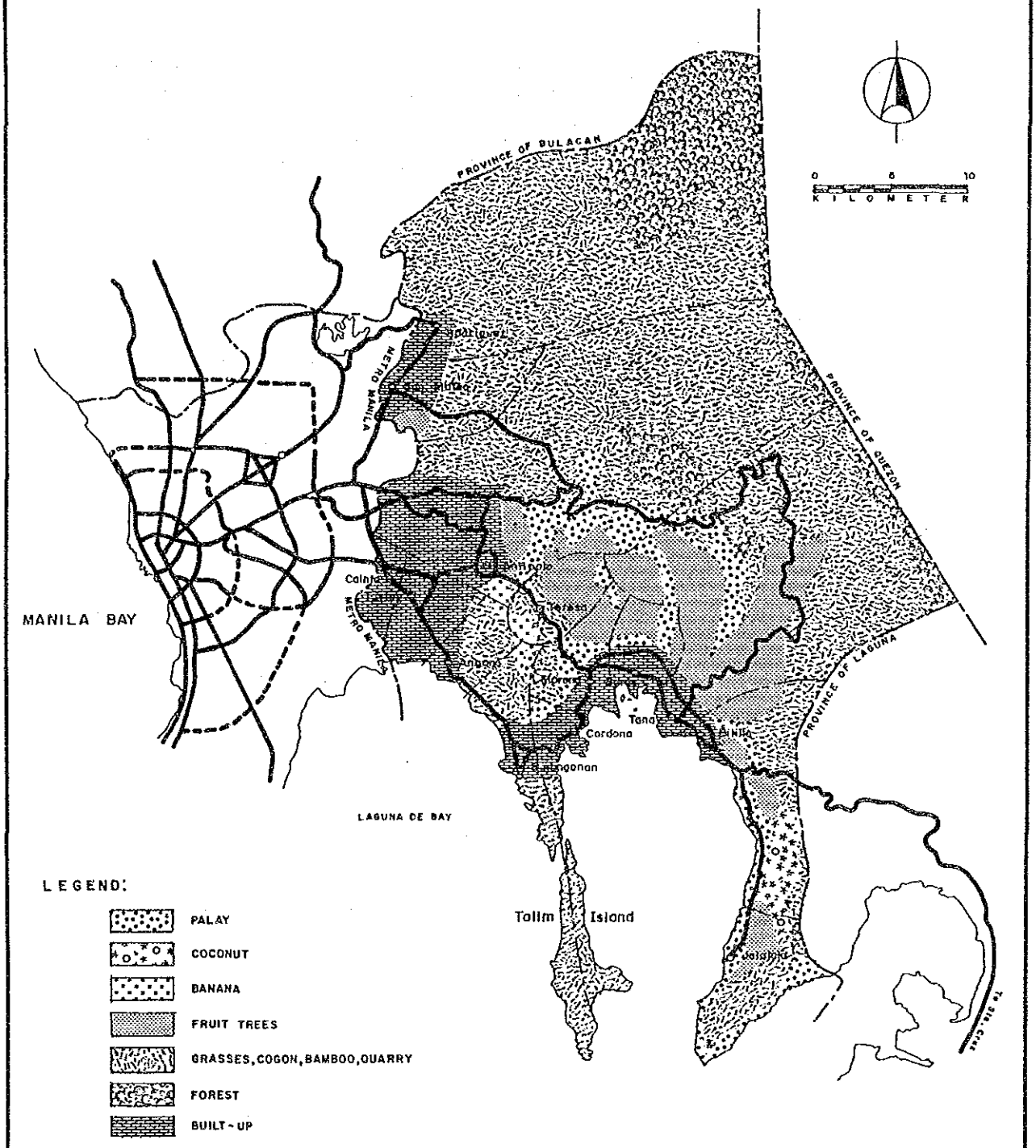


FIGURE 1.5-1 AGRICULTURAL LAND USE

CHAPTER 2
ROAD NETWORK OF THE PROVINCE

2.1 GENERAL

The province was classified as one of the provinces of which road network development represents the high level in the Philippines. In this Chapter, present level of road network development is assessed more in details, then general direction of the future road network development is established. Based on the said assessment and the functional road classification criteria, the major road network for the province is proposed.

2.2 PRESENT LEVEL OF ROAD NETWORK DEVELOPMENT

Present level of the road network development level is assessed in terms of road extension (quantity of roads), surface type and conditions (quality of roads) and road network pattern.

2.2.1 Present Level of Road Development in terms of Road Extension

Rizal has a total of 1,237.2 kms. of roads, comprising 224.2 kms. of National, 66.8 kms. of Provincial, 143.4 kms. of Municipal and 782.8 kms. of Barangay Roads in 1987.

Table 2.2-1 shows road density by class of road which is compared with national average. In comparison with the national average, road development level of the province in terms road extension is summarized as follows:

National roads .....higher by 1.26 times
Provincial roads.....low at only 31% of the national average
Barangay roads.....higher by 1.24 times
All roads.....almost same as national average

In terms of road extension, provincial class of roads are extremely scarce, however, other classes of roads are considered to be in the satisfactory level.

2.2.2 Present level of Road development in terms of surface type and surface condition

The Study Team conducted an extensive field survey on the existing road conditions of which results are summarized in Table 2.2-2.

TABLE 2.2-1

EXISTING ROAD LENGTH AND ROAD DENSITY
Province of Rizal

Road Class	Road Length In 1987 (kms.)	Road Density (L/ PA)		
		Rizal	Philippines	Rizal/Phils
National Rd.	244.2 (19.7	0.2518	0.1994	1.26
Prov'l. Rd.	66.8 (5.4)	0.0689	0.2211	0.31
Sub-Total	311.0 (25.1)	0.3207	0.4205	0.76
City Rd.	- -	-	0.0304	-
Municipal Rd	143.4 (11.6)	0.1479	0.0981	1.51
Barangay Rd.	782.8 (63.3)	0.8073	0.6536	1.24
TOTAL	1,237.2(100.0)	1.2759	1.2026	1.06

SOURCE: DPWH Infrastructure Atlas, 1989

TABLE 2.2-2

EXISTING SURFACE CONDITION (SURVEYED ROADS ONLY)
Province of Rizal

Road Class	Pavement Type	Surface Condition 1/			% of Pavement Type 2/	
		Good/Fair	Bad/Very Bad	Total (%)	Rizal	Phils.
National Road	PCC	116.7 (96.7)	4.0 (3.3)	120.7 (100.0)	44.8	23.6
	Bituminous	43.1 (53.1)	38.0 (46.9)	81.1 (100.0)	40.8	22.3
	Gravel	10.3 (37.6)	17.1 (62.4)	27.4 (100.0)	14.4	51.3
	Earth	-	- -	- (100.0)	-	2.8
	Total:	170.1 (74.2)	59.1 (25.8)	229.2 (100.0)	100.0	100.0
Provincial Road	PCC	3.9 (88.6)	0.5 (11.4)	4.4 (100.0)	10.9	2.5
	Bituminous	7.5 (52.1)	6.9 (47.9)	14.4 (100.0)	23.5	8.9
	Gravel	14.4 (72.0)	5.6 (28.0)	20.0 (100.0)	20.2	70.6
	Earth	- -	- -	- (100.0)	45.4	18.0
	Total:	25.8 (66.5)	13.0 (33.5)	38.8 (100.0)	100.0	100.0
National and Provincial Road	PCC	120.6 (96.4)	4.5 (3.6)	125.1 (100.0)	37.5	12.5
	Bituminous	50.6 (53.0)	44.9 (47.0)	95.5 (100.0)	37.1	15.3
	Gravel	24.7 (52.1)	22.7 (47.9)	47.4 (100.0)	15.7	61.4
	Earth	- -	- -	- (100.0)	9.7	10.8
	Total:	195.9 (73.1)	72.1 (26.9)	268.0 (100.0)	100.0	100.0

SOURCE: 1/ Survey by Study Team in 1989
2/ DPWH Infrastructure Atlas, 1989

Present level of road development in terms of surface condition (quality of roads) could be summarized as follows:

National Roads

- About 85% of national roads in the Province are paved with either PCC or bituminous surfaces which is higher than the national average of 46%.
- Surface conditions of national roads are relatively well maintained. About 74% of national roads in the province were rated either good or fair.
- In terms of road quality, national roads in the province are in high level.

Provincial Roads

- About 34% of provincial roads in the province are paved with either PCC or bituminous surfaces, which level is higher than the national average of 11%.
- Surface conditions of provincial roads in the province are relatively in good condition. About 66% of provincial roads are assessed either good or fair condition.
- Compared with other provinces, provincial roads in the province is relatively high level.

2.2.3 Present Road Network Pattern

Present road network is presented in Figure 2.2-1, which shows all existing national and provincial roads. Present road network of the Province is assessed as follows:

- In the southern and south-western area, a mesh type road network is formed. In the northern area, the road network is not developed due to rugged mountainous area of southern Sierra Madre Ranges.
- The main axis is the national road running along Laguna de Bay.
- All municipal towns are accessed by the national or provincial road.

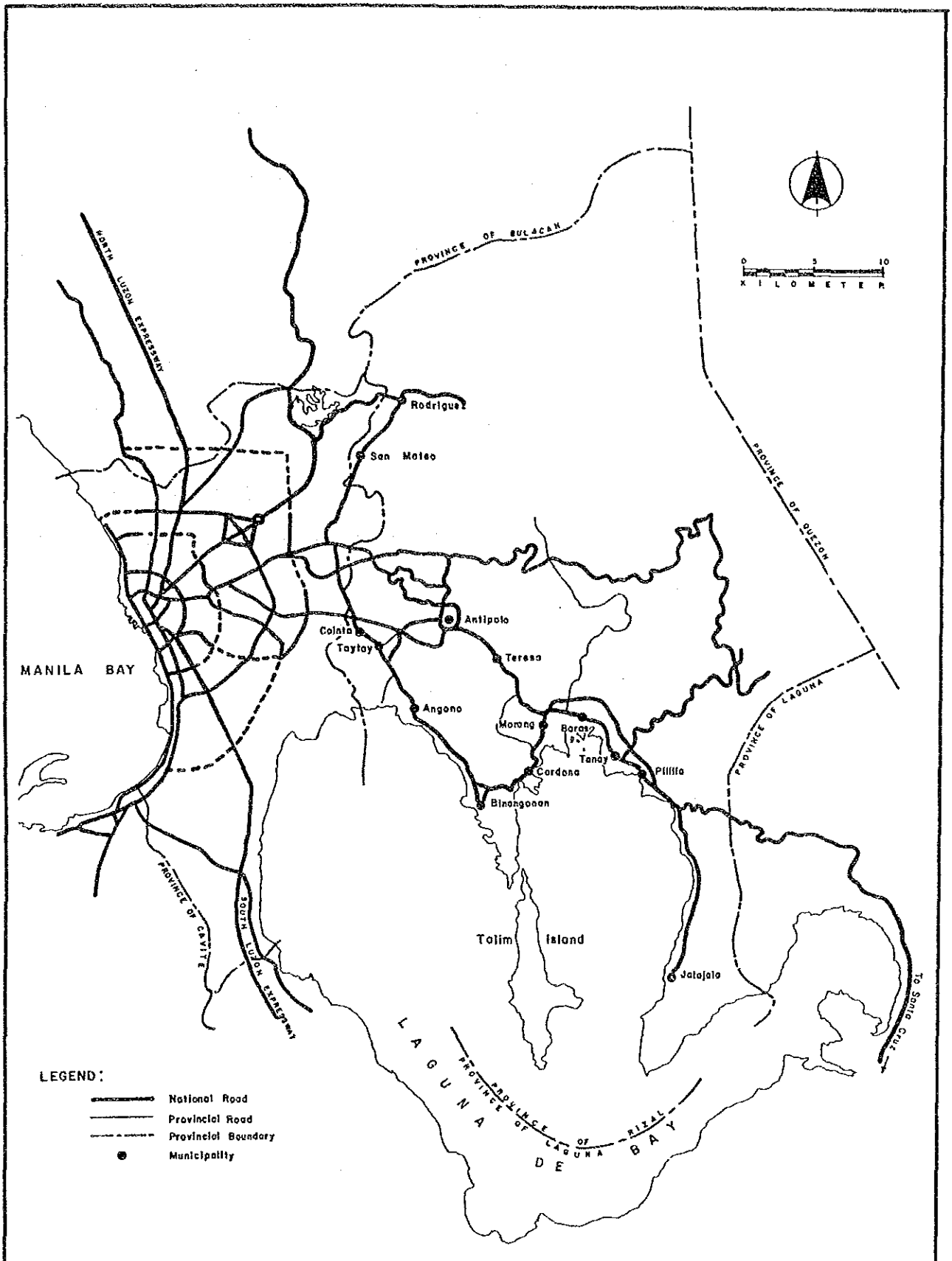


FIGURE 2.2-1 EXISTING ROAD MAP

2.3 GENERAL DIRECTION OF ROAD NETWORK DEVELOPMENT

Results of assessment of present road network development level are summarized as follows:

- In terms of road extension, provincial class roads are extremely scarce.
- Surface type and conditions of national and provincial roads are relatively high standard.
- Basic road network is formed.

Based on the above assessment, general direction of road network development of the Province will be as follows:

(1) As provincial roads are quite scarce, collector class roads should be strengthened.

(2) Existing roads in the Northern area where roads are scarce should be improved to acceptable condition.

(3) Proper coordination with private developers who are constructing access roads to their subdivisions should be maintained in order to establish systematic road network.

2.4 PROPOSED MAJOR ROAD NETWORK

2.4.1 Procedure

To identify major roads, all existing roads are firstly classified in accordance with the functional road classification criteria which is shown in Table 2.4-1. Functional classification groups roads according to importance and quality of services they are intended to provide. Individual road links of similar importance and quality of services are organized into systems so that a road network in accordance with the hierarchy of functions can be planned and formed. They can be efficiently managed with consistent policies, design and operation.

After identification of existing major roads, necessity of additional new links is assessed. For example, if a certain municipal town has no access, a new major road is added to the existing major road network. Thus, the initial major road network is proposed and subjected to evaluation whether the proposed one is well-balanced or not. Evaluation is made by two (2) indicators as follows:

a) Network Value

$$Nv = \frac{L}{\sqrt{PA}}$$

Where: Nv = Network Value
L = Road length delineating a block
P = Population in a block
A = Land Area in a block
Block= Area delineated by major roads

b) Accessibility

Accessibility $AC = \sum pl$

Average Accessibility $A\,ave = \frac{\sum pl}{P}$

Where
p = Population of a Barangay
l = Distance from a barangay center to respective major road
P = Total population in a block

If indicators of some blocks show imbalanced value, additions or deletions of major road links are made until indicators show almost balanced values. After these adjustment, the major road network is finally proposed.

Table 2.4-1 Proposed Functional Road Classification Criteria for Rural Road Network

Functional Classification		General Definition	General Characteristics and Services Provided	Relationship with Administrative Classification				
				National Road	Provincial Road	City Road	Municipal Road	Barangay Road
Major Road	Primary Major Road	. Major inter-provincial roads. . Intra-provincial roads linking two (2) or more municipal towns to the Provincial Capital . Intra-provincial roads which form a skelton road network of a province	. Provides the highest level of service at the high speed for the long uninterrupted distance . Serves for long distance trips . Mobility is given the highest consideration	●				
	Secondary Major Road	. Roads linking municipal towns each other . Roads linking a municipal town to the Provincial Capital . Roads linking one (1) or more municipal towns to the primary major road network	. Provides high level of service . Serves for medium distance trips . Mobility is given high consideration	●	●	●		
Minor Road	Collector Road	. Roads linking secondary major roads each other or a primary road with a secondary road . Roads linking two (2) or more barangays to the municipal town or to the higher level network	. Provides rather low level of mobility . Serves for short distance trips . Collects traffic from feeder roads and connects them with major roads . Mobility and land access		●	●		●
	Feeder Road	. Roads linking one or more barangays centers to the higher level network . Roads linking farm areas to their respective barangay centers or to the higher level network	. Primarily provides access to abutting land with little or no through traffic . Serves for local traffic . Land access is given high			●		●
Street		. Roads within built-up population centers (Poblacion) with essentially urban rather than rural rural functions	. Primarily provides access to abutting land in urban areas . Through traffic usage discouraged			●	●	

NOTE: Relationship between functional classification and administrative classification gives only general guideline, therefore, some national roads may be classified as minor roads, or some barangay roads may be classified as major roads.

2.4.2 Proposed Major Road Network

The major road network for the Province of Rizal was proposed as shown in Figure 2.4-1. For establishing the major road network, the following were taken into consideration:

- Present network of mesh type was based to formulate major road network.
- Existing national roads were mostly included in major road network.
- Although road network in the northern area is scarce, no new link was considered necessary due to no substantial concentration of population.

Network value and accessibility of each block were computed to evaluate whether the proposed major road network is a balanced one. Based on these values, addition or deletion of road links was made and finally the major road network was proposed as shown in Figure 2.4-1.

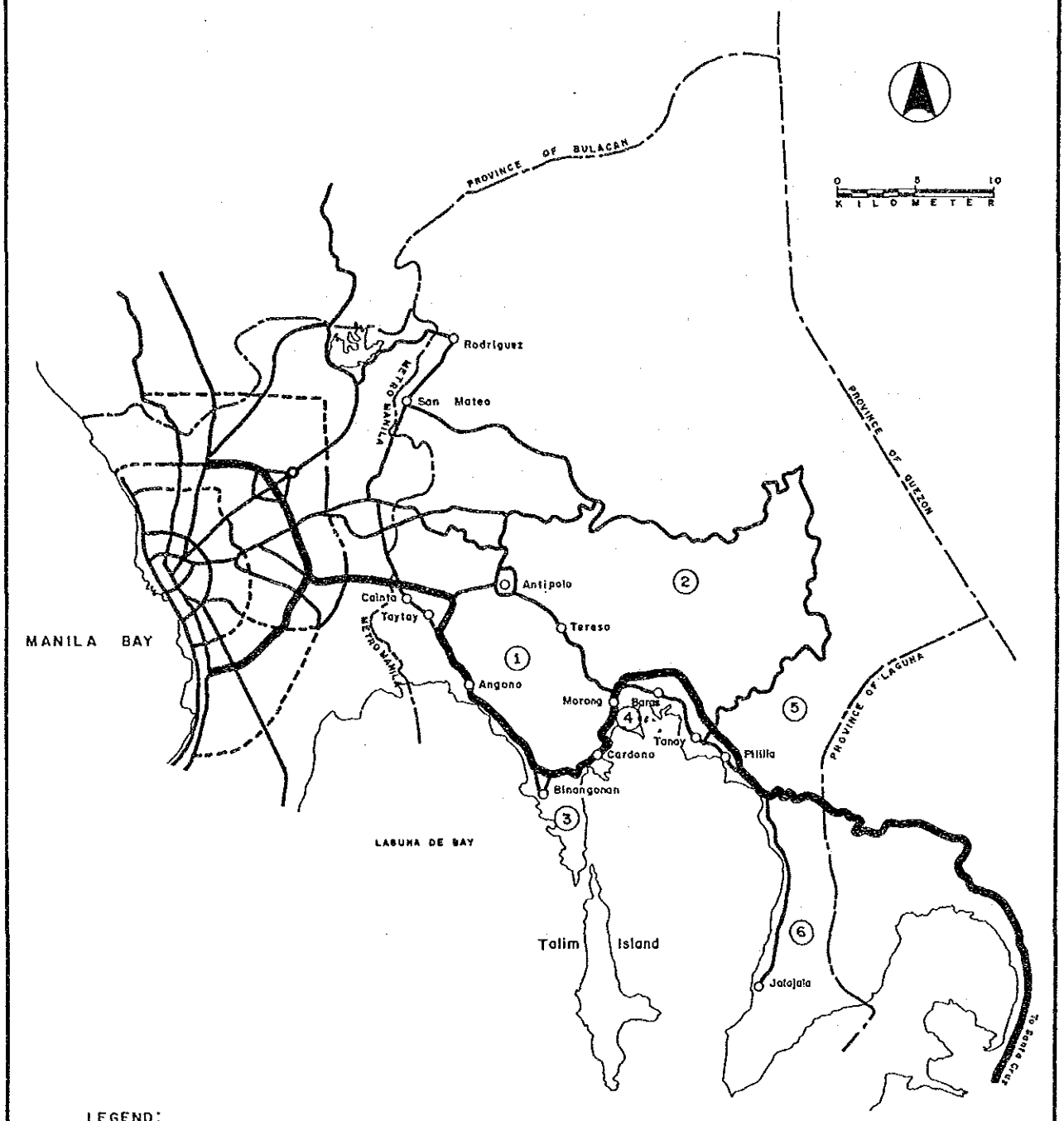
Network value and accessibility of the proposed major road network are presented in Table 2.4-2.

Proposed major road network has a total length of 208.3 Kilometers, all of which are national roads.

Table 2.4-2

NETWORK VALUE/ACCESSIBILITY
Province of Rizal

Block No.	Population (1990)	Land Area (km^2)	Road Length (km)	Network Value	Access (p.km)	Average Access. (km.)
1	124,352	80.92	43.9	0.438	35,663	0.287
2	48,371	182.77	83.8	0.891	3,388	0.070
3	47,228	14.51	10.6	0.405	65,214	1.381
4	86,908	22.67	21.5	0.484	21,665	0.249
5	7,021	68.49	26.4	1.204	0	0
6	27,766	83.72	33.0	0.684	43,553	1.569
Ave.	56,941	75.55	36.5	0.556	28,247	0.496



LEGEND:

- Primary Major Roads
- Secondary Major Roads
- Municipality
- (1) Block Number
- Provincial Boundary

FIGURE 2.4-1 PROPOSED MAJOR ROAD NETWORK

CHAPTER 3
TRAFFIC

3.1 TRAFFIC SURVEY RESULTS

Roadside traffic count survey was conducted on selected roads. Traffic counts were carried out on two (2) consecutive days for 12 hours from 6:00 AM to 6:00 PM each day. Traffic volume was counted by direction and by vehicle type every hour. The vehicle type was classified as follows:

- Car
- Jeep
- Van
- Jeepney
- Bus (mini bus & large bus)
- Truck (including trailer)
- Motor-tricycle
- Motorcycle
- Animal drawn
- Pedestrian
- Others

Figure 3.1-1 shows the location of traffic count stations. Traffic survey results are summarized in Table 3.1-1.

Survey results were converted to Average Daily Traffic (ADT) by using the hourly factors based on the data from the Nationwide Traffic Counts Program (NTCP). Considering other factors such as market days, harvest season, rainy season, etc., AADT were estimated by vehicle type.

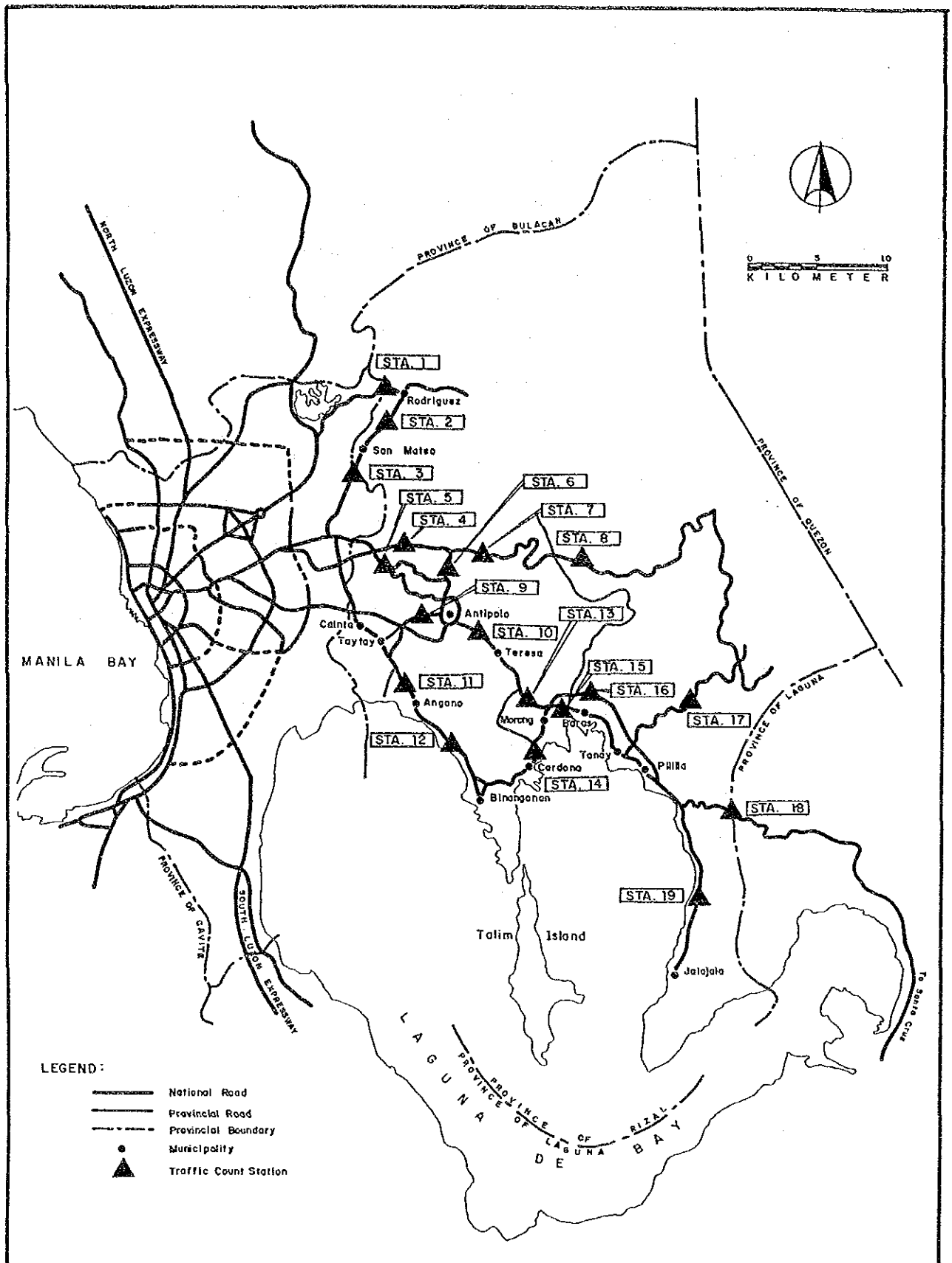


FIGURE 3.1-1 TRAFFIC COUNT STATIONS

TABLE 3.1-1 SUMMARY OF TRAFFIC SURVEY RESULTS
- RIZAL -

(ADT as of May, 1990)

Station No.	Car	Jeep	Pickup /Van	Jeepney	Bus	Truck	Sub-Total	Tri-cycle	Motor-cycle	Animal Drawn	Total
1	156	265	182	187	8	187	985	3767	129	0	4882
2	744	941	903	3189	86	950	6813	450	246	9	7518
3	1743	1528	1496	3415	566	1351	10098	819	458	0	11375
4	1148	576	1019	4954	35	1885	9617	227	285	0	10130
5	1638	490	1058	534	69	515	4304	376	189	0	4869
6	333	143	257	143	20	77	972	853	156	0	1981
7	53	85	90	261	7	160	655	113	42	0	810
8	23	18	8	44	9	53	156	12	8	0	176
9	2239	664	2031	3418	348	858	9558	316	399	0	10273
10	503	516	729	1270	220	620	3858	442	166	0	4467
11	2371	2046	2477	5658	417	1134	14102	796	714	3	15614
12	1011	746	1373	3721	395	593	7839	576	319	1	8735
13	308	325	416	1157	202	227	2635	315	142	0	3091
14	478	404	481	1534	182	319	3398	1860	160	3	5421
15	280	390	424	1602	306	140	3141	823	157	5	4126
16	216	280	419	227	47	242	1430	155	135	0	1720
17	99	134	139	324	1	109	806	152	75	0	1033
18	98	75	278	200	29	99	779	17	52	0	848
19	47	38	156	408	22	79	750	74	29	1	854

Source: Traffic Survey by Study Team (May, 1990)

3.2 TRAFFIC ANALYSIS AND FORECAST: TRAFFIC PROJECTS.

3.2.1 Analysis of Present Traffic

1) General Procedure

Present traffic on each major road network was analyzed according to the procedure shown in Figure 3.2-1.

The analysis is divided into three major steps:

Step I : Analysis of Traffic Survey Results

The number of passengers and commodity tonnage were obtained from the results of the traffic survey. These data are, however, available only on the surveyed road links and used for calibration purposes for the traffic model described below.

Step II : Analysis by Traffic Model

Traffic generation and attraction, in terms of passengers and commodity tons, were estimated based on population and per capita traffic generation factors; traffic distribution (OD distribution) was estimated by the gravity model; then, OD distribution was assigned to the major road network expressed by the node and link system. In the analysis, since only traffic generation factors were unknown, assumed values were used in the first step.

Step III : Comparison of Both Figures

The number of passengers and commodity tonnage estimated by the traffic model were compared with those derived from the traffic survey. On the basis of the comparison, traffic generation factors were appropriately adjusted and the traffic model analysis was reiterated until the traffic model reflected the actual people and freight movements with a high accuracy.

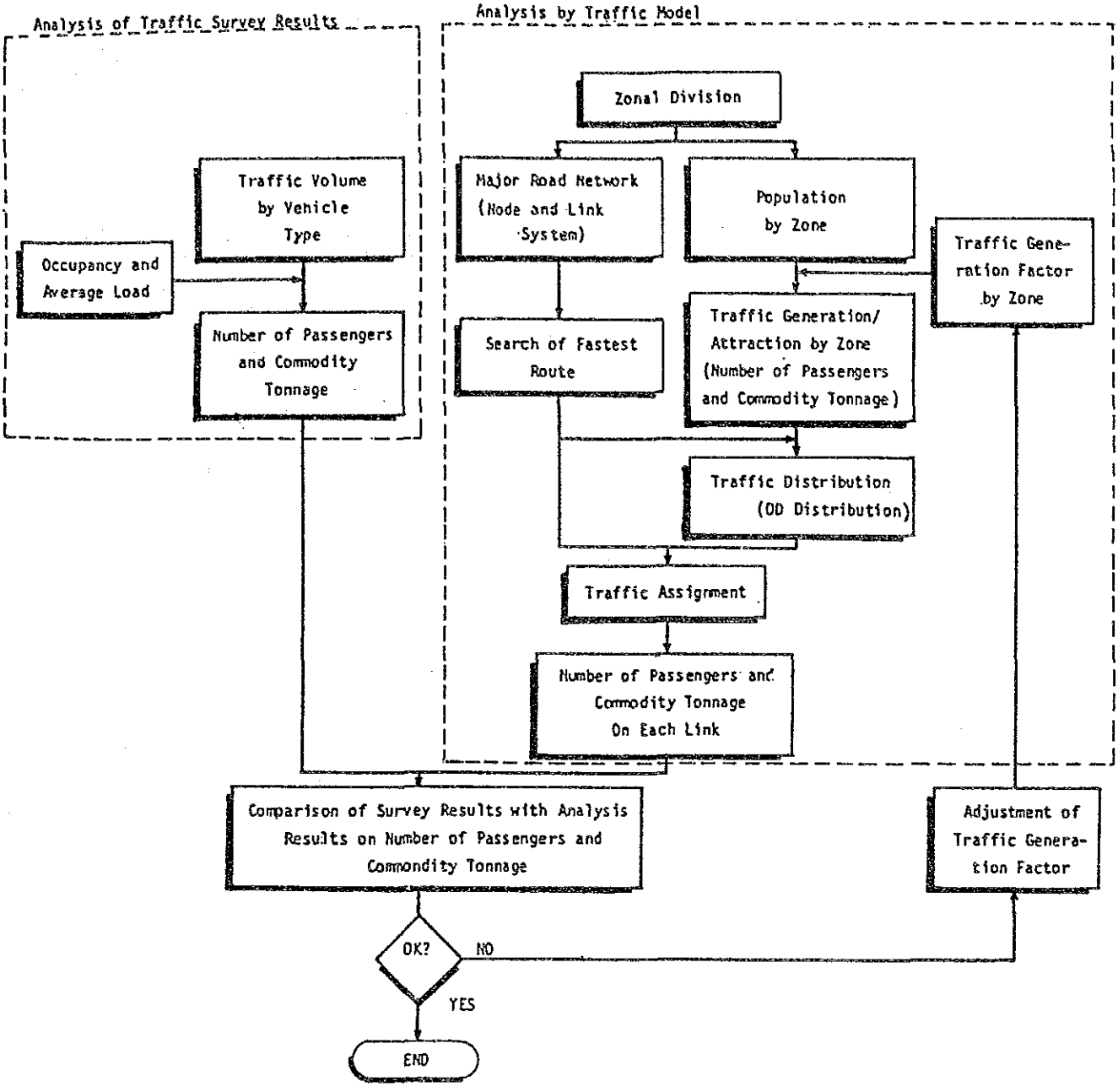


FIGURE 3.2-1
PROCEDURE OF ANALYSIS OF PRESENT TRAFFIC ON MAJOR ROAD NETWORK

2) Analysis of Traffic Survey Results

Traffic volume by vehicle type counted in the traffic survey was converted to number of passengers and commodity tonnage using the occupancy and average load shown in Table 3.2-1.

Table 3.2-1 OCCUPANCY AND AVERAGE LOAD
Province of Rizal

	Average Number of Passenger per vehicle	Average Load (ton per vehicle)
Car/Taxi	3.40	1.00
Jeep	3.40	1.00
Van/Pickup	3.40	1.00
Jeepney	11.80	1.00
Bus	30.90	1.00
Truck	4.00	4.00
Motor-tricycle	2.50	0.30
Motorcycle	1.60	0.10
Animal Drawn	1.50	0.15

3) Analysis by Traffic Model

i) Zonal Division:
The province was divided into traffic zones corresponding to municipal divisions in principle.

ii) Major Road Network:
The major road network was expressed by a node and link system. Each link was given length and average speed according to the actual road condition. A node and link system of the Province is presented in Figure 3.2-2.

iii) Search for the Fastest Route:
The fastest route for each zone pair was calculated by Moore's Method.

iv) Traffic Generation Factor:
Per capita traffic generation factors (trip/person/day and ton/person/day) vary between zones even in the same province with many factors such as:

- Economic Activity
- Size of Population
- Distance from Provincial Capital
- Road Condition
- Other Physical Conditions

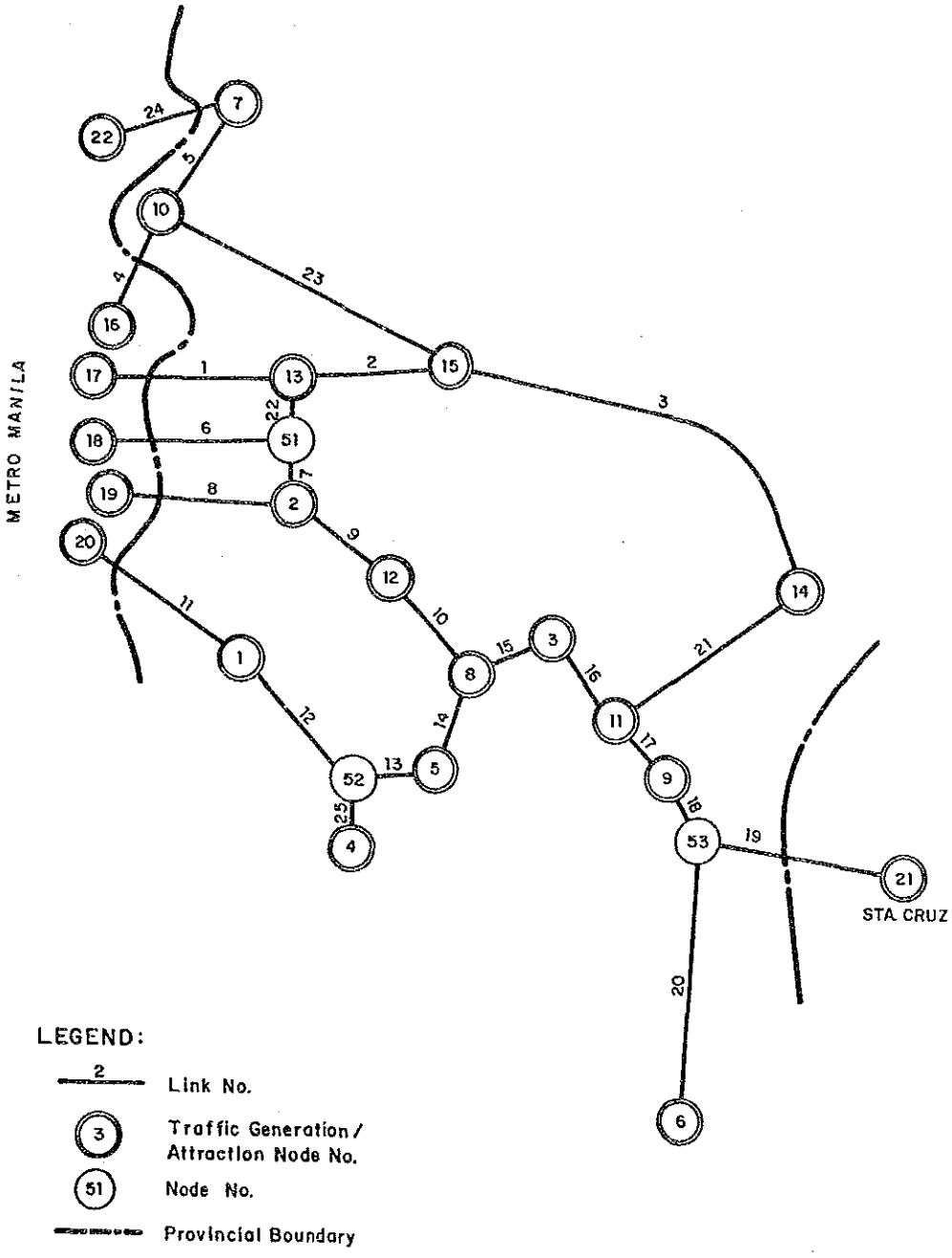


FIGURE 3.2-2 LINK / NODE SYSTEM
PROVINCE OF RIZAL

The generation factors which best illustrate the observed people and freight movement were estimated by the iterative method. The traffic generation factors thus estimated are summarized in Table 3.2-2.

TABLE 3.2-2 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1990 W/O) Province of Rizal

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.117 - 0.780	15.3 - 101.9
Mean Value	0.364	47.6

v) Traffic Generation and Attraction by Zone:

Traffic generation and attraction were obtained in terms of passengers and commodity tonnage as the product by generation factors.

vi) Traffic Distribution:

Traffic distribution (OD distribution) was estimated by the gravity model:

$$Xij = k\frac{Gi.Aj}{tiJ^2}$$

Where, Xij = Traffic from zone i to zone j
k = Parameter
Gi = Traffic generation in zone i
Aj = Traffic attraction in zone j
tij = Travel time from zone i to zone j along the fastest route

OD distribution was adjusted so as to satisfy the following conditions by the Frator Method:

$$Gi = \sum_{j+1}^{n} Xij$$

$$Aj = \sum_{i+1}^{n} Xij$$

Where, n = Number of zones

vii) Traffic Assignment:

Each OD traffic was assigned to the major road network expressed by the node and link system on an all-or-nothing basis. Thus, the number of passengers and commodity tonnage for each link were calculated.

3.2.2 Traffic Forecast

Figure 3.2-3 illustrates the procedure of traffic forecast.

The traffic model prepared for the analysis of present traffic was basically used for forecasting future traffic on the major road network with the following additions/ modifications:

1) Major Road Network and Fastest Route Search

The node and link system for the "with" case was prepared by changing the characteristics of the links included under this feasibility study as well as the links committed to be improved.

The fastest route search was carried out both in the "w/o" and "with" case networks.

2) Traffic Generation/Attraction and Distribution

The future population was based on the NCSO 1980 Census of Population and Housing.

Per capita traffic generation factors in the "with" case were estimated referring to the generated transport demand/transport cost reduction elasticity shown in "Highway Planning Manual, Volume 3, MPWH" and also based on the results of the analysis of present traffic. For instance, a zone showing a small generation factor at present due to poor road conditions is expected to increase the factor to some extent by road improvement, and the degree of increase can be estimated referring to other zones in similar situations but with better road conditions.

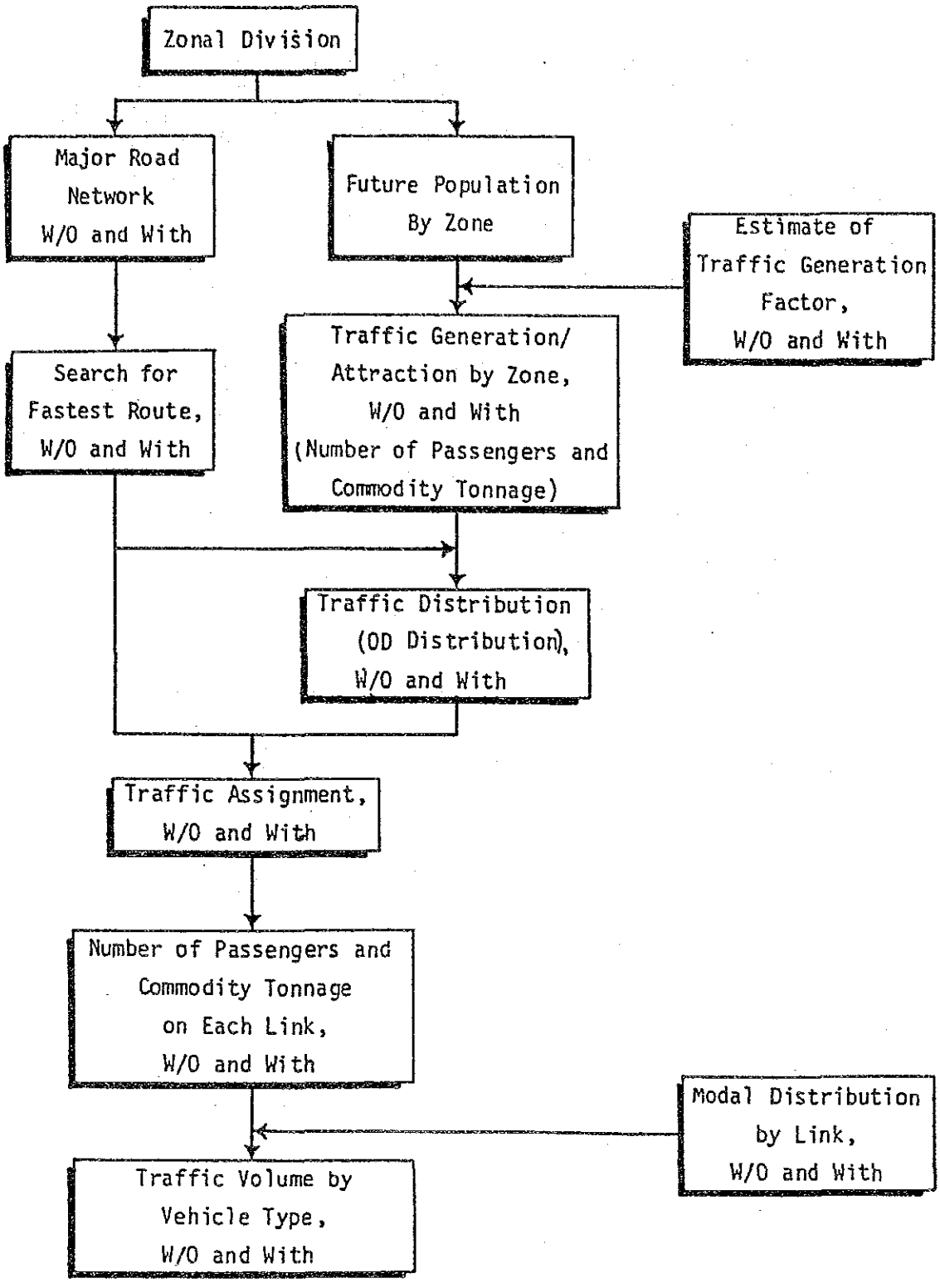


FIGURE 3.2-3
PROCEDURE OF FORECASTING TRAFFIC ON MAJOR ROAD NETWORK

The traffic generation factors thus estimated are summarized in Table 3.2-3.

TABLE 3.2-3 PER CAPITA TRAFFIC GENERATION FACTORS (MAJOR ROAD, 1990 WITH) Province of Rizal

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.117 - 0.780	15.3 - 101.9
Mean Value	0.364	47.6

The transition period, i.e., the period which will elapse after opening of the improved road before the full impact on generation will take place, was assumed to be three years.

Traffic distribution for the "with" case was estimated by the same method as used in the analysis of present traffic.

3) Traffic Assignment

The number of passengers and commodity tonnage on each link in the "with" case was estimated by assigning OD traffic to the major road network in the "with" case. They were converted to the number of vehicles using the modal distribution in the "with" case. Changes in modal distribution with changes in road condition were estimated reffering to the present distribution in other road links in a similar situation but in the road condition. The transition period of a complete change in modal distribution was assumed to be three years.

The traffic in the "with" case was broken down into following four categories for convenience of traffic benefit estimation:

Normal Traffic: Flow of passengers and freight which will occur even without road improvement. However, changes in the number of vehicles is possible due to changes in modal distribution.

Diverted Traffic-1: Traffic which diverts to a certain road from other routes as a consequence of road improvement. This is usually called simply diverted traffic.

Diverted Traffic-2: Traffic which changes destination as a consequence of road improvement but for the same trip purpose as in the "w/o" case. This is possible in the case of improvement of the access road to the nearest town which is at present barely accessible due to poor conditions. This traffic is called "Diverted Traffic-2" in this Study, distinguished from Diverted Traffic-1.

Generated Traffic: Increased traffic brought about by road improvement.

3.2.3 Estimated Present and Future Traffic

Estimated present and future traffic on the major road is illustrated in Figure 3.2-4 and Figure 3.2-5, respectively.

Estimated present and future movements of passengers and commodity by link are presented in Table 3.2-4, and estimated traffic volumes are presented in Table 3.2-5.

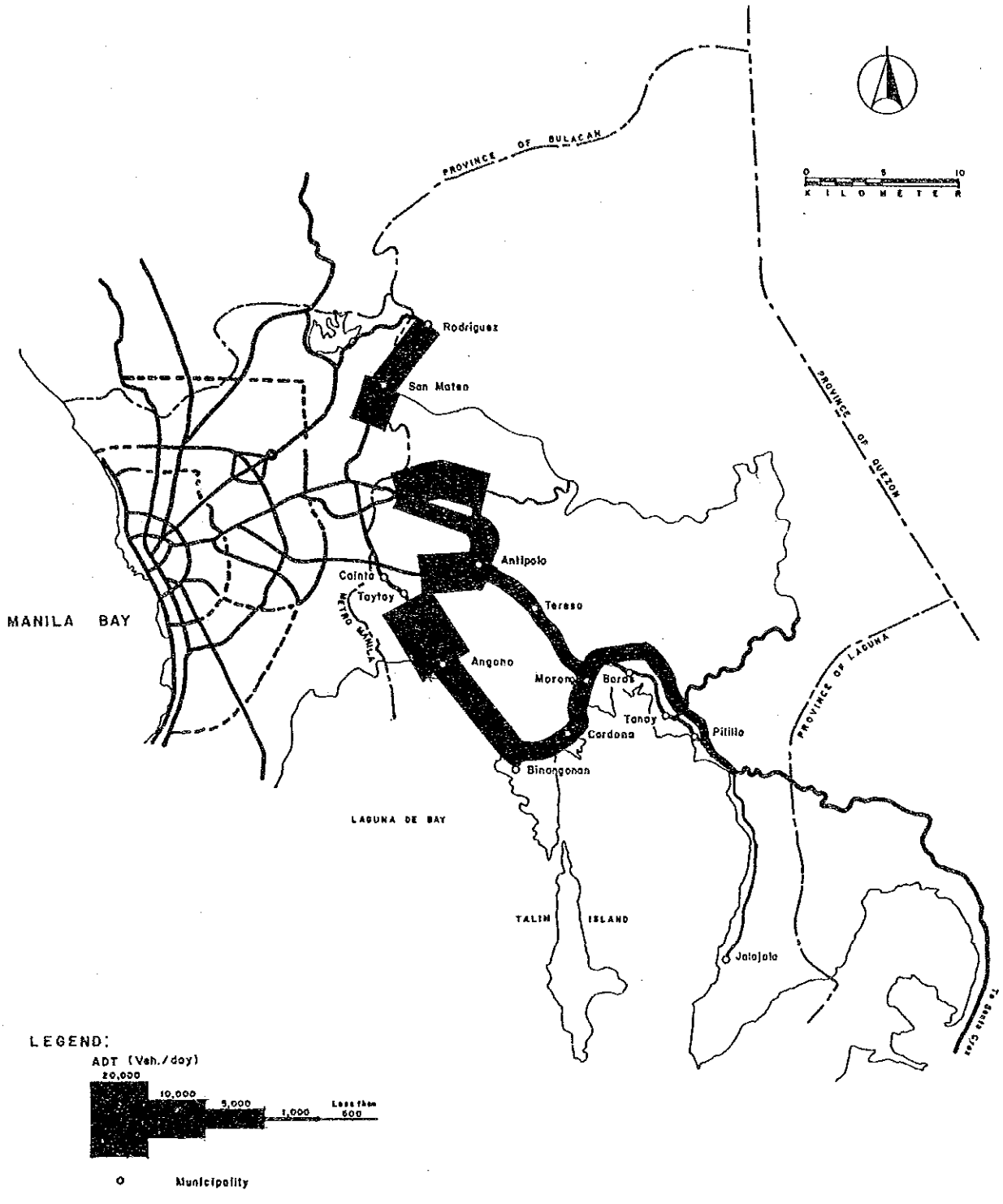


FIGURE 3.2-4 ESTIMATED TRAFFIC VOLUME (1990)

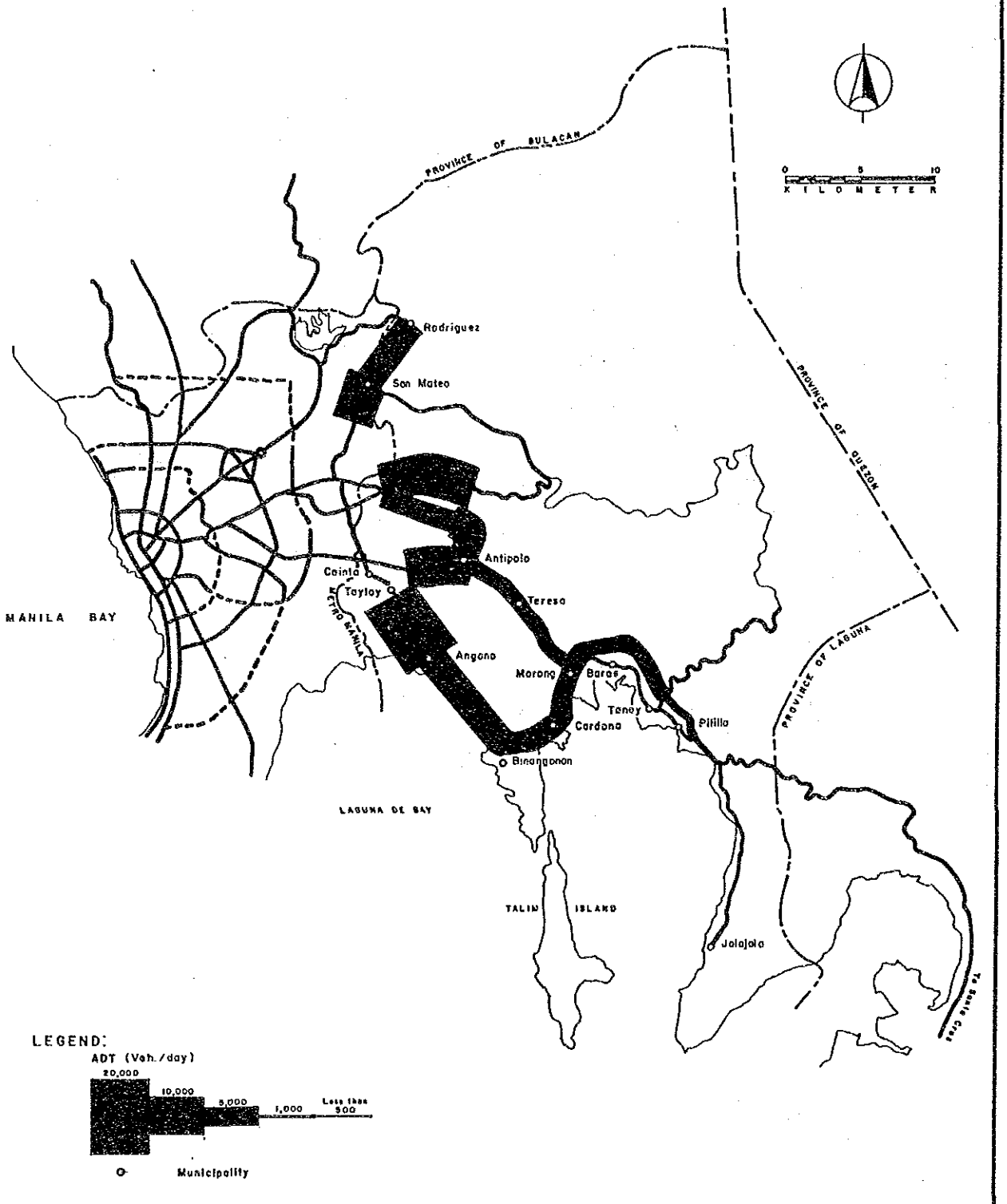


FIGURE 3.2-5 ESTIMATED TRAFFIC VOLUME (1993)
"WITH PROJECT" CASE

TRAFFIC PROJECTION RIZAL

TABLE 3.2 - 4 (1)

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
1	1990	54758				54758	9348.05				9348.05
	1993	61435	-	-9	-	61426	10216.13	-	-1.71	-	10214.42
	1997	71491	-	28	-	71518	11495.92	-	-3.87	-	11492.04
	2007	98582	-	63	-	98645	14482.09	-	1.71	-	14483.80
	2017	127281	-	103	-	127384	16960.59	-	10.60	-	16971.19
2	1990	2952				2952	376.83				376.83
	1993	3458	50	2709	-	6216	428.04	16.78	243.85	-	688.67
	1997	4264	78	3381	-	7723	509.49	12.76	309.33	-	831.58
	2007	6613	174	5442	-	12229	727.20	11.61	531.31	-	1270.12
	2017	9268	308	7889	-	17465	932.07	15.49	765.25	-	1712.80
3	1990	25				25	5.10				5.10
	1993	27	50	56	-	133	6.29	16.78	12.03	-	35.10
	1997	30	78	74	-	182	7.35	12.76	12.30	-	32.42
	2007	40	174	136	-	349	7.64	11.61	14.41	-	33.66
	2017	54	308	210	-	573	8.04	15.49	18.53	-	42.06
4	1990	61549				61549	7592.60				7592.60
	1993	69071	-	1	-	69073	8276.04	-	.23	-	8276.27
	1997	80551	-	3	-	80554	9283.94	-	.34	-	9284.28
	2007	111747	-	7	-	111755	11688.16	-	.90	-	11689.06
	2017	144718	-	22	-	144740	13738.03	-	2.07	-	13740.10
5	1990	42228				42228	5102.24				5102.24
	1993	46458	-	167	-	46625	5447.13	-	34.69	-	5481.83
	1997	52768	-	215	-	52983	5945.04	-	45.47	-	5990.51
	2007	68474	-	357	-	68831	6988.51	-	81.26	-	7069.77
	2017	83379	-	509	-	83888	7723.27	-	118.02	-	7841.29
6	1990	15443				15443	3076.89				3076.89
	1993	17328	-	-19	-	17309	3359.29	-	-1.99	-	3357.30
	1997	20187	-	-1	-	20186	3772.30	-	-3.06	-	3769.24
	2007	27933	-	25	-	27958	4739.89	-	.56	-	4740.45
	2017	36201	-	-14	-	36187	5570.71	-	-.65	-	5570.07
7	1990	23364				23364	4561.67				4561.67
	1993	28358	-50	2270	-	30578	4910.26	-16.78	158.80	-	5052.28
	1997	37284	-78	2655	-	39861	5532.08	-12.76	222.66	-	5741.98
	2007	66384	-174	3887	-	70098	7719.27	-11.61	368.83	-	8076.48
	2017	101216	-308	5416	-	106325	10336.86	-15.49	497.63	-	10819.00
8	1990	55491				55491	5779.76				5779.76
	1993	62257	-	-68	-	62189	6310.29	-	-3.78	-	6306.51
	1997	72525	-	-2	-	72523	7085.82	-	-5.77	-	7080.05
	2007	100349	-	91	-	100440	8902.57	-	1.12	-	8903.70
	2017	130054	-	-52	-	130001	10462.91	-	-1.18	-	10461.73

TRAFFIC PROJECTION RIZAL
TABLE 3.2 - 4 (2)
Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
	1990	21877				21877	2832.55				2832.55
	1993	27374	-50	888	-	28211	3448.35	-16.78	.44	-	3432.01
9	1997	36166	-78	685	-	36773	4506.36	-12.76	-35.84	-	4457.76
	2007	61221	-174	229	-	61276	7298.86	-11.61	-163.70	-	7123.54
	2017	88317	-308	300	-	88309	9610.69	-15.49	-251.35	-	9343.85
	1990	20783				20783	2586.65				2586.65
	1993	26001	-50	866	-	26817	3176.55	-16.78	2.12	-	3161.89
10	1997	34443	-78	673	-	35038	4204.52	-12.76	-33.75	-	4158.00
	2007	58866	-174	226	-	58918	6960.46	-11.61	-161.59	-	6787.26
	2017	85531	-308	305	-	85528	9264.70	-15.49	-249.32	-	8999.89
	1990	82405				82405	7948.82				7948.82
	1993	92463	-	128	-	92591	8661.69	-	4.04	-	8665.73
11	1997	107818	-	57	-	107876	9722.11	-	3.17	-	9725.28
	2007	149701	-	-132	-	149569	12285.25	-	-13.96	-	12271.28
	2017	193855	-	31	-	193886	14459.60	-	-22.99	-	14436.61
	1990	49795				49795	3687.85				3687.85
	1993	55347	-	193	-	55540	3950.09	-	6.90	-	3957.00
12	1997	63719	-	88	-	63806	4340.84	-	5.67	-	4346.50
	2007	86694	-	-202	-	86492	5330.23	-	-22.88	-	5307.35
	2017	111093	-	53	-	111147	6186.53	-	-38.49	-	6148.04
	1990	38409				38409	2615.19				2615.19
	1993	43160	-	277	-	43437	2861.63	-	13.29	-	2874.91
13	1997	50421	-	162	-	50583	3266.91	-	7.12	-	3274.03
	2007	70953	-	-151	-	70802	4418.72	-	-44.25	-	4374.47
	2017	93281	-	108	-	93389	5461.01	-	-82.15	-	5378.86
	1990	35672				35672	2452.64				2452.64
	1993	40371	-	315	-	40686	2720.68	-	13.37	-	2734.05
14	1997	47591	-	194	-	47785	3168.24	-	4.84	-	3173.08
	2007	68120	-	-129	-	67990	4432.80	-	-53.67	-	4379.13
	2017	90493	-	121	-	90614	5552.33	-	-96.08	-	5456.25
	1990	23786				23786	2762.53				2762.53
	1993	26599	-50	-267	-	26282	3111.04	-16.78	-41.88	-	3052.38
15	1997	30910	-78	-281	-	30551	3637.95	-12.76	-49.23	-	3575.95
	2007	42828	-174	-332	-	42323	4863.40	-11.61	-59.38	-	4792.41
	2017	56285	-308	-454	-	55523	5912.32	-15.49	-64.37	-	5832.46
	1990	21718				21718	2573.12				2573.12
	1993	24308	-50	-239	-	24018	2889.93	-16.78	-38.22	-	2834.93
16	1997	28284	-78	-254	-	27952	3369.52	-12.76	-44.58	-	3312.18
	2007	39346	-174	-304	-	38869	4498.12	-11.61	-53.38	-	4433.13
	2017	51985	-308	-425	-	51252	5486.81	-15.49	-58.46	-	5412.85

TRAFFIC PROJECTION RIZAL
TABLE 3.2 - 4 (3)
Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
	1990	12339				12339	1694.68				1694.68
	1993	13519	-	-37	-	13482	1827.97	-	-4.90	-	1823.07
17	1997	15272	-	-28	-	15244	2020.24	-	-5.87	-	2014.37
	2007	19656	-	-7	-	19649	2421.39	-	-5.18	-	2416.21
	2017	23912	-	-26	-	23886	2707.64	-	-4.86	-	2702.79
	1990	7775				7775	1150.41				1150.41
	1993	8555	-	-19	-	8536	1243.16	-	-2.63	-	1240.53
18	1997	9721	-	-12	-	9708	1377.17	-	-3.05	-	1374.12
	2007	12699	-	3	-	12702	1666.57	-	-1.98	-	1664.60
	2017	15675	-	-12	-	15663	1887.82	-	-1.81	-	1886.01
	1990	3688				3688	656.98				656.98
	1993	4140	-	-6	-	4134	716.78	-	-.35	-	716.43
19	1997	4828	-	-2	-	4826	804.69	-	-.49	-	804.21
	2007	6689	-	6	-	6695	1011.81	-	.26	-	1012.07
	2017	8668	-	-3	-	8665	1189.32	-	.19	-	1189.51
	1990	4169				4169	544.03				544.03
	1993	4502	-	-6	-	4495	570.91	-	-.28	-	570.62
20	1997	4985	-	-2	-	4982	608.54	-	-.37	-	608.17
	2007	6109	-	5	-	6114	676.83	-	.17	-	677.01
	2017	7109	-	-2	-	7107	714.59	-	.12	-	714.70
	1990	4597				4597	598.29				598.29
	1993	5451	-50	-64	-	5337	688.74	-16.78	-12.53	-	659.44
21	1997	6839	-78	-78	-	6683	831.47	-12.76	-12.99	-	805.72
	2007	11349	-174	-127	-	11048	1254.47	-11.61	-14.23	-	1228.62
	2017	17671	-308	-218	-	17144	1773.90	-15.49	-18.41	-	1740.00
	1990	8173				8173	1561.53				1561.53
	1993	11305	-50	2319	-	13574	1602.20	-16.78	166.13	-	1751.55
22	1997	17414	-78	2689	-	20025	1792.50	-12.76	230.58	-	2010.32
	2007	38877	-174	3905	-	42608	3000.33	-11.61	372.61	-	3361.32
	2017	65545	-308	5476	-	70713	4786.89	-15.49	502.74	-	5274.14
	1990	139				139	10.32				10.32
	1993	159	-	2832	-	2992	12.10	-	260.10	-	272.20
23	1997	192	-	3503	-	3695	15.44	-	330.45	-	345.89
	2007	289	-	5557	-	5846	26.26	-	556.46	-	582.72
	2017	400	-	8005	-	8405	37.30	-	790.43	-	827.73
	1990	3318				3318	992.30				992.30
	1993	3724	-	-	-	3724	1081.62	-	-.05	-	1081.56
24	1997	4343	-	-	-	4343	1213.34	-	-.06	-	1213.28
	2007	6025	-	-	-	6025	1527.56	-	-.05	-	1527.51
	2017	7803	-	-	-	7803	1795.49	-	.04	-	1795.53

TRAFFIC PROJECTION RIZAL

TABLE 3.2 - 4 (4)

Movement of Passengers and Commodity

Link	Year	Number of Passengers					Commodity Tonnage				
		Normal	Diverted-1	Diverted-2	Generated	Total	Normal	Diverted-1	Diverted-2	Generated	Total
	1990	12420				12420	1623.88				1623.88
	1993	13496	-	-22	-	13473	1714.24	-	-.88	-	1713.37
25	1997	15074	-	-9	-	15064	1841.01	-	-.82	-	1840.19
	2007	18821	-	20	-	18841	2081.67	-	1.93	-	2083.60
	2017	22225	-	-6	-	22219	2228.05	-	2.58	-	2230.63

TRAFFIC PROJECTION RIZAL

TABLE 3.2 - 5 (1)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
1	1990	2747	4954	35	1872	9608	-	274	-	9882									
	1993	3056	5529	40	2046	10671	-	307	-	10978	3056	5529	40	2045	10670	-	307	-	10977
	1997	3520	6393	46	2302	12261	-	357	-	12619	3520	6395	46	2301	12263	-	358	-	12620
	2007	4725	8672	64	2900	16361	-	493	-	16853	4727	8677	64	2900	16368	-	493	-	16861
	2017	5937	11014	82	3396	20430	-	636	-	21066	5941	11023	82	3398	20445	-	637	-	21082
2	1990	170	233	-	77	481	-	39	-	520									
	1993	198	272	-	88	558	-	45	-	603	347	473	4	141	965	-	82	-	1047
	1997	242	335	-	104	681	-	56	-	737	428	556	17	170	1171	-	101	-	1273
	2007	368	515	-	149	1032	-	87	-	1119	672	878	27	260	1837	-	160	-	1997
	2017	506	716	-	191	1413	-	122	-	1535	949	1247	38	351	2585	-	229	-	2814
3	1990	2	2	-	1	5	-	.2	-	5									
	1993	2	2	-	1	6	-	.3	-	6	12	10	-	7	29	-	1	-	31
	1997	3	2	-	1	7	-	.3	-	7	12	13	-	7	33	-	2	-	34
	2007	3	3	-	2	8	-	.4	-	8	22	25	-	8	54	-	3	-	57
	2017	4	4	-	2	10	-	.5	-	10	35	40	-	10	84	-	5	-	90
4	1990	4762	3417	566	1351	10095	-	462	-	10557									
	1993	5295	3812	635	1473	11215	-	518	-	11733	5296	3812	635	1473	11216	-	518	-	11734
	1997	6103	4413	740	1653	12908	-	604	-	13512	6103	4413	740	1653	12909	-	604	-	13513
	2007	8230	6014	1027	2080	17352	-	838	-	18190	8231	6015	1027	2081	17353	-	838	-	18191
	2017	10382	7663	1330	2445	21820	-	1085	-	22905	10383	7664	1330	2446	21823	-	1086	-	22909
5	1990	2698	3381	93	906	7077	-	264	-	7341									
	1993	2940	3699	102	967	7709	-	290	-	7999	2953	3715	103	973	7743	-	291	-	8035
	1997	3298	4173	116	1055	8643	-	330	-	8972	3315	4193	117	1063	8688	-	331	-	9019
	2007	4156	5329	151	1240	10876	-	428	-	11304	4185	5362	151	1255	10953	-	430	-	11383
	2017	4926	6395	183	1371	12875	-	521	-	13396	4968	6443	185	1392	12987	-	524	-	13511
6	1990	3216	540	69	518	4344	-	193	-	4537									
	1993	3582	602	78	566	4828	-	217	-	5045	3578	602	78	566	4824	-	216	-	5040
	1997	4132	697	91	636	5555	-	252	-	5807	4131	696	91	635	5553	-	252	-	5805
	2007	5577	947	126	799	7449	-	349	-	7798	5581	948	126	799	7454	-	349	-	7803
	2017	7062	1207	163	939	9371	-	453	-	9823	7060	1207	163	939	9368	-	452	-	9820
7	1990	4839	813	70	769	6491	430	292	-	7213									
	1993	5691	965	85	827	7569	522	354	-	8445	6066	1032	92	851	8041	563	382	-	8986
	1997	7213	1236	112	932	9494	686	466	-	10646	7662	1316	120	968	10065	733	498	-	11297
	2007	12223	2127	200	1301	15851	1221	830	-	17902	12886	2243	211	1361	16701	1290	876	-	18867
	2017	18220	3192	305	1742	23459	1862	1265	-	26587	19128	3352	320	1823	24623	1956	1329	-	27909
8	1990	4981	3448	352	864	9646	-	416	-	10062									
	1993	5540	3848	395	943	10726	-	467	-	11193	5534	3844	394	943	10716	-	466	-	11182
	1997	6378	4451	460	1059	12349	-	544	-	12892	6376	4450	460	1058	12345	-	544	-	12889
	2007	8570	6051	637	1331	16589	-	753	-	17341	8576	6056	637	1331	16600	-	753	-	17353
	2017	10802	7715	825	1564	20906	-	975	-	21882	10799	7712	825	1564	20900	-	975	-	21875

TRAFFIC PROJECTION RIZAL

TABLE 3.2 - 5 (2)

Traffic Volume

Link	Year	w/o								with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
	1990	1595	1189	212	517	3513	-	164	-	3677									
	1993	1977	1481	265	629	4352	-	205	-	4557	2013	1517	273	626	4430	-	212	-	4642
9	1997	2602	1953	350	822	5728	-	271	-	5999	2621	1977	356	814	5767	-	276	-	6043
	2007	4340	3282	592	1332	9546	-	459	-	10005	4309	3271	593	1300	9473	-	460	-	9932
	2017	6082	4665	855	1754	13356	-	662	-	14018	6030	4645	855	1705	13234	-	662	-	13897
	1990	1356	1370	214	384	3324	-	156	-	3480									
	1993	1682	1705	268	472	4126	-	195	-	4321	1705	1741	276	470	4192	-	201	-	4393
10	1997	2227	2258	354	624	5464	-	258	-	5722	2235	2279	361	617	5492	-	263	-	5755
	2007	3749	3825	606	1034	9213	-	441	-	9654	3706	3801	606	1008	9121	-	442	-	9563
	2017	5230	5429	880	1376	12915	-	641	-	13557	5163	5389	880	1336	12768	-	641	-	13410
	1990	6861	5618	413	1125	14017	-	721	-	14739									
	1993	7623	6268	464	1226	15580	-	809	-	16389	7632	6275	464	1226	15597	-	810	-	16408
11	1997	8779	7255	541	1376	17950	-	943	-	18894	8783	7259	541	1376	17959	-	944	-	18903
	2007	11833	9902	751	1738	24225	-	1310	-	25535	11822	9893	750	1736	24202	-	1309	-	25510
	2017	14899	12619	972	2046	30536	-	1696	-	32232	14894	12617	973	2043	30526	-	1697	-	32223
	1990	2801	3360	361	509	7031	-	280	-	7311									
	1993	3072	3709	401	545	7727	-	311	-	8039	3081	3720	403	546	7750	-	312	-	8063
12	1997	3480	4234	462	599	8775	-	358	-	9133	3485	4240	463	600	8787	-	359	-	9146
	2007	4577	5661	628	736	11602	-	488	-	12089	4563	5646	627	732	11568	-	487	-	12055
	2017	5688	7143	805	854	14489	-	625	-	15114	5679	7139	806	848	14472	-	625	-	15097
	1990	2088	2478	288	384	5239	-	240	-	5479									
	1993	2328	2772	324	421	5844	-	270	-	6114	2341	2789	326	423	5879	-	271	-	6150
13	1997	2700	3225	379	480	6784	-	315	-	7100	2708	3235	380	481	6804	-	316	-	7120
	2007	3755	4510	533	650	9447	-	443	-	9891	3738	4495	532	643	9408	-	443	-	9850
	2017	4850	5873	700	803	12226	-	583	-	12809	4833	5865	701	791	12190	-	584	-	12774
	1990	1926	2236	277	383	4823	-	245	-	5068									
	1993	2168	2522	314	425	5429	-	278	-	5706	2183	2541	316	427	5467	-	280	-	5747
14	1997	2547	2968	370	495	6379	-	327	-	6706	2555	2979	371	496	6401	-	329	-	6729
	2007	3622	4233	529	693	9076	-	468	-	9545	3605	4218	528	684	9035	-	467	-	9502
	2017	4736	5572	703	868	11879	-	622	-	12501	4719	5564	704	853	11839	-	623	-	12462
	1990	1588	1653	176	429	3846	-	178	-	4024									
	1993	1781	1852	196	483	4312	-	199	-	4512	1755	1827	194	474	4249	-	197	-	4446
15	1997	2075	2155	228	565	5023	-	232	-	5255	2046	2128	225	555	4954	-	229	-	5183
	2007	2833	2961	316	755	6865	-	321	-	7187	2796	2925	312	744	6777	-	317	-	7094
	2017	3609	3824	415	918	8766	-	422	-	9189	3560	3773	410	905	8648	-	416	-	9064
	1990	1502	1510	153	397	3561	-	176	-	3738									
	1993	1683	1692	171	446	3991	-	198	-	4189	1658	1669	169	437	3933	-	195	-	4128
16	1997	1960	1969	199	520	4648	-	230	-	4878	1933	1944	196	511	4584	-	227	-	4811
	2007	2680	2714	276	694	6364	-	320	-	6684	2645	2680	273	684	6282	-	316	-	6597
	2017	3426	3526	365	846	8164	-	422	-	8586	3379	3477	360	835	8050	-	416	-	8467

TRAFFIC PROJECTION RIZAL

TABLE 3.2 - 5 (3)

Traffic Volume

Link	Year	w/o									with							
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
17	1990	939	884	82	260	2165	-	100	-	2265									
	1993	1022	965	90	281	2357	-	110	-	2467	1019	962	89	280	2350	-	110	-	2460
	1997	1142	1085	101	310	2638	-	124	-	2762	1140	1082	101	309	2632	-	124	-	2756
	2007	1423	1374	130	372	3299	-	160	-	3459	1421	1373	130	371	3296	-	160	-	3455
	2017	1669	1642	159	416	3886	-	194	-	4079	1666	1640	158	415	3880	-	194	-	4074
18	1990	631	563	49	175	1418	-	68	-	1486									
	1993	688	617	54	190	1548	-	75	-	1623	686	615	54	189	1544	-	75	-	1619
	1997	772	697	61	210	1739	-	85	-	1824	770	696	61	210	1736	-	85	-	1821
	2007	972	895	80	254	2200	-	111	-	2312	971	895	80	254	2200	-	111	-	2311
	2017	1153	1085	98	288	2624	-	137	-	2761	1152	1084	98	288	2622	-	137	-	2759
19	1990	454	201	29	100	784	-	53	-	837									
	1993	503	224	33	109	869	-	60	-	928	502	224	33	109	868	-	59	-	927
	1997	576	260	38	122	996	-	69	-	1066	576	260	38	122	996	-	69	-	1065
	2007	764	354	53	153	1324	-	96	-	1420	764	354	53	153	1325	-	96	-	1421
	2017	949	451	69	180	1649	-	125	-	1774	949	451	69	180	1649	-	125	-	1773
20	1990	227	358	18	83	687	-	23	-	710									
	1993	242	384	20	87	733	-	25	-	758	241	384	20	87	732	-	25	-	757
	1997	262	422	22	93	799	-	28	-	827	262	421	22	93	798	-	28	-	826
	2007	305	506	27	103	941	-	34	-	976	305	506	27	103	942	-	34	-	976
	2017	338	577	32	109	1056	-	40	-	1096	338	577	32	109	1056	-	40	-	1096
21	1990	400	361	-	102	863	-	86	-	949									
	1993	470	426	-	118	1013	-	102	-	1116	457	392	9	113	971	-	100	-	1071
	1997	583	530	-	142	1256	-	128	-	1384	568	431	33	138	1170	-	125	-	1295
	2007	941	868	-	214	2022	-	213	-	2235	917	702	55	210	1884	-	207	-	2091
	2017	1426	1333	-	303	3061	-	331	-	3393	1388	1072	85	297	2842	-	321	-	3164
22	1990	1306	309	-	205	1820	1298	215	-	3333									
	1993	1595	399	-	211	2205	1714	297	-	4215	1849	471	-	230	2551	2032	356	-	4939
	1997	2199	582	-	236	3017	2541	457	-	6015	2509	667	-	264	3441	2914	526	-	6880
	2007	4528	1251	-	395	6173	5525	1021	-	12719	4990	1374	-	442	6806	6066	1118	-	13991
	2017	7530	2095	-	629	10255	9275	1721	-	21251	8166	2266	-	694	11125	10023	1856	-	23004
23	1990	44	-	-	2	45	-	-	-	45									
	1993	50	-	-	2	52	-	-	-	52	691	70	-	53	814	-	9	-	824
	1997	60	-	-	3	63	-	-	-	63	220	260	-	74	554	-	35	-	588
	2007	91	-	-	5	96	-	-	-	96	354	411	-	124	889	-	55	-	944
	2017	127	-	-	7	134	-	-	-	134	507	591	-	176	1274	-	79	-	1353
24	1990	603	187	-	187	977	-	129	-	1106									
	1993	670	209	-	204	1083	-	144	-	1227	670	209	-	204	1082	-	144	-	1227
	1997	771	242	-	229	1242	-	168	-	1410	771	242	-	229	1242	-	168	-	1410
	2007	1037	330	-	288	1655	-	233	-	1888	1037	330	-	288	1655	-	233	-	1888
	2017	1305	420	-	338	2064	-	302	-	2366	1305	420	-	338	2064	-	302	-	2366

TRAFFIC PROJECTION RIZAL

TABLE 3.2 - 5 (4)

Traffic Volume

Link	Year	w/o									with								
		Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total	Car /Van	Jeep-ney	Bus	Tru-ck	Sub-Total	Tri-cycl	Mot. cycl	Ani-mal	Total
	1990	1700	432	-	214	2346	1863	326	-	4534									
	1993	1828	467	-	225	2521	2017	354	-	4892	1826	466	-	225	2518	2014	354	-	4885
25	1997	2014	518	-	242	2774	2242	396	-	5411	2013	518	-	242	2772	2240	395	-	5408
	2007	2432	636	-	274	3342	2767	494	-	6603	2434	637	-	274	3345	2770	495	-	6610
	2017	2784	740	-	293	3817	3234	583	-	7634	2784	740	-	293	3818	3233	583	-	7634

3.3 TRAFFIC ANALYSIS AND FORECAST: DEVELOPMENT PROJECT

Traffic on development project roads was forecasted separately for passenger traffic, non-agricultural traffic and agricultural traffic. The number of passengers and commodity tonnage were estimated first, and then they were converted to the number of vehicles assuming modal distribution and occupancy/average load. Figure 3.3.-1 shows the schematic diagram of traffic forecast for development project.

3.3.1 Passenger Traffic and Non-Agricultural Traffic

The population residing within the road influence area, which is defined as the area from which local existing or potential traffic using the road derives, was obtained mainly from distribution of barangays shown in 1:50,000 topographical maps and the NCSO 1980 Census of Population and Housing, and supplemented by information obtained from barangay interviews. The population forecasts were prepared using the NCSO report.

The number of passengers and non-agricultural commodity tonnage were obtained as the product of population by the per capita generation factor. Table 3.3-1 shows the generation factors commodity used in the analysis, which was derived mainly based on the traffic survey and referring to previous studies. In the case of particular roads where the common values were deemed inapplicale, specific values were used.

TABLE 3.3-1 PER CAPITA TRAFFIC GENERATION FACTORS (MINOR ROAD) : Province of Rizal

Existing Road Condition	Passenger Movement (trip/person/day)		Non-Agricultural Commodity (kg/person/day)	
	w/o	with	w/o	with
Paved/Gravel				
Good/Fair	0.30	0.30	6.0	6.0
Bad	0.25	0.28	4.8	5.4
Very Bad	0.20	0.28	1.8	3.0
Earth Road	0.15	0.28	1.5	3.0
Impassable to motoried vehicle	0.03	0.10	1.2	3.0

The modal distribution and the occupancy/average load used in the conversion to traffic volume by vehicle type were estimated individually for each road based on the road

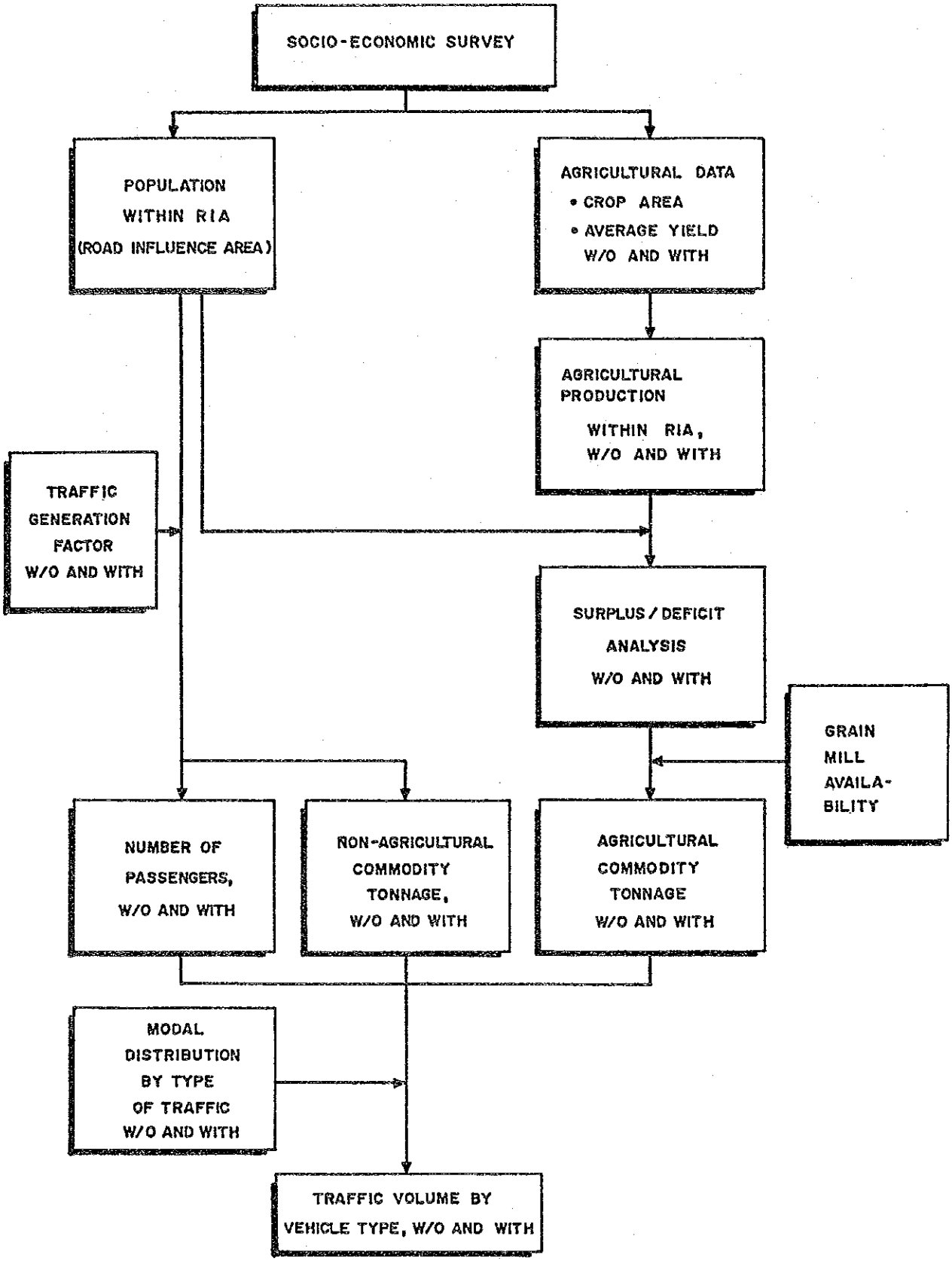


FIGURE 3.3-1
PROCEDURE OF TRAFFIC FORECAST FOR DEVELOPMENT PROJECTS

inventory survey and the traffic survey.

3.3.2 Agricultural Traffic

Agricultural commodity tonnage was estimated based on the agricultural production within the road influence area, taking into consideration i) home consuption and surplus/deficit and ii) availability of grain mill(s) in the road influence area, as regards food grain.

i) Home consumption of food grain was calculated as population times per capita grain consumption (assumed to be 130 kg in a milled form), and the surplus or deficit production was calculated based thereupon.

ii) In case of no mill in the road influence area, all net production is assumed to move out in the form of palay/unmilled corn. Milled grain products for home comsumption are then transported back. An eventual deficit moves into the road influence area in the form of milled products.

Provided one or more mills exist in the road influence area, the transport flows are assumed as follows:

- Home consumption remains in the road influence area (no transport movement assumed).
- Surplus production would be transported out, traditionally in the form of unmilled food grains.
- Deficit production would be moved into the road influence area in milled form.

Agricultural commodity tonnage was cnverted to number of vehicles using the modal distribution and average load, which were estimated individually for each road considering the transport circumstances.

3.3.3 Estimated Present and Future Traffic

Estimated present and future traffic is presented in Table 3.4-1 in the next Section.

3.4 SUMMARY OF TRAFFIC VOLUME ON STUDIED ROADS

Estimated present and future traffic volumes of the studied roads comprising of traffic and development projects are presented by each road project in Table 3.4-1.

TABLE 3.4 - 1 (1)

Traffic Volume by Vehicle Type RIZAL

Class of Road	Type of Impr't	Road Number	w/o										with									
			Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat	Car	Jeep-ney	Bus	Truck	Total	Tri-cycle	Motor cycle	Ani-mal	Walk-ing	Boat
Primary Major	Rehab/ Imp-1	N13-5	7623	6268	464	1226	15580	0	809	-	-	-	7632	6275	464	1226	15597	0	810	-	-	-
		N13-7	3072	3709	401	545	7727	0	311	-	-	-	3081	3720	403	546	7750	0	312	-	-	-
Second'y Major	Rehab/ Imp-1	N10-2	3582	602	78	566	4828	-	217	-	-	-	3578	602	78	566	4824	-	216	-	-	-
		N10-3	3582	602	78	566	4828	-	217	-	-	-	3578	602	78	566	4824	-	216	-	-	-
		N12-3	1977	1481	265	629	4352	0	205	-	-	-	2013	1517	273	626	4430	0	212	-	-	-
		N12-4	1977	1481	265	629	4352	0	205	-	-	-	2013	1517	273	626	4430	0	212	-	-	-
		N12-5	1682	1705	268	472	4126	0	195	-	-	-	1705	1741	276	470	4192	0	201	-	-	-
		N2-2	1595	399	-	211	2205	1714	297	-	-	-	1849	471	-	230	2551	2032	356	-	-	-
		N20-2	470	426	-	118	1013	0	102	-	-	-	457	392	9	113	971	0	100	-	-	-
		N18-1	242	384	20	87	733	0	25	-	-	-	241	384	20	87	732	0	25	-	-	-
		N23-1	50	-	-	2	52	0	-	-	-	-	691	70	-	53	814	0	9	-	-	-
		N1-4	2	2	-	1	6	-	0	-	-	-	12	10	-	7	29	-	1	-	-	-
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P3-1	26	37	-	4	68	33	12	12	32	-	30	41	-	5	76	35	13	-	-	-
		N1-5	50	43	-	6	99	-	8	23	20	-	63	42	-	8	113	-	13	-	-	-
		P3-2	9	18	-	2	29	-	-	15	44	-	14	19	-	2	36	16	6	-	-	-
		N3-1	322	259	-	20	601	157	85	-	-	-	330	266	-	20	616	161	87	-	-	-
		P5-1	116	164	-	11	290	216	54	-	-	-	119	180	-	11	310	171	55	-	-	-
		P18-1	80	109	-	7	196	148	35	-	-	-	79	120	-	8	206	113	37	-	-	-
		P2-1	60	37	-	6	102	293	51	-	246	-	66	57	-	6	128	328	58	-	92	-
		N4-3	204	117	-	130	452	-	29	-	-	-	170	96	13	113	391	-	31	-	-	-
Minor (Baran-gay)	Rehab/ Imp-1	B11-6	4	7	-	1	11	-	-	5	16	-	6	8	-	1	16	7	3	-	-	-
		B11-5	12	30	-	3	45	-	-	22	73	-	24	34	-	3	61	29	11	-	-	-
		B1-1	186	253	-	19	458	306	83	-	-	-	208	312	-	19	540	265	96	-	-	-
		B9-2	30	44	-	4	78	39	14	11	38	-	34	49	-	4	87	41	15	-	-	-
		B7-2	65	62	-	94	222	-	10	13	24	-	83	65	-	98	246	-	15	-	-	-
		B0-1	31	43	-	4	78	52	14	-	-	-	73	107	-	7	188	91	33	-	-	-

CHAPTER 4
PROJECT IDENTIFICATION AND SCREENING

4.1 PROJECT IDENTIFICATION

4.1.1 Field Surveys

Field survey was conducted by the Study Team to assess present condition of all major roads and some other typical minor roads (these are referred to as "Surveyed Roads").

Road projects (mostly minor roads) proposed by the local officials were also collected and road conditions of these roads were obtained by the interview survey (these are referred to as " Road Projects proposed by local officials").

Road projects surveyed by the Study Team and proposed by the local officials were combined and integrated, because some road projects were both surveyed by the Study Team and also proposed by the local officials, and a list of Studied Roads was prepared.

Summaries of "Surveyed Roads", "Road Projects proposed by Local officials "and" Studied Roads" are shown in Table 4.1-1.

TABLE 4.1-1 SUMMARY OF SURVEYED ROADS
Road Projects Proposed by Local Officials and Studied Roads
Province of Rizal

	Road Class	National Roads	Prov'l/City Roads	Barangay Roads	Total
Surveyed Road	Major Rd.	194.3	-	-	194.3
	Minor Rd.	34.9	40.8	-	75.7
	Total	299.2	40.8	-	270.0
Rd. Proj. Proposed by Local Officials	Major Rd.	86.6	-	-	86.6
	Minor Rd.	23.7	16.5	126.6	166.8
	Total	110.3	16.5	126.6	253.4
Studied Road	Major Rd.	208.3	-	-	208.3
	Minor Rd.	34.9	40.8	126.6	202.3
	Total	243.2	40.8	126.6	410.6

4.1.2 Project Identification

1) Project Identification Criteria

Project identification criteria are shown in Table 4.1-2.

TABLE 4.1-2 PROJECT IDENTIFICATION CRITERIA

Item	Condition of Identification	
	Major Roads	Minor Roads
(1) Existing Links		
* Carriageway Width	Less than 6.0 meter	Less than 4.0 meters
* Pavement Type	Inferior to recommended type in the engineering Standards	Inferior to gravel
* Surface Condition	Bad or very bad 1/	Bad or very bad2/
(2) New Links	Impassable Abandoned Non-existing	
(3) Bridges	Ford crossing Spillway Timber bridge Bailey bridge	Ford crossing Spillway in structurally unsound condition Bailey bridge for AADT more than 300

Notes: 1/ Gravel road which is proposed for improvement by local officials shall be identified, even though surface condition is "fair".

2/ Gravel road of which surface condition is "fair" shall be identified, as the surface condition of gravel minor roads is easily deteriorated.

2) Identified Road Projects

All studied Roads, except those of the national primary roads and committed roads, were evaluated in accordance with the identification criteria. Road projects identified are summarized in Table 4.1-3.

TABLE 4.1-3 SUMMARY OF IDENTIFIED ROAD PROJECTS
Province of Rizal

Road Class		National Road	Prov'l/City Road	Barangay Road	Total
Major Road	Length (kms.)	119.5	-	-	119.5
	(% to Studied Roads)	(57%)	-	-	(57%)
Minor Road	Length (kms.)	22.2	36.8	126.6	185.6
	(% to Studied Roads)	(64%)	(90%)	(100%)	(92%)
Total	Length (kms.)	141.7	36.8	126.6	305.1
	(% to Studied Roads)	(58%)	(90%)	(100%)	(74%)

4.2 PROJECT SCREENING

4.2.1 Categorization

Road projects are categorized by the following factors in order to establish comprehensive prioritization criteria:

(1) Class of Roads

Major Roads	Minor Roads
* Primary major roads	*National/provincial/city roads
* Secondary major roads	* Barangay roads

(2) Urgency of work

Improvement criteria for roads and bridges are established as shown in Tables 4.2-1 and 4.2-2, respectively. Improvement works are classified into five (5) types as shown in Table 4.2-3. In view of the urgency of work to be implemented, the types of improvement are grouped into two (2) as follows:

Type A (Urgent Projects)

* Rehabilitation: Improvement of deteriorated road surface, but standard or superior class pavement, to acceptable condition.
* Improvement -1: Improvement of deteriorated road surface and substandard class pavement, to acceptable and standard pavement.
* New Construction: Construction of new road including re-construction of abandoned road.

Type B (Less Urgent Projects)

* Improvement -2: Upgrading of substandard pavement class to standard pavement class, though existing road surface condition is acceptable.
* Widening : Widening of roads with substandard carriageway width, other conditions meet engineering standards.

Note: Road projects which include only improvement of bridges are classified as "Rehabilitation".

(3) Economic Viability

Major Roads

Simplified economic evaluation is conducted for major roads. Internal Rate of Return (IRR) is calculated based on roughly estimated construction cost and traffic cost savings. Categorization is made as follows:

Improvment Type A:

* IRR of 7.5% or more
* IRR of less than 7.5%

Improvement Type B:

* IRR of 15% or more
* IRR of less than 15.0%

Minor Roads

Minor road Pre-evaluation Indicator (MPI) is developed based on Phase-1 Study results. Categorization of minor roads is made based on calculated MPI as follows:

* MPI of 7.5 or more
* MPI of less than 7.5

TABLE 4.2-1 IMPROVEMENT CRITERIA FOR ROAD

Road Class	Major Road		Minor Road	
	Standard/ Superior	Substandard	Standard/ Superior	Substandard
Good/Fair	No improvement or widening (widening)	Upgrading of pavement type (improvement-2)	No improvement	No improvement
Bad/Very bad	Improvement of surface condition (Rehabilitation)	Upgrading of pavement type (improvement-1)	Improvement surface con (Rehabilitation)	Upgrading of pavement type (Improvement-1)
Abandoned/ Non-existing	Construction of new road (New Construction)			

Note: 1) In case of carriageway width less than 6.0 meters.

TABLE 4.2-2 IMPROVEMENT CRITERIA FOR BRIDGES

Existing Bridge Type	Proposed Improvement		
	Major Road	Minor Road	
Ford Crossing	2-lane permanent bridge	Carriageway width 4.0 m: 1-lane spillway Carriageway width 6.0 m: 2-lane spillway	
Spillway	2-lane permanent bridge	No improvement	
Timber Bridge	2-lane permanent bridge	AADT less than 200	1-lane permanent bridge
		AADT more than 200	2-lane permanent bridge
Bailey Brridge	2-lane permanent bridge	AADT less than 300	No improvement
		AADT more than 300	2-lane permannet bridge

Note: 1) Where the site condition is not favorable for a spillway, a permanent bridge should be planned in accordance with the criteria for a timber bridge.

2) When the existing spillway is structurally sound and traffic disturbance is estimated less, the existing one can be utilized. Under other conditions, a permanent bridge should be planned in accordance with the criteria for a timber bridge.

TABLE 4.2-3 TYPES OF IMPROVEMENT

Type	Existing Pavement Type	Existing Surface Condition	Proposed Improvement Work
Rehabilitation	Standard or superior	Bad/ very bad	Improvement of surface condition
Improvement-1	Substandard	Bad/ very bad	Upgrading of surface type
Improvement-2	Substandard	Good/Fair	Upgrading of surface type
Widening	Standard (carriageway is narrowed than standard)	Good/Fair	Widening of existing road
New Construction	Impassable/abandoned non-existing		Construction of new road

Note: Improvement-2 and widening are not applied to minor roads.

4.2.2 Prioritization and Selection Criteria

Prioritization and selection criteria of road projects for feasibility studies are established as shown in Tables 4.2-4 and 4.2-5.

TABLE 4.2-4 PRIORITIZATION AND SELECTION OF ROAD PROJECTS
- Major Roads -

Category	Road Class	Type of Improvement	IRR	Priority Criteria	Selection Criteria
1	Primary	A	7.5 ≦ IRR	MA-1	↑
2	Secondary	A	7.5 ≦ IRR	MA-1	
3	Primary	B	15.0 ≦ IRR	MA-2	To be selected for F/S
4	Secondary	B	15.0 ≦ IRR	MA-2	
5	Primary	A	IRR < 7.5	MA-2	
6	Secondary	A	IRR < 7.5	MA-2	
7	Primary	B	IRR <15.0	MA-3	
8	Secondary	B	IRR <15.0	MA-3	

TABLE 4.2-5 PRIORITIZATION AND SELECTION OF ROAD PROJECTS
- Minor Roads -

Category	Road Class	Type of Improvement	MPI	Priority Criteria	Selection Criteria
1	National/Provincial/ City	A	7.5 ≦ MPI	MI-1	↑
2	Barangay	A	7.5 ≦ MPI	MI-1	To be selected for F/S
3	National/Provincial/ City	A	MPI < 7.5	MI-2	
4	Barangay	A	MPI <7.5	MI-2	

Note: Improvement Type A: Rehabilitation, Improvement-1, New Construction
Improvement Type B: Improvement-2, Widening

4.2.3 Priority of Identified Road Projects

Identified projects were evaluated and prioritized in accordance with criteria discussed and summarized in Tables 4.2-6 and 4.2-7.

TABLE 4.2-6 PRIORITY OF IDENTIFIED MAJOR ROADS
Province of Rizal

Category	Road Class	Type of Improvement	IRR	Priority Group	Road Length	No. of Road Links
1	Primary	A	7.5 ≤ IRR	MA-1	9.0	2
2	Secondary	A	7.5 ≤ IRR	MA-1	73.6	10
3	Primary	B	15.0 ≤ IRR	MA-2	-	-
4	Secondary	B	15.0 ≤ IRR	MA-2	-	-
5	Primary	A	IRR<7.5	MA-2	-	-
6	Secondary	A	IRR<7.5	MA-2	34.9	1
7	Primary	B	IRR<15.0	MA-3	-	-
8	Secondary	B	IRR<15.0	MA-3	2.0	1
	Total				119.5	14

Table 4.2-7 PRIORITY OF IDENTIFIED MINOR ROADS
Province of Rizal

Category	Road Class	Type of Improvement	MPI	Priority Group	Road Length	No. of Rd.Links
1	Nat'l/Provi/ City	A	7.5 ≤ MPI	MI-1	30.7	8
2	Barangay	A	7.5 ≤ MPI	MI-1	29.1	6
3	Nat'l/Provi/	A	MPI < 7.5	MI-2	28.3	4
4	Barangay	A	MPI < 7.5	MI-2	97.5	15
	Total				185.6	23

4.2.4 Selection of Road Projects For Feasibility Studies

In accordance with selection criteria discussed above, road projects under priority groups MA-1 and MA-2 for major roads and priority groups MI-1 for minor roads were initially selected, and these were plotted on 1:100,000 map to evaluate the following:

- Distribution of initially selected road projects (when these are concentrated in certain area, some minor roads were deleted, and where road projects are scarce, some minor roads were added.)

- Linkage of road projects
  (There is a case that a selected lower class road is connected with a higher class road, however, the latter is not selected due to lower priority. Such a case, a higher class road is also selected to maintain similar condition of road after implementation.)

After adjustment mentioned above, road projects were finally selected and summarized as follows:

Major Road	111.5 kms.	(12 projects)
Minor Road	67.3 kms.	(14 projects)
Total	178.8 kms.	(26 projects)

CHARTER 5
PROJECT EVALUATION

5.1 PRELIMINARY DESIGN AND COST ESTIMATE

5.1.1 Preliminary Design

1) Design Concept
There are two options in design concept for rural road improvement, as follows :

* Designing rural roads with optimum standards aimed at improving all aspects including horizontal and vertical alignments, which sometimes require massive earth works and is costly.

* Designing rural roads by basically concentrating on improving surface conditions, thus improving horizontal and vertical alignments is limited to the required minimum.

Rural roads are extensive in the number of road links as well as in length, and their present conditions are still at a poor level. Thus, requirements for rural road improvement are quite huge, while financial resources are limited. Under these circumstances, the Study Team placed priority on improving surface conditions of more roads. The preliminary design was undertaken in line with the concept of the second option.

2) Preliminary Design
On the basis of the findings of the road inventory survey, the type of improvement was determined for each subsection of road in accordance with the engineering standards and the improvement criteria.

Typical road sections for each type of improvement/rehabilitation are summarized as shown in Table 5.1-1.

Special considerations were given to steep gradient sections and flood section.

"PCC pavement for steep gradient section" was applied to sections with steep gradients where otherwise gravel surfacing might be applied, as a countermeasure against excessive gravel losses during heavy rains and impossibility for vehicles to climb. "Grade raising in flood area", was applied to sections located in flood areas.

Table 5.1-2 shows the proposed improvement for each road project subjected to the feasibility study.

TABLE 5.1-1 EXISTING CONDITION VS PROPOSED IMPROVEMENT/REHABILITATION

Type of Improvement	Road Section Type	Existing Pavement Type	Existing Pavement Condition	Proposed Pavement Type	Pavement Structure (cm) Surface Course	Base	Subbase
Rehabilitation	1 - 1	PCC	Bad/Very Bad	PCC	20 - 23	-	10
	1 - 2	PCC	Bad/Very Bad	AC Overlay	5	-	-
	1 - 3	Bituminous	- do -	AC	5	20	10
	1 - 4	Bituminous	- do -	AC Overlay	5	-	-
	1 - 5	Bituminous	- do -	BMP/DBST	5.5/1.6	15	5
	1 - 6	Gravel	- do -	Gravel	15	-	10
Improvement - 1	2 - 1	Bituminous	Bad/Very Bad	PCC	20 - 23	-	10
	2 - 2	Gravel	- do -	PCC	20 - 23	-	20
	2 - 3	Gravel	- do -	AC	5	20	20
	2 - 4	Gravel	- do -	BMP/DBST	5.5/1.6	15	15
	2 - 5	Earth	Any Condition	PCC	20 - 23	-	20
	2 - 6	Earth	- do -	AC	5	20	20
	2 - 7	Earth	- do -	BMP/DBST	5.5/1.6	15	15
	2 - 8	Earth	- do -	Gravel	15	-	10
Improvement - 2	3 - 1	Bituminous	Good/fair	PCC	20 - 23	-	10
	3 - 2	Gravel	- do -	PCC	20 - 23	-	10
	3 - 3	Gravel	- do -	AC	5	20	10
	3 - 4	Gravel	- do -	BMP/DBST	5.5/1.6	15	5
Widening	4 - 1	PCC	Good/fair	Widening w/PCC	20 - 23	-	20
	4 - 2	Bituminous	- do -	Widening w/AC	5	20	20
	4 - 3	Bituminous	- do -	Widening w/BMP/DBST	5.5/1.6	15	15
	4 - 4	Gravel	- do -	Widening w/Gravel	15	-	10
New Construction	5 - 1	-	-	PCC	20 - 23	-	20
	5 - 2	-	-	AC	5	20	20
	5 - 3	-	-	BMP/DBST	5.5/1.6	15	15
	5 - 4	-	-	Gravel	15	-	10
Special Treatment	6	PCC pavement for steep gradient section					
	7	Grade raising in flood area					

TABLE 5.1 - 2 (1)

Summary of Proposed Improvement RIZAL

Primary Major

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Existing Condition Width	Existing Condition Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Cost (Million Peso) Bridge	Cost (Million Peso) Total	IRR (%)
Rehab/ Imp-1	N13-5	3.2	1558	015597	.2	7.0	PCC Fair	-		3.89	.00	3.89	100.0 (T)
					.5	7.0	BT Good	-					
					2.5	7.0	PCC Bad	Rehab(7.0-Ovl)					
	N13-7	5.0	7727	7750	3.1	6.0	PCC Good/Fair	-		2.58	.00	2.58	100.0 (T)
					1.9	6.0	PCC Bad	Rehab(6.0-Ovl)					

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (2)

Summary of Proposed Improvement RIZAL

Secondary Major

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Existing Condition Width	Existing Condition Type	Existing Condition Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Cost (Million Peso) Bridge	Cost (Million Peso) Total	IRR (%)
Rehab/ Imp-1	N10-2	2.7	4828	4824	1.6	6.0	PCC	Good	-		1.42	.00	1.42	100.0 (T)
					1.1	6.0	BT	Bad	Rehab(6.0-Ovl)					
	N10-3	4.7	4828	4824	1.7	6.0	BT	Good/Fair	-		1.42	.00	1.42	100.0 (T)
					1.1	6.0	BT	Bad	Rehab(6.0-Ovl)					
					1.9	6.0	PCC	Good	-					
	N12-3	1.8	4352	4430	1.5	6.0	BT	Bad	Rehab(6.0-Ovl)		1.95	.00	1.95	100.0 (T)
					.3	6.0	BT	Good	-					
	N12-4	6.1	4352	4430	4.7	6.0	BT	Good/Fair	-		1.87	.00	1.87	100.0 (T)
					.5	6.0	BT	Bad	Rehab(6.0-Ovl)					
					.9	6.0	PCC	Bad	Rehab(6.0-Ovl)					
	N12-5	6.7	4126	4192	1.3	6.0	PCC	Good	-		3.89	.00	3.89	100.0 (T)
					2.4	6.0	BT	Good/Fair	-					
					3.0	6.0	BT	Bad	Rehab(6.0-Ovl)					
	N2-2	2.4	2205	2551	1.2	6.0	PCC	Good	-		2.38	.00	2.38	95.9 (T)
					.4	6.0	BT	Good	-					
					.8	6.0	GRV	Bad	Imp-1(6.7-PCC)					
	N20-2	13.8	1013	971	7.9	6.0	BT	Bad	Rehab(6.0-Ovl)		26.11	.00	26.11	59.2 (T)
					5.9	6.0	BT	V.Bad	Rehab(6.0-AC)					
	N18-1	13.8	733	732	4.6	6.0	BT	Fair	-		11.17	.00	11.17	45.6 (T)
					4.6	8.0	BT	V.Bad	Rehab(6.0-AC)					
					4.6	6.0	PCC	Good	-					
	N23-1	19.1	52	814	4.9	6.0	BT	Good	-		37.79	.00	37.79	35.5 (T)
					11.1	4.5-6.0	GRV	Bad/V.Bad	Imp-1(6.0-AC)					
					2.0	4.5	EAR	Bad	Imp-1(6.0-AC)					
					1.1	6.0	PCC	Good	-					
	N1-4	32.2	6	29	.7	6.0	BT	Fair	-		45.92	.00	45.92	.0 (T)
					2.1	6.0	BT	Bad	Rehab(6.0-Ovl)					
					7.0	6.0	BT	V.Bad	Rehab(6.0-BMP)					
					17.0	5.5-6.0	GRV	Bad/V.Bad	Rehab(6.0-GRV)					
					4.0	3.0	PCC	Good/Bad	Widen(6.0-PCC)					
					1.4	6.0	PCC	Fair	-					

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (3)

Summary of Proposed Improvement RIZAL

Minor(National/Provincial)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	P3-1	1.9	68	76	1.9	4.5-6.0	GRV Bad	Rehab(6.0-GRV)		1.46	.00	1.46	36.5 (D)
	N1-5	5.9	99	113	1.7	6.0	PCC Good	-		4.31	.00	4.31	19.8 (D)
					.7	3.0	PCC Fair	Widen(6.0-PCC)					
					.3	6.0	GRV Bad	Imp-1(6.0-PCC)					
					3.2	6.0	GRV Bad	Rehab(6.0-GRV)					
	P3-2	4.0	29	36	1.5		None	New-C(6.0-GRV)	2-lane Sp (n= 2,L= 65m)	4.73	1.18	5.91	18.1 (D)
					2.5	4.5	GRV Bad	Rehab(6.0-GRV)					
	N3-1	5.0	601	616	1.8	6.0	BT Bad	Rehab(6.0-Ovl)		4.88	.00	4.88	16.9 (D)
					2.4	5.0	BT Bad	Rehab(5.0-Ovl)					
					.8	6.0	PCC Good	-					
	P5-1	4.5	290	310	.4	6.0	PCC Fair	-	2-lane Br (n= 1,L= 6m)	3.78	1.01	4.79	14.8 (D)
					1.5	6.0	BT Bad	Rehab(6.0-Ovl)					
					1.3	5.0	BT Good	-					
					1.0	5.0	BT Bad	Rehab(5.0-Ovl)					
					.3	4.5	GRV Bad	Imp-1(6.0-BMP)					
	P18-1	7.0	196	206	1.8	6.0	BT Bad	Rehab(6.0-Ovl)		7.15	.00	7.15	4.9 (D)
					2.1	6.0	BT Good/Fair	-					
					2.0	5.0	BT V.Bad	Rehab(6.0-BMP)					
					.2	5.0	PCC Good	-					
					.9	5.0	BT Bad	Rehab(5.0-Ovl)					
	P2-1	1.2	102	128	.5	6.0	PCC Good	-		2.11	.00	2.11	3.2 (D)
					.7	4.5	GRV Bad	Rehab(6.0-GRV)					
	N4-3	5.2	452	391	1.5	8.0	PCC Fair	-	2-lane Br (n= 1,L= 10m)	8.69	1.20	9.90	.0 (D)
					3.7	4.5	GRV Bad/V.Bad	Imp-1(6.0-BMP)					

(T):Traffic Project
(D):Development Project

TABLE 5.1 - 2 (4)

Summary of Proposed Improvement RIZAL

Minor(Barangay)

Type of Impr't	Road Number	Length (km)	1993 AADT w/o	1993 AADT with	Existing Condition L	Width	Type	Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Bridge	Total	IRR (%)
Rehab/ Imp-1	B11-6	2.5	11	16	2.5	2.8	EAR	V.Bad	Imp-1(4.0-GRV)	1-lane Sp (n= 2,L= 30m)	1.24	.40	1.63	36.4 (D)
	B11-5	5.5	45	61	.6	5.0	BT	Good	-	1-lane Sp (n= 3,L= 61m)	2.57	.81	3.37	36.3 (D)
					2.1	4.5	GRV	V.Bad	Rehab(4.0-GRV)					
					2.8	4.0-4.5	EAR	V.Bad	Imp-1(4.0-GRV)					
	B1-1	5.0	458	540	1.6	6.0	BT	Bad	Rehab(6.0-Ovl)		8.15	.00	8.15	17.0 (D)
					.5	6.0	BT	V.Bad	Rehab(6.0-AC)					
					.9	6.0	PCC	Good	-					
					1.9	3.2-4.5	GRV	Bad/V.Bad	Imp-1(6.0-AC)					
					.1	4.0	PCC	Fair	Widen(6.0-PCC)					
	B9-2	4.6	78	87	.5	3.0	BT	Bad	Rehab(6.0-BMP)	1-lane Sp (n= 2,L= 16m)	3.24	.21	3.45	9.6 (D)
					.2	3.0	BT	Fair	Widen(6.0-BMP)					
					3.9	2.4-3.2	GRV	Bad/V.Bad	Rehab(4.0-GRV)					
	B7-2	8.7	222	246	.6	6.0	GRV	Fair	Imp-2(6.0-PCC)	2-lane Sp (n= 2,L= 60m)	18.77	1.09	19.86	6.7 (D)
					3.7	4.5-6.0	GRV	Bad	Imp-1(6.0-PCC)					
					4.4	4.5	GRV	Bad	Rehab(6.0-GRV)					
	B0-1	6.3	78	188	1.0	6.0	PCC	Bad	Rehab(6.0-Ovl)		3.49	.00	3.49	.0 (D)
					4.7	3.2-6.0	GRV	Bad	Rehab(4.0-GRV)					
					.6	6.0	PCC	Good	-					

(T):Traffic Project
(D):Development Project

5.1.2 Cost Estimate

1) Unit Cost

Unit prices for construction equipment, materials and labor were obtained from Associated Construction Equipment Lessors, Inc. (ACEL), the Price Monitoring Section of DPWH, market price survey by the Study Team and relevant studies. Based on the data collected, unit prices at April 1990 prices were developed. Exchange rates used were : P22.50 = US$1.00 = Y155.

Unit costs for major construction items are presented in Table 5.1-3.

2) Construction Cost Estimate

Based on the results of the road inventory survey and proposed type of improvement, the quantity of each construction item was computed for each road project. Then the constuction cost was estimated.
Table 5.1-4 presents estimated quantities and construction cost of each road project.

TABLE 5.1-3 UNIT COST OF MAJOR CONSTRUCTION ITEMS

Unit: Pesos at April 1990 Prices

Item No.	Description	Unit	Unit Price
100	Clearing nad Grubbing	sq.m.	2.10
102	Stripping	cu.m.	52.00
106	Roadway and Drainage Excavation	cu.m.	58.00
107	Borrow	cu.m.	110.00
108	Aggregate Subbase	cu.m.	225.00
118-1	Preparation Of Previously Constructed Road (Gravel)	sq.m.	7.00
118-2	Preparation Of Previously Constructed Road (Asphalt)	sq.m.	8.00
118-3	Preparation of Existing Pavement Surface (PCC)	sq.m.	22.50
118-4	Preparation of Existing Pavement Surface (AC)	sq.m.	17.00
200	Crushed Aggregate Base Course	cu.m.	305.00
300	Crushed Aggregate Surface Course	cu.m.	305.00
302	Bituminous Prime Coat	MT	11,100.00
303	Bituminous Tact Coat	MT	11,500.00
306	Bituminous Macadam Pavement	sq.m.	95.00
310	Bituminous Concrete Surface Course	MT	1,350.00
314	Double Bituminous Surface Treatment	sq.m.	45.00
316-1	PCC Pavement (t = 23cm)	sq.m.	320.00
316-2	PCC Pavement (t = 20cm)	sq.m.	280.00
316-3	PCC Pavement (t = 18cm)	sq.m.	250.00
413-1	RCPC (Ø 910mm)	sq.m.	1,550.00
413-2	Headwal T for RCPC (Ø 910mm)	set	2,900.00
500	Grouted Riprap	sq.m.	625.00
517	Side Ditch (Grouted Riprap)	m	360.00
Bridge Cost			
	2-lane Superstructure	m	43,500.00
	Abutment for 2-lane bridge	each	330,000.00
	Pier for 2-lane bridge	each	285,000.00
	1-lane Superstructure	m	32,000.00
	Abutment for 1-lane bridge	each	230,000.00
	Pier for 1-lane bridge	each	200,000.00
Reinforced Concrete Box Culvert			
	1-Cell RCBC	m	20,600.00
	2-Cell RCBC	m	36,000.00
	Wing wall and Apron for 1-Cell RCBC	set	132,000.00
	Wing wall and Apron for 2-Cell RCBC	set	155,000.00
Spillway			
	2-lane Spillway	m	16,500.00
	1-lane Spillway	m	12,000.00
Slope Protection Cost			
	Cut Slope Protection	m	23,000.00
	Embankment Slope Protection	m	25,000.00

TABLE 5.1 - 4 (1)

Quantity and Construction Cost RIZAL

		Unit	N13-5	N13-7	N10-2	N10-3	N12-3	N12-4	N12-5	N2-2	N20-2	N18-1	N23-1
Total Road Length		km	3.2	5.0	2.7	4.7	1.8	6.1	6.7	2.4	13.8	13.8	19.1
Improvement Length		km	2.5	1.9	1.1	1.1	1.5	1.4	3.0	.8	13.8	4.6	13.1
Proposed Pavement Type			7.0-Ovl	6.0-Ovl	6.0-Ovl	6.0-Ovl	6.0-Ovl	6.0-Ovl	6.0-Ovl	6.7-PCC	6.0-Ovl 6.0-AC	6.0-AC	6.0-AC
Quantity													
100	Clearing & Grubbing	m2	-	-	-	-	-	-	-	-	-	-	-
	Stripping	m3	-	-	-	-	-	-	-	-	-	-	-
102	Roadway & Drainage Excavation	m3	-	-	-	-	-	-	-	600	36945	5145	86782
104	Borrow	m3	-	-	-	-	-	-	-	-	-	2520	1710
200	Aggregate Subbase	m3	500	380	165	165	225	255	450	2288	12182	10836	30752
	Preparation of Prev.Road(Grvl)	m2	10000	7600	3300	3300	4500	5100	9000	9040	22200	-	97880
	Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	35400	36800	-
	Preparation of Pave.Surf.(PCC)	m2	17500	11400	-	-	-	5400	-	-	-	-	-
	Preparation of Pave.Surf.(AC)	m2	-	-	6600	6600	9000	3000	18000	-	47400	-	-
202	Crushed Aggregate Base Course	m3	-	-	-	-	-	-	-	-	7965	6210	17685
300	Crushed Aggr. Surface Course	m3	-	-	-	-	-	-	-	-	-	-	-
301	Bituminous Prime Coat	M.T.	21	14	8	8	11	10	22	-	99	33	94
302	Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305	Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	-	-	-
310	Bitum.Concrete Surface Course	M.T.	1925	1254	726	726	990	924	1980	-	9108	3036	8646
304	Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1	PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2	PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	5360	-	-	-
311-3	PCC Pavement (t=18 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
500	RCPC (dia.910mm)	m	75	60	30	30	45	45	90	30	420	135	390
	Headwall for RCPC (dia.910mm)	Set	5	4	2	2	3	3	6	2	28	9	26
504	Grouted Riprap	m3	-	-	-	-	-	-	-	-	-	-	-
	Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-	2900	700	7600
	Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
	Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
	1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
	1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
	1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
	2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
	1-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
	1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
	2-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
	Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
	Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
	Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost		M.p.	3.89	2.58	1.42	1.42	1.95	1.87	3.89	2.38	26.11	11.17	37.79
Bridge Construction Cost		M.p.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Total Construction Cost		M.p.	3.89	2.58	1.42	1.42	1.95	1.87	3.89	2.38	26.11	11.17	37.79
Road Construction Cost/Impr't km		M.p.	1.56	1.36	1.29	1.29	1.30	1.34	1.30	2.98	1.89	2.43	2.88
Total Construction Cost/Total km		M.p.	1.22	.52	.53	.30	1.08	.31	.58	.99	1.89	.81	1.98

TABLE 5.1 - 4 (2)
Quantity and Construction Cost RIZAL

	Unit	N1-4	P3-1	N1-5	P3-2	N3-1	P5-1	P18-1	P2-1	N4-3	B11-6	B11-5
Total Road Length	km	32.2	1.9	5.9	4.0	5.0	4.5	7.0	1.2	5.2	2.5	5.5
Improvement Length	km	30.1	1.9	4.2	4.0	4.2	2.8	4.7	.7	3.7	2.5	4.9
Proposed Pavement Type		6.0-Ovl	6.0-GRV	6.0-PCC	6.0-GRV	6.0-Ovl	6.0-Ovl	6.0-Ovl	6.0-GRV	6.0-BMP	4.0-GRV	4.0-GRV
		6.0-BMP		6.0-GRV		5.0-Ovl	5.0-Ovl	6.0-BMP				
		6.0-GRV					6.0-BMP	5.0-Ovl				
		6.0-PCC										
Quantity												
100 Clearing & Grubbing	m2	-	-	-	27000	-	-	-	-	-	-	-
Stripping	m3	-	-	-	2700	-	-	-	-	-	-	-
102 Roadway & Drainage Excavation	m3	144650	1713	5963	16125	-	2250	9002	525	25050	3000	8228
104 Borrow	m3	4319	615	1008	5910	-	-	-	7864	-	825	1324
200 Aggregate Subbase	m3	23895	1254	3460	2640	420	834	2667	462	6019	1150	2254
Preparation of Prev.Road(Grvl)	m2	115920	12540	23520	13900	8400	8800	6300	4620	23568	9700	21940
Preparation of Prev.Road(Asph)	m2	42000	-	-	-	-	-	10000	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	12600	-	-	-	22800	14000	15300	-	-	-	-
202 Crushed Aggregate Base Course	m3	7161	-	-	-	-	307	2046	-	3785	-	-
300 Crushed Aggr. Surface Course	m3	15300	1710	2880	3600	-	-	-	630	-	1500	2940
301 Bituminous Prime Coat	M.T.	66	-	-	-	27	19	33	-	27	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	42000	-	-	-	-	1800	12000	-	22200	-	-
310 Bitum.Concrete Surface Course	M.T.	1386	-	-	-	2508	1540	1683	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	12000	-	3900	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
500 RCPC (dia.910mm)	m	844	60	106	150	120	90	135	45	105	40	80
Headwall for RCPC (dia.910mm)	Set	60	4	8	10	8	6	9	3	7	5	10
504 Grouted Riprap	m3	-	-	-	-	-	-	-	982	-	-	-
Side Ditch (Grouted Riprap)	m	11400	450	1000	1300	-	300	1000	-	3300	-	-
Slope Protection (Cut Slope)	m	120	-	-	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	40	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	6	-	-	10	-	-
1-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Abutment	Each	-	-	-	-	-	2	-	-	2	-	-
1-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	65	-	-	-	-	-	-	-
1-lane Spillway	m	-	-	-	-	-	-	-	-	-	30	61
1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	45.92	1.46	4.31	4.73	4.88	3.78	7.15	2.11	8.69	1.24	2.57
Bridge Construction Cost	M.p.	.00	.00	.00	1.18	.00	1.01	.00	.00	1.20	.40	.81
Total Construction Cost	M.p.	45.92	1.46	4.31	5.91	4.88	4.79	7.15	2.11	9.90	1.63	3.37
Road Construction Cost/Impr't km	M.p.	1.53	.77	1.03	1.18	1.16	1.35	1.52	3.01	2.35	.50	.52
Total Construction Cost/Total km	M.p.	1.43	.77	.73	1.48	.98	1.07	1.02	1.76	1.90	.65	.61

TABLE 5.1 - 4 (3)

Quantity and Construction Cost RIZAL

	Unit	B1-1	B9-2	B7-2	B0-1
Total Road Length	km	5.0	4.6	8.7	6.3
Improvement Length	km	4.1	4.6	8.7	5.7
Proposed Pavement Type		6.0-Ovl 6.0-AC 6.0-PCC	6.0-BMP 4.0-GRV	6.0-PCC 6.0-GRV	6.0-Ovl 4.0-GRV
Quantity					
100 Clearing & Grubbing	m2	-	-	-	-
Stripping	m3	-	-	-	-
102 Roadway & Drainage Excavation	m3	7354	8498	22740	3536
104 Borrow	m3	-	1489	11589	1268
200 Aggregate Subbase	m3	5185	2447	14240	2262
Preparation of Prev.Road(Grvl)	m2	18400	15210	64900	23620
Preparation of Prev.Road(Asph)	m2	3000	1500	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	6000
Preparation of Pave.Surf.(AC)	m2	9600	-	-	-
202 Crushed Aggregate Base Course	m3	3240	614	-	-
300 Crushed Aggr. Surface Course	m3	-	2340	3960	2820
301 Bituminous Prime Coat	M.T.	29	4	-	7
302 Bituminous Tack Coat	M.T.	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	3600	-	-
310 Bitum.Concrete Surface Course	M.T.	2640	-	-	660
304 Double Bitum.Surface Treatment	m2	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	200	-	25800	-
311-3 PCC Pavement (t=18 cm)	m2	-	-	-	-
500 RCPC (dia.910mm)	m	120	79	345	102
Headwall for RCPC (dia.910mm)	Set	8	9	23	11
504 Grouted Riprap	m3	-	-	1866	-
Side Ditch (Grouted Riprap)	m	1000	500	1700	-
Slope Protection (Cut Slope)	m	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	-	-
2-lane Bridge,Abutment	Each	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-
2-lane Spillway	m	-	-	60	-
1-lane Spillway	m	-	16	-	-
1-cell RCBC	m	-	-	-	-
2-cell RCBC	m	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-
Miscellaneous	l.s.	1	1	1	1
Road Construction Cost	M.p.	8.15	3.24	18.77	3.49
Bridge Construction Cost	M.p.	.00	.21	1.09	.00
Total Construction Cost	M.p.	8.15	3.45	19.86	3.49
Road Construction Cost/Impr't km	M.p.	1.99	.70	2.16	.61
Total Construction Cost/Total km	M.p.	1.63	.75	2.28	.55

5.1.3 Summary of Preliminary Design

Results of preliminary design were summarized in Tables 5.1-5 and 5.1-6 for major and minor roads, respectively.

TABLE 5.1-5 SUMMARY OF PRELIMINARY DESIGN :
Province of Rizal
- Major Roads -

	Type of Improvement			
	Rehabilitation/ Improvement - 1	Improvement-2/ Widening	New Construction	Total
Primary Major Roads				
1. No. of Links	2	-	-	2
2. Total Length (km)	8.2	-	-	8.2
3. Improvement Length (km)	4.4	-	-	4.4
4. Construction Cost (million P)	6.5	-	-	6.5
5. Const. Cost/Imp. Length (MP/km)	1.48	-	-	1.48
Secondary Major Roads				
1. No. of Links	10	-	-	10
2. Total Length (km)	103.3	-	-	103.3
3. Improvement Length (km)	70.5	-	-	70.5
4. Construction Cost (million P)	133.9	-	-	133.9
5. Const. Cost/Imp. Length (MP/km)	1.90	-	-	1.90
Major Roads Total				
1. No. of Links	12	-	-	12
2. Total Length (km)	111.5	-	-	111.5
3. Improvement Length (km)	74.9	-	-	74.9
4. Construction Cost (million P)	140.4	-	-	140.4
5. Const. Cost/Imp. Length (MP/km)	1.87	-	-	1.87

TABLE 5.1-6 SUMMARY OF PRELIMINARY DESIGN
Province of Rizal
- Minor Roads -

	Type of Improvement		
	Rehabilitation/ Improvement-1&2/ Widening	New Construction	Total
Minor Roads (National/ Provincial/City)			
1. No. of Links	8	-	8
2. Total Length (km)	34.7	-	34.7
3. Improvement Length (km)	26.2	-	26.2
4. Construction Cost (million P)	40.5	-	40.5
5. Const. Cost/Imp. Length (MP/km)	1.55	-	1.55
Minor Roads (Barangay)			
1. No. of Links	6	-	6
2. Total Length (km)	32.6	-	32.6
3. Improvement Length (km)	30.5	-	30.5
4. Construction Cost (million P)	40.0	-	40.0
5. Const. Cost/Imp. Length (MP/km)	1.31	-	1.31
Minor Roads Total			
1. No. of Links	14	-	14
2. Total Length (km)	67.3	-	67.3
3. Improvement Length (km)	56.7	-	56.7
4. Construction Cost (million P)	80.5	-	80.5
5. Const. Cost/Imp. Length (MP/km)	1.42	-	1.42

5.2 ECONOMIC EVALUATION

5.2.1 Basic Assumptions

The commonly used cost-benefit analysis was applied under the following basic assumptions:

i) Analysis Period

1991 - Detailed design
1992 - Construction
1993 ┐
     ↕ -Project life (25 years)
2017 ┘

ii) Discount Rate: 15% pa

iii) Quantified Cost

Initial construction/improvement costs
Periodic maintenance costs

iv) Quantified Benefit

Traffic benefit
Development benefit (only for development projects)
Maintenance cost savings

The periodic maintenance costs, or rehabilitation costs, such as overlay, reconstruction and regravelling which will be needed after completion of the project to prolong the pavement life, were treated as project costs in this study, while the difference between routine maintenance costs and total maintenance costs in the "w/o" case was taken into account as a project benefit. In the case where the routine maintenance costs are higher than the "w/o" maintenance costs, the difference is considered as a negative benefit.

5.2.2 Economic Costs

1) Initial Construction/Improvement Costs

The construction costs discussed in Section 5.2.1 are the financial costs and do not include the costs for detailed design and construction supervision. In the cost-benefit analysis, the following economic cost was used:

Construction Cost	100%
-Tax	-15%
+Detailed Design Cost	4%
+Construction Supervision Cost	6%
Total Economic Cost	95%

In the cost-benefit stream, 4% for detailed design cost was assumed to be spent in 1991 and the remaining 91% in 1992.

2) Periodic Maintenance Costs

Periodic maintenance, or rehabilitation, will be necessary when the riding quality of a pavement decreases to a certain minimum level of acceptability. Table 5.2-1 shows the periodic maintenance assumed in this Study.

TABLE 5.2-1 PERIODIC MAINTENANCE COST ASSUMED IN THE ANALYSIS

Surface Type	Periodic Maintenance Work	Timing	Financial Cost 1) (million₱/Km)	Economic Cost
Gravel	10cm Regravelling	When thickness of gravel is reduced by 10cm, assuming 1.5cm loss annually from rainfall and 1.5cm loss every 100,000 vehicles (2-6 years)	4.0 m Gravel: ₱ 0.210 M 6.0 m Gravel: ₱ 0.320 M	85% of Cost
BMP	5.5cm BMP Overlay	When pavement serviceability decreases to 2.0, assuming 85,000 ESAL or 350,000 vehicle repetitions (4-10 years)	₱ 0.830 M	85% of Cost
AC	5 cm AC Overlay	When pavement serviceability decreases to 2.0, assuming 800,000 ESAL or 2,300,000 vehicle repetitions (8-20 years)	₱ 1.170 M	85% of Cost
PCC	5 cm AC Overlay	When pavement serviceability decreases to 2.0, assuming 2,000,000 ESAL or 5,700,000 vehicle repetitions (10-25 years)	₱ 1.200 M	85% of Cost

Note: 1) As of April 1990

5.2.3 Benefits

1) Traffic Benefits

a) Traffic Cost

Basic Traffic Costs

The basic traffic costs were provided by PMO-FS, as shown in Table 5.2-2.

TABLE 5.2-2 BASIC TRAFFIC COSTS EXCLUDING TAX (AS OF DECEMBER 1989)

	Running Cost (₱/km)	Fixed Cost (₱/hour)	Time Cost (₱/hour)
Car/Van	1.75	6.30	17.70
Jeepney	1.12	23.76	26.40
Bus	2.81	35.64	95.04
Truck	3.48	38.88	0
Motor-tricycle	0.36	8.76	4.98
Motorcycle	0.31	0.72	8.34

Actual Traffic Costs

The actual traffic costs were estimated according to the dl-system concerning running costs and the dt-system with regard to fixed and time costs. The dl-values and operating speed for different surface conditions are shown in Tables 5.2-3 and 5.2-4, respectively.

TABLE 5.2-3 DL-VALUES IN KM PER ACTUAL KM

Surface Condition \ Surface Type	PCC/AC	BMP/DBST	Gravel	Earth
Good	0	0.14	0.29	-
Fair	0.17	0.38	0.60	-
Bad	0.43	0.65	0.87	1.20
Very Bad	0.89	1.04	1.20	1.56
Impassable	1.73	1.73	1.73	1.73

TABLE 5.2-4 OPERATING SPEED IN KM/HOUR

Surface Condition	PCC/AC			BMP/DBST			Gravel			Earth		
	OV	TR	MC	OV	TR	MC	OV	TR	MC	OV	TR	MC
Good	65	40	60	63	38	55	60	35	50	-	-	-
Fair	55	35	50	53	33	45	50	30	40	-	-	-
Bad	30	20	20	30	20	20	30	20	20	20	10	10
Very Bad	20	10	10	20	10	10	20	10	10	10	5	5
Impassable	10	5	5	10	5	5	10	5	5	10	5	5

Note: OV = Car/Jeepney/Bus/Truck
TR = Motor-tricycle
MC = Motorcycle

Traffic Costs of Other Transport Modes

In addition to the land-based motorized vehicles, the traffic costs of other modes were estimated as shown in Table 5.2-5.

TABLE 5.2-5 TRAFFIC COST OF OTHER MODES (COMMON TO ALL SURFACE TYPES AND CONDITIONS)

Mode	Traffic Cost in ₱/Km
Animal Drawn	4.0
Walking (head loading)	1.2
Banca Boat	2.25

b) Traffic Benefits in Traffic Projects

Traffic on the project roads wwas broken down into four categories: normal traffic, diverted traffic-1, diverted traffic-2 and generated traffic.

The traffic benefits were estimated as follows:

i) Normal Traffic : Difference in traffic costs between "w/o" and "with" cases. The change in traffic costs results not only from the improvement of surface type and condition but also from consequent change in modal distribution.

ii) Diverted Traffic-1 : Difference between traffic costs along the "w/o" route and those along the "with" route. Where diverted traffic passes through two or more project roads, the benefits were allocated to each road in proportion to length.

iii) Diverted Traffic-2 and Generated Traffic: Half of the difference in traffic costs between "w/o" and "with" cases. This is the commonly used approximation.

Traffic costs were calculated assuming the following surface conditions:

"W/O" Case : Present surface condition is maintained.
"With" Case: Gravel/BMP are maintained in a fair condition.
AC/PCC are maintained in a good condition

c) Traffic Benefits in Development Projects

No diverted traffic is expected in most development projects. The benefits from normal traffic generated traffic were estimated in the same way as used for the traffic projects paying attention to the following:

i) The travel distance considered in the benefit calculation is the distrance from the average gravity point of transport (gravity of population for passenger traffic and non-agricultural traffic and gravity of agricultural production for agricultural traffic) to the connecting point with a higher road.

ii) The benefit from generated agricultural traffic is not considered as a traffic benefit because it is included in the development benefit. Therefore, the generated traffic benefits are only from passenger traffic and non-agricultural traffic.

2) Development Benefits

Development benefits were assessed using the producer surplus approach, under the hypothesis that substantial road improvement which removes constraints on development will permit and encourage farmers to adopt modern agricultural techniques and inputs. The development benefit consists of the difference in the

net value of total production (farmgate value less production costs) between the "w/o" and "with" cases. Changes in the volume and value of agricultural production will be achieved by one or more of the following:

i) Increase in cultivated area
ii) Increase in yield
iii) Increase in intensity of land use through increasing the number of harvest or intercropping
iv) Changes in the type of crop

Using the data obtained from the socio-economic survey, development benefits were calculated from the following equation:

Benefit = PRODw(FGPw-CPw)-(FGPw-CPw/o)

where, PRODw = Production in metric tons, with
PRODw/o= Production in metric tons, w/o
FGPw = Farmgate price in pesos per metric ton, with
CPw = Production cost in pesos per metric ton, with
CPw/o = Production cost in pesos per metric ton, w/o

The increase in farmgate price resulting from reduction in traffic cost is not included in the development benefits, because it is considered a part of the traffic benefits.

Table 5.2-6 presents the summary of demographic and agricultural data.

TABLE 5.2 - 6 (1)

Summary of Demographic and Agricultural Data RIZAL

Class of Road	Type of Impr't	Road Number	Road Length (km)	1990 Population Total	1990 Population /km	1990 Crop Area (ha) Total	1990 Crop Area (ha) Major Crop	1993 AADT w/o	1993 AADT with	IRR (%)
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P3-1	1.9	2055	1082	627	526(Banan) 101(Palay)	68	76	36.5
		N1-5	5.9	4270	724	681	438(Banan) 150(Coco.) 93(Palay)	99	113	19.8
		P3-2	4.0	1370	343	251	213(Banan) 38(Palay)	29	36	18.1
		N3-1	5.0	13938	2788	238	238(Banan)	601	616	16.9
		P5-1	4.5	9168	2037	38	38(Palay)	290	310	14.8
		P18-1	7.0	6745	964	713	413(Palay) 300(Banan)	196	206	4.9
		P2-1	1.2	4991	4159	220	182(Palay) 38(Vege.)	102	128	3.2
		N4-3	5.2	16624	3197	564	501(Palay) 63(Banan)	452	391	.0
Minor (Baran-gay)	Rehab/ Imp-1	B11-6	2.5	612	245	137	75(Palay) 62(Banan)	11	16	36.4
		B11-5	5.5	2168	394	300	175(Palay) 125(Banan)	45	61	36.3
		B1-1	5.0	18584	3717	238	143(Banan) 95(Palay)	458	540	17.0
		B9-2	4.6	2729	593	281	156(Banan) 125(Palay)	78	87	9.6
		B7-2	8.7	3745	430	475	288(Palay) 187(Banan)	222	246	6.7
		B0-1	6.3	5143	816	75	75(Palay)	78	188	.0

3) Maintenance Cost Savings

The difference in maintenance costs between the "w/o" and "with" cases is considered one of the benefits. Maintenance costs in the "w/o" case were estimated based on the current EMK system, while maintenance costs in the "with" case were estimated as shown in b) below. It is noted that periodic maintenance cost in the "with" case is not included in the calculation of maintenance cost savings, because it is treated as a part of project costs.

In the case where the routine maintenance costs in the "with" case are higher than the maintenance costs in the "w/o" case (especially in the case of new construction, the maintenance cost in the "w/o" case in zero), the difference is considered as a negative benefit).

a) Maintenance Cost in "w/o" Case

According to the current EMK system, the annual maintenance cost per km was estimated as basic maintenance cost of ₱17,143.00/km times the EMK factor as shown in Table 5.2-7.

TABLE 5.2-7
EMK FACTOR FOR DIFFERENT SURFACING AND AADT

AADT / Surface Type	25	50	75	100	150	200	300	400
Earth	0.35	0.40	0.50					
Gravel	0.40	0.60	0.90	1.40	1.90	2.20	2.40	2.50	2.60

AADT / Surface Type	400	600	1000	1500	2000	3000	5000	10000
Bituminous	1.10	1.55	2.10	2.50	2.60			
Gravel	0.50	0.60	0.80	0.85	0.90	0.95	1.00	1.05	1.10

b) Routine Maintenance Costs in "with" Case

The costs deemed necessary to maintain the improved roads in a fair condition were estimated as shown in Table 5.2-8.

TABLE 5.2-8
ESTIMATED ROUTINE MAINTENANCE COSTS

Surface Type	Operation	Annual Cost (peso/km)
Gravel	Vegetation Control	1,150
	Ditch Cleaning Grading Pothole Repair	4.0 m Gravel: 2,650 + 40 AADT 6.0 m Gravel: 3,000 + 45 AADT
	Total	4.0 m Gravel: 3,800 + 45 AADT 6.0 m Gravel: 4,150 + 45 AADT
BMP	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Patching	8,000 + 7.5 AADT
	Regravelling Shoulder	8,600
	Total	21,000 + 7.5 AADT
AC	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Crack and Joint Sealing	9,300
	Regravelling Shoulder	8,600
	Total	20,400
PCC	Vegetation Control	1,150
	Ditch Cleaning	1,100
	Shoulder Repair	2,150
	Crack and Joint Sealing	5,600
	Regravelling Shoulder	8,600
	Total	18,600

5.2.4 Economic Evaluation

Results of economic evaluation are summarized in Table 5.2-9 and illustrated in Figure 5.2-1. Results of economic evaluation of each project road is presented in Table 5.2-10.

PROVINCE OF RIZAL

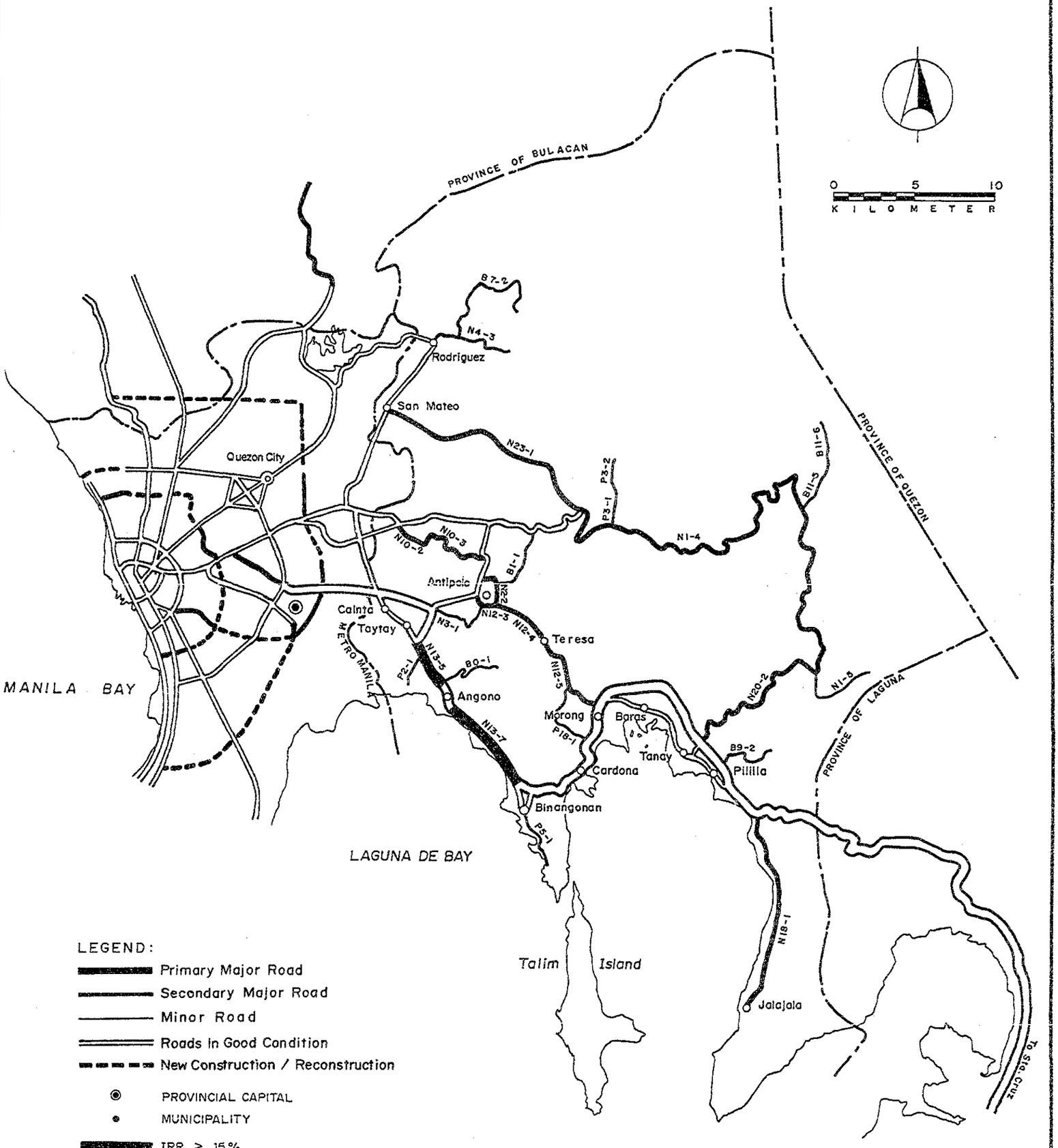


FIGURE 5.2 - 1 PROJECT ROADS and ECONOMIC EVALUATION RESULTS

TABLE 5.2 - 9 (1)

Road Length and Construction Cost RIZAL

Class of Road	Range of IRR	Rehabilitation/Improvement-1						Improvement-2/Widening						New Construction					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost	No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	2	8.2	4.4	6.5	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	2	8.2	4.4	6.5	-	6.5	-	-	-	-	-	-	-	-	-	-	-	-
Second'y Major	15<	9	71.1	40.4	88.0	-	88.0	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	1	32.2	30.1	45.9	-	45.9	-	-	-	-	-	-	-	-	-	-	-	-
	Total	10	103.3	70.5	133.9	-	133.9	-	-	-	-	-	-	-	-	-	-	-	-
Minor (Nat'l/ Prov'l)	15<	4	16.8	14.3	15.4	1.2	16.6	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	1	4.5	2.8	3.8	1.0	4.8	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	3	13.4	9.1	18.0	1.2	19.2	-	-	-	-	-	-	-	-	-	-	-	-
	Total	8	34.7	26.2	37.1	3.4	40.5	-	-	-	-	-	-	-	-	-	-	-	-
Minor (Barangay)	15<	3	13.0	11.5	12.0	1.2	13.2	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	1	4.6	4.6	3.2	.2	3.5	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	2	15.0	14.4	22.3	1.1	23.4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	6	32.6	30.5	37.5	2.5	40.0	-	-	-	-	-	-	-	-	-	-	-	-
Total	15<	18	109.1	70.6	121.8	2.4	124.2	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	1	4.5	2.8	3.8	1.0	4.8	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	1	4.6	4.6	3.2	.2	3.5	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	6	60.6	53.6	86.1	2.3	88.4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	26	178.8	131.6	215.0	5.9	220.9	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 5.2 - 9 (2)

Road Length and Construction Cost RIZAL

Class of Road	Range of IRR	Total					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	2	8.2	4.4	6.5	-	6.5
	10-15	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-
	Total	2	8.2	4.4	6.5	-	6.5
Second'y Major	15<	9	71.1	40.4	88.0	-	88.0
	10-15	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-
	<7.5	1	32.2	30.1	45.9	-	45.9
	Total	10	103.3	70.5	133.9	-	133.9
Minor (Nat'l/ Prov'l)	15<	4	16.8	14.3	15.4	1.2	16.6
	10-15	1	4.5	2.8	3.8	1.0	4.8
	7.5-10	-	-	-	-	-	-
	<7.5	3	13.4	9.1	18.0	1.2	19.2
	Total	8	34.7	26.2	37.1	3.4	40.5
Minor (Baran-gay)	15<	3	13.0	11.5	12.0	1.2	13.2
	10-15	-	-	-	-	-	-
	7.5-10	1	4.6	4.6	3.2	.2	3.5
	<7.5	2	15.0	14.4	22.3	1.1	23.4
	Total	6	32.6	30.5	37.5	2.5	40.0
Total	15<	18	109.1	70.6	121.8	2.4	124.2
	10-15	1	4.5	2.8	3.8	1.0	4.8
	7.5-10	1	4.6	4.6	3.2	.2	3.5
	<7.5	6	60.6	53.6	86.1	2.3	88.4
	Total	26	178.8	131.6	215.0	5.9	220.9

TABLE 5.2 - 10 (1)
Summary of Economic Analysis RIZAL Cost/Benefit:1991-2017 Discounted Total

Class of Road	Type of Impr't	Road Number	1993 AADT w/o	1993 AADT with	Length (km) Total	Length (km) Improvement	Economic Cost (Mp/km) Construct.	Economic Cost (Mp/km) Period Maint.	Economic Cost (Mp/km) Total	Benefit (Mp/km) Normal	Diverted	Generated	Develop't	Maint sav'g	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Primary Major	Rehab/ Imp-1	N13-5	****15597		3.2	2.5(7.0-Ovl)	1.29	.33	1.62	62.73	-	.01	-	-.02	62.72	152.7	38.6	100.0
		N13-7	7727	7750	5.0	1.9(6.0-Ovl)	1.13	.33	1.46	31.82	-	.02	-	-.03	31.81	57.7	21.8	100.0
Second'y Major	Rehab/ Imp-1	N10-2	4828	4824	2.7	1.1(6.0-Ovl)	1.07	.33	1.40	23.87	-	.00	-	.10	23.97	24.8	17.1	100.0
		N10-3	4828	4824	4.7	1.1(6.0-Ovl)	1.07	.33	1.40	23.87	-	.00	-	.10	23.97	24.8	17.1	100.0
		N12-3	4352	4430	1.8	1.5(6.0-Ovl)	1.08	.33	1.41	29.11	-	.11	-	.10	29.32	41.9	20.8	100.0
		N12-4	4352	4430	6.1	1.4(6.0-Ovl)	1.11	.33	1.44	25.37	-	.10	-	.02	25.48	33.7	17.7	100.0
		N12-5	4126	4192	6.7	3.0(6.0-Ovl)	1.08	.33	1.41	27.49	-	.10	-	.10	27.69	78.9	19.7	100.0
		N2-2	2205	2551	2.4	.8(6.7-PCC)	2.48	.22	2.70	22.73	-	1.40	-	.11	24.25	17.2	9.0	95.9
		N20-2	1013	971	13.8	7.9(6.0-Ovl) 5.9(6.0-AC)	1.57	.22	1.79	7.66	-	-	-	.10	7.76	82.3	4.3	59.2
		N18-1	733	732	13.8	4.6(6.0-AC)	2.02	.10	2.12	6.35	-	.00	-	.06	6.41	19.7	3.0	45.6
		N23-1	52	814	19.1	13.1(6.0-AC)	2.40	.06	2.45	.66	-	6.26	-	-.03	6.89	58.1	2.8	35.5
		N1-4	6	29	32.2	2.1(6.0-Ovl) 7.0(6.0-BMP) 17.0(6.0-GRV) 4.0(6.0-PCC)	1.27	.14	1.41	.03	.05	.04	-	-.02	.10	-39.3	.1	.0
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P3-1	58	76	1.9	1.9(6.0-GRV)	.64	.25	.89	.44	-	.02	2.39	.07	2.92	3.9	3.3	36.5
		N1-5	99	113	5.9	1.0(6.0-PCC) 3.2(6.0-GRV)	.85	.21	1.06	.29	-	.01	1.10	.07	1.46	1.7	1.4	19.8
		P3-2	29	36	4.0	4.0(6.0-GRV)	1.23	.20	1.43	.89	-	.10	.79	.00	1.78	1.4	1.2	18.1
		N3-1	601	616	5.0	1.8(6.0-Ovl) 2.4(5.0-Ovl)	.97	.14	1.11	.95	-	.03	.19	.07	1.24	.6	1.1	16.9
		P5-1	290	310	4.5	1.5(6.0-Ovl) 1.0(5.0-Ovl) .3(6.0-BMP)	1.42	.07	1.50	1.42	-	.05	.00	.00	1.47	-.1	1.0	14.8
		P18-1	196	206	7.0	1.8(6.0-Ovl) 2.0(6.0-BMP) .9(5.0-Ovl)	1.26	.13	1.40	.36	-	.02	.28	-.03	.64	-3.6	.5	4.9
		P2-1	102	128	1.2	.7(6.0-GRV)	2.50	.32	2.82	.85	-	.14	.00	.09	1.08	-1.2	.4	3.2
		N4-3	452	391	5.2	3.7(6.0-BMP)	2.22	.64	2.86	.70	-	.03	.07	.07	.88	-7.3	.3	0
Minor (Barangay)	Rehab/ Imp-1	B11-6	11	16	2.5	2.5(4.0-GRV)	.54	.11	.66	.74	-	.25	1.11	.00	2.11	3.6	3.2	36.4
		B11-5	45	61	5.5	4.9(4.0-GRV)	.57	.14	.71	.88	-	.18	1.14	.01	2.20	7.3	3.1	36.3
		B1-1	458	540	5.0	1.6(6.0-Ovl) 2.4(6.0-AC) .1(6.0-PCC)	1.65	.16	1.82	1.56	-	.34	.10	.07	2.07	1.0	1.1	17.0
		B9-2	78	87	4.6	.7(6.0-BMP) 3.9(4.0-GRV)	.62	.16	.78	.10	-	.01	.36	.07	.53	-1.2	.7	9.6
		B7-2	222	246	8.7	4.3(6.0-PCC) 4.4(6.0-GRV)	1.90	.20	2.10	.75	-	.03	.23	.10	1.10	-8.7	.5	6.7
		B0-1	78	188	6.3	1.0(6.0-Ovl) 4.7(4.0-GRV)	.51	.29	.80	.03	-	.05	.00	-.02	.07	-4.2	.1	.0