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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume 5)

PROJECT EVALUATION
IN
THE PROVINCE OF NUEVA VIZCAYA

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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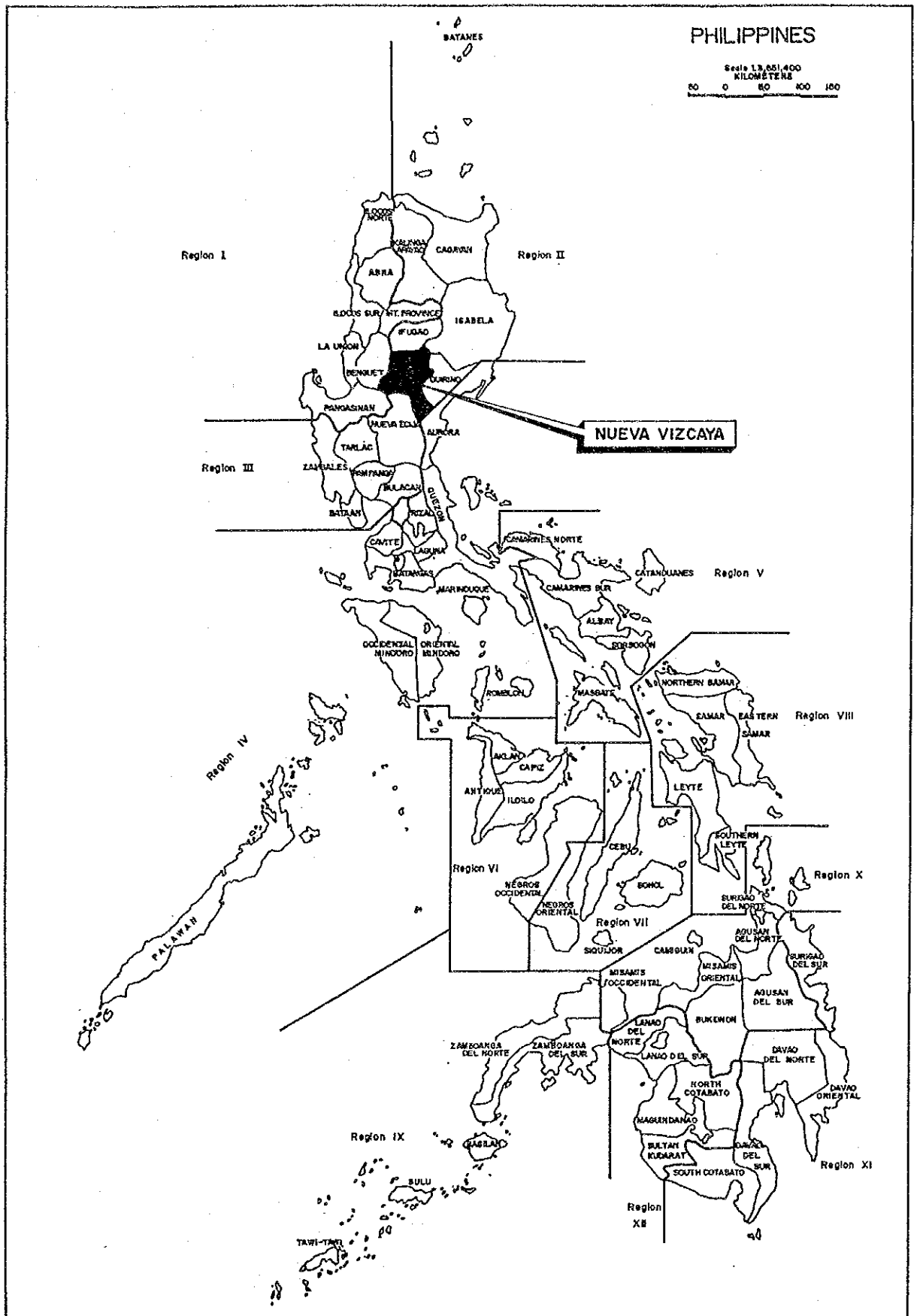

FEASIBILITY STUDY ON THE RURAL ROAD NETWORK DEVELOPMENT PROJECT	LOCATION MAP

VOLUME - 5
PROVINCE OF NUEVA VIZCAYA

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CHAPTER 1
SOCIO-ECONOMIC PROFILE OF THE PROVINCE

1.1 GENERAL

The Province of Nueva Vizcaya 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 inland mountainous

1.2 GEOGRAPHY AND TOPOGRAPHY

The province is located in the northeastern part of Luzon, bounded on the north by Isabela and Ifugao Provinces, on the east by Quirino and Aurora Provinces, on the south by Nueva Ecija and Pangasinan Provinces and on the west by Benguet Province.

The province is situated in the Caraballo and Central Cordillera Mountains, therefore, topography is predominantly mountainous. Magat River runs mostly along the Pan-Philippine Highway. Due to these topographical characteristics, the province is a typical inland mountainous province.

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

1.3 POPULATION

The province is composed of fifteen (15) municipalities and the provincial capital is located at Bayombong.

Population in 1990 is estimated at 319,800. The average annual population growth rate for the period of 10 years from 1980 to 1990 was estimated 2.8% which is higher than the national average of 2.4%. Population density of the province in 1990 is 81.9 persons per square kilometer which is much lower 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. Most municipal towns are located along the Pan-Philippine Highway, except municipalities of Alfonso Castaneda and Kasibu.

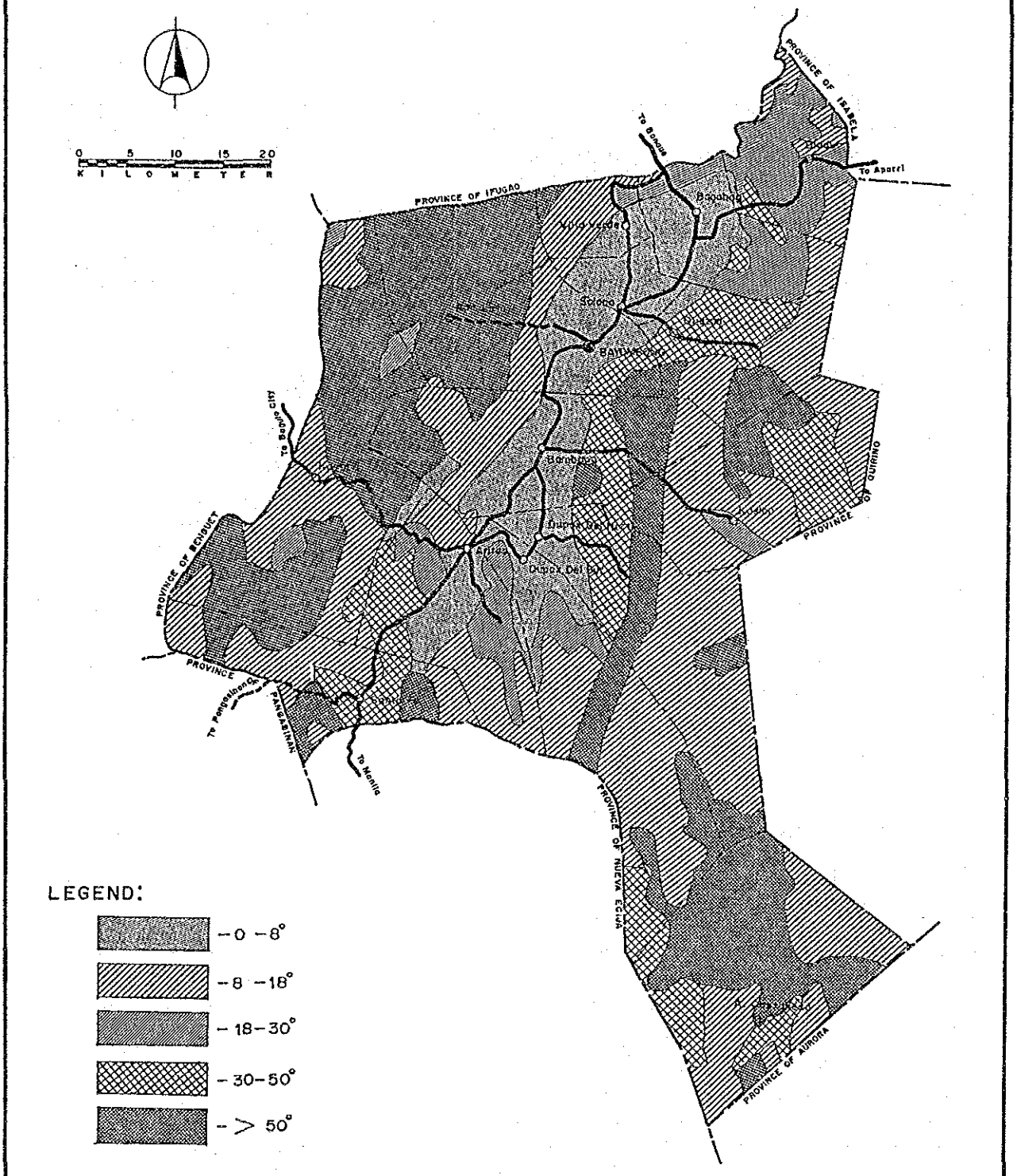

FIGURE 1.2 - 1 SLOPE MAP

Table 1.3-1

POPULATION, LAND AREA AND DENSITY (1990)
Province of Nueva Vizcaya

City/Municipality	Projected Population (1990)	Annual Growth Rate (%)	Land Area (km^2)	Density (p/km^2)
1. Bayombong	41,824	2.6	130.5	320.5
2. Ambaguio	6,260	4.9	178.1	35.2
3. Aritao	28,426	2.5	254.9	111.5
4. Bagabag	24,912	1.7	176.2	141.4
5. Bambang	33,902	2.6	331.1	102.4
6. Diadi	14,142	5.0	173.9	81.3
7. Dupax del Norte	21,630	2.5	333.3	64.9
8. Dupax del Sur	12,443	2.5	359.6	34.6
9. Kasibu	25,177	5.2	463.5	54.3
10. Kayapa	23,321	1.2	463.5	50.3
11. Quezon	16,368	5.3	169.1	96.8
12. Sta. Fe	8,188	2.5	297.5	27.5
13. Solano	46,320	2.3	134.2	345.2
14. Villa Verde	13,306	2.2	78.2	170.2
15. Alfonso Castaneda	3,613	2.5	360.3	10.0
T O T A L	319,832	2.8	3,903.9	81.9

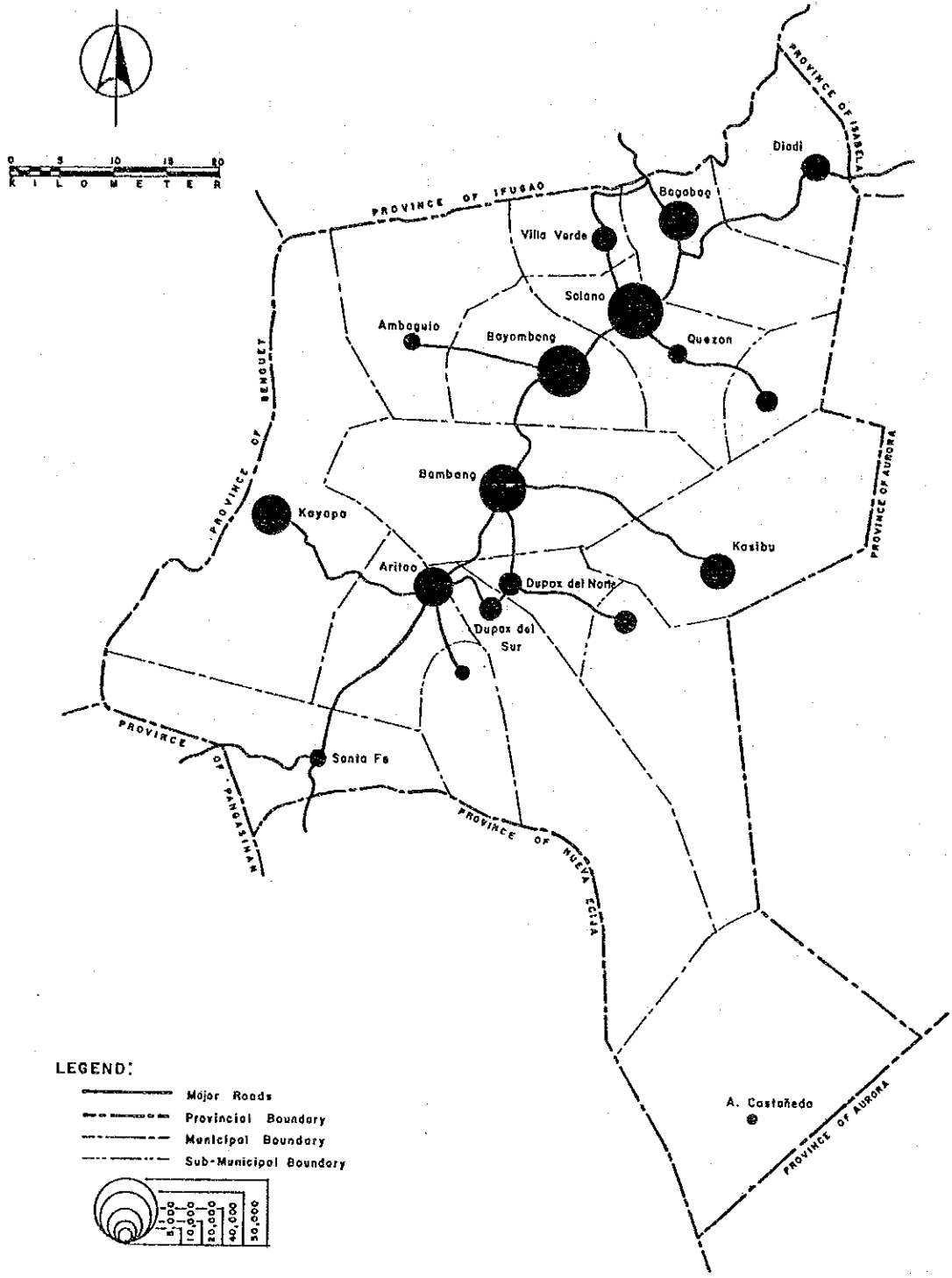

FIGURE 1.3-1 POPULATION BY MUNICIPALITY (1990)

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 0.3% 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 lower level than the national average.

Per capita income of the province is higher by 1.12 times than the national average. Incidence of poverty is lower than the national average. Unemployment rate is lower, but underemployment rate is higher than the national average.

Agriculture is the predominant industry of the province and shares 68% in terms of number of workers.

Table 1.4-1
MAJOR SOCIO-ECONOMIC DATA OF PROVINCE OF NUEVA VIZCAYA

	Nueva Vizcaya (A)	Philippines (B)	(A)/(B)
1. Total Land Area (sq.km.)	3,904	300,000	0.013
2. Population in 1990 (1000 persons)	320	61,483	0.005
3. Population Density (persons/sq.km.)	82	205	0.40
4. GRDP (Million ₱ at 1000 prices)	1,800	623,051	0.003
5. Per Capita Income in 1985 (₱/person)	6,274	5,593	1.12
6. Number of Workers by Industrial Sector in 1980 (1000 persons)			
* Agricultural	47.0 (68%)	7,303 (51%)	0.006
* Industry	5.2 (8%)	2,177 (15%)	0.002
* Service	16.2 (23%)	4,552 (32%)	0.004
* Total 1/	69.1 (100%)	14,197 (100%)	0.005
7. Incidence of Poverty in 1985 (%)	52.4	59.3	-
8. Unemployment Rate in 1988 (%)	6.6	8.3	-
9. Underemployment Rate in 1988 (%)	16.8	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

Nueva Vizcaya has a total land area of 3,904 square kilometers, representing 1.3% of the total land area of the Philippines. Table 1.5-1 shows general land use of the province. About 49% of the province is covered by forest. Agricultural area occupies only about 13% of the total land area.

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, camote, banana and tomato.

Table 1.5-1
LAND USE OF NUEVA VIZCAYA

Land Use	Area in sq.km.	%
Agricultural Area	491.9	12.6
Grass/Shrub Area	1,436.6	36.8
Forest Area	1,901.2	48.7
Water Reservoir	62.5	1.6
Built-up Area	11.7	0.3
Total	3,903.9	100.0

Source: Bureau of Soil

Table 1.5-2
MAJOR CROPS OF PROVINCE OF NUEVA VIZCAYA

Major Crops	Area Utilized (ha.)		Production (M.T.)	
	1985	1986	1985	1986
Palay	37,160	36,510	111,240	109,465
Corn	9,790	9,950	10,445	11,005
Camote	2,571	2,489	7,713	8,886
Banana	1,641	1,444	7,989	7,326
Tomato	787	789	3,745	3,965

Source: Bureau of Agricultural Statistics

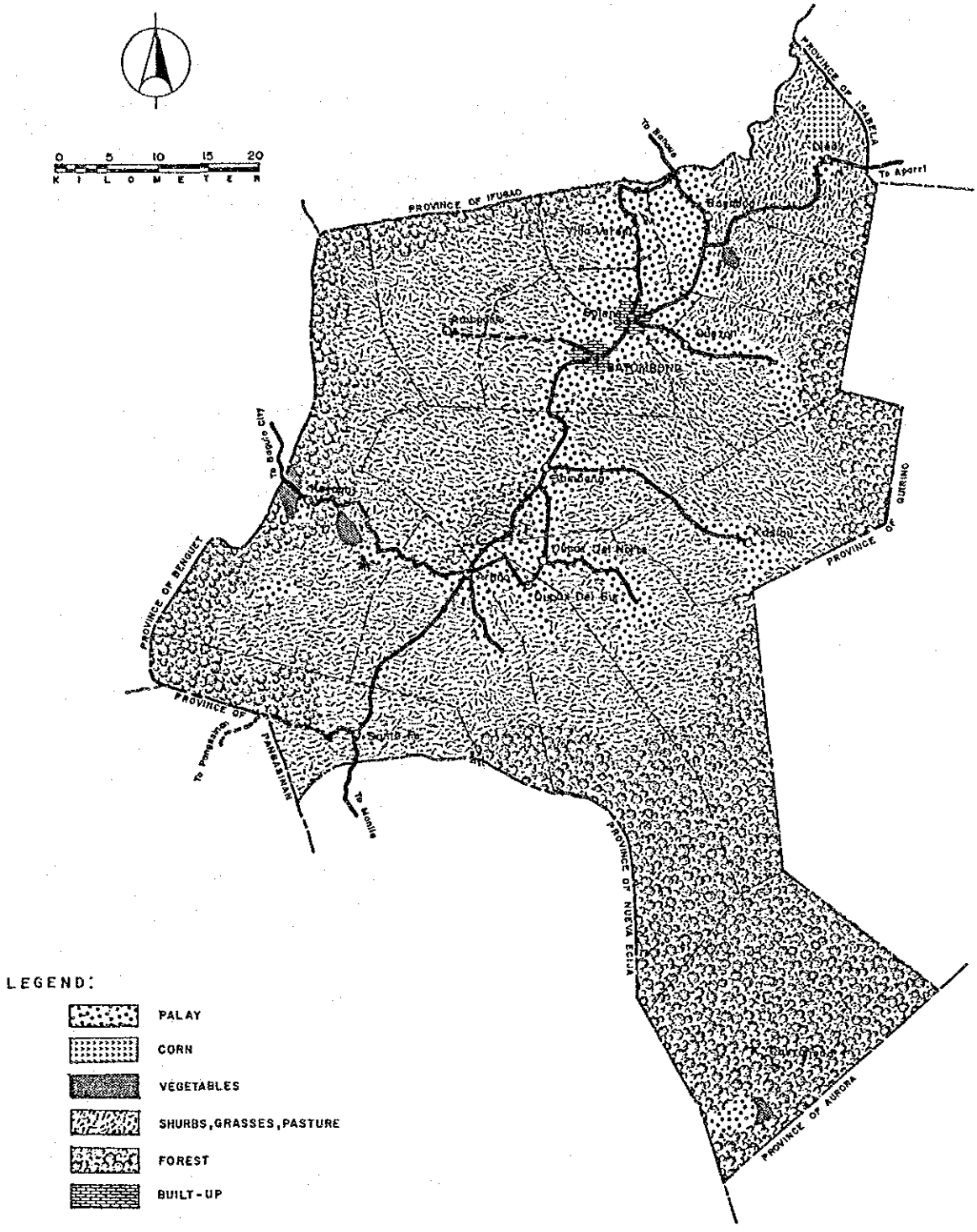

FIGURE 1.5 - 1 AGRICULTURAL LAND USE

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

Nueva Vizcaya has a total of 2,403.0 kms. of roads, comprising 313.2 kms. of National, 369.7 kms. of Provincial, 285.7 kms. of Municipal and 1,434.4 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 of road extension is summarized as follows:

National roads .....higher by 1.46 times
Provincial roads.....higher by 1.56 times
Barangay roads.....higher by 2.05 times
All roads.....higher by 1.86 times

In terms of road extension, road development of the province is in quite high 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 Nueva Vizcaya

Road Class	Road Length In 1987 (kms.)	Road Density (L/ PA)		
		Nueva Viscaya	Philippines	Nueva Viscaya/Phils
National Rd.	313.2 (13.0)	0.2919	0.1994	1.46
Prov'l. Rd.	369.7 (15.4)	0.3445	0.2211	1.56
Sub-Total	682.9 (28.4)	0.6364	0.4205	1.51
City Rd.	- -	-	0.0304	-
Municipal Rd	285.7 (11.9)	0.2663	0.0981	2.71
Barangay Rd.	1,434.4 (59.7)	1.3367	0.6536	2.05
TOTAL	2,403.0(100.0)	2.2394	1.2026	1.86

SOURCE: DPWH Infrastructure Atlas, 1989

TABLE 2.2-2
EXISTING SURFACE CONDITION (SURVEYED ROADS ONLY)
Province of Nueva Vizcaya

Road Class	Pavement Type	Surface Condition 1/			% of Pavement Type 2/	
		Good/Fair	Bad/Very Bad	Total (%)	Nueva Vizcaya	Phils.
National Road	PCC	114.4 (86.9)	17.2 (13.1)	131.6 (100.0)	38.5	23.6
	Bituminous	-	-	(100.0)	0.7	22.3
	Gravel	21.0 (20.3)	82.2 (79.7)	103.2 (100.0)	43.9	51.3
	Earth	-	4.9 (100.0)	4.9 (100.0)	16.9	2.8
	Total:	135.4 (56.5)	104.3 (43.5)	239.7 (100.0)	100.0	100.0
Provincial Road	PCC	-	- -	(100.0)	0.4	2.5
	Bituminous	9.2 (68.7)	4.2 (31.3)	13.4 (100.0)	1.8	8.9
	Gravel	72.5 (33.8)	141.7 (66.2)	214.2 (100.0)	65.2	70.6
	Earth	-	12.4 (100.0)	12.4 (100.0)	32.6	18.0
	Total:	81.7 (34.0)	158.3 (66.0)	240.0 (100.0)	100.0	100.0
National and Provincial Road	PCC	114.4 (87.0)	17.2 (13.0)	131.6 (100.0)	17.7	12.5
	Bituminous	9.2 (68.7)	4.2 (31.3)	13.4 (100.0)	1.3	15.3
	Gravel	93.5 (29.5)	223.9 (70.5)	317.4 (100.0)	55.4	61.4
	Earth	-	17.3 (100.0)	17.3 (100.0)	25.4	10.8
	Total:	217.1 (45.3)	262.6 (54.7)	479.7 (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 39% of national roads in the Province are paved mostly with PCC surfaces. Compared with the national average of 46%, national roads in the Province are in lower level in terms of high type pavement ratio.
- About 17% of national roads in the Province are still earth roads which frequently become impassable.
- Only about 56% of national roads are assessed either good or fair. The rest of the roads are in bad/very bad condition.
- In terms of road quality, national roads in the province are still in poor condition.

Provincial Roads

- Only about 2% of provincial roads are paved with PCC or bituminous surfaces, which is far below the national average of 11%.
- About 33% of provincial roads are still earth roads.
- Only 34% of provincial roads are assessed in good to fair condition.

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:

- Fish-bone type network with the axis of Pan-Philippine Highway is formed.
- In addition to Pan-Philippine Highway, there are three (3) inter-provincial roads as follows:
  - * Sta. Fe - San Nicolas Road which is currently impassable.
  - * Aritao - Baguio Road
  - * Bagabag - Bontoc Road
- Two (2) municipal towns, Ambaguio and Castaneda have access problem. The road going to Ambaguio is presently impassable. A. Castaneda located in the remote mountainous area has no access at present.

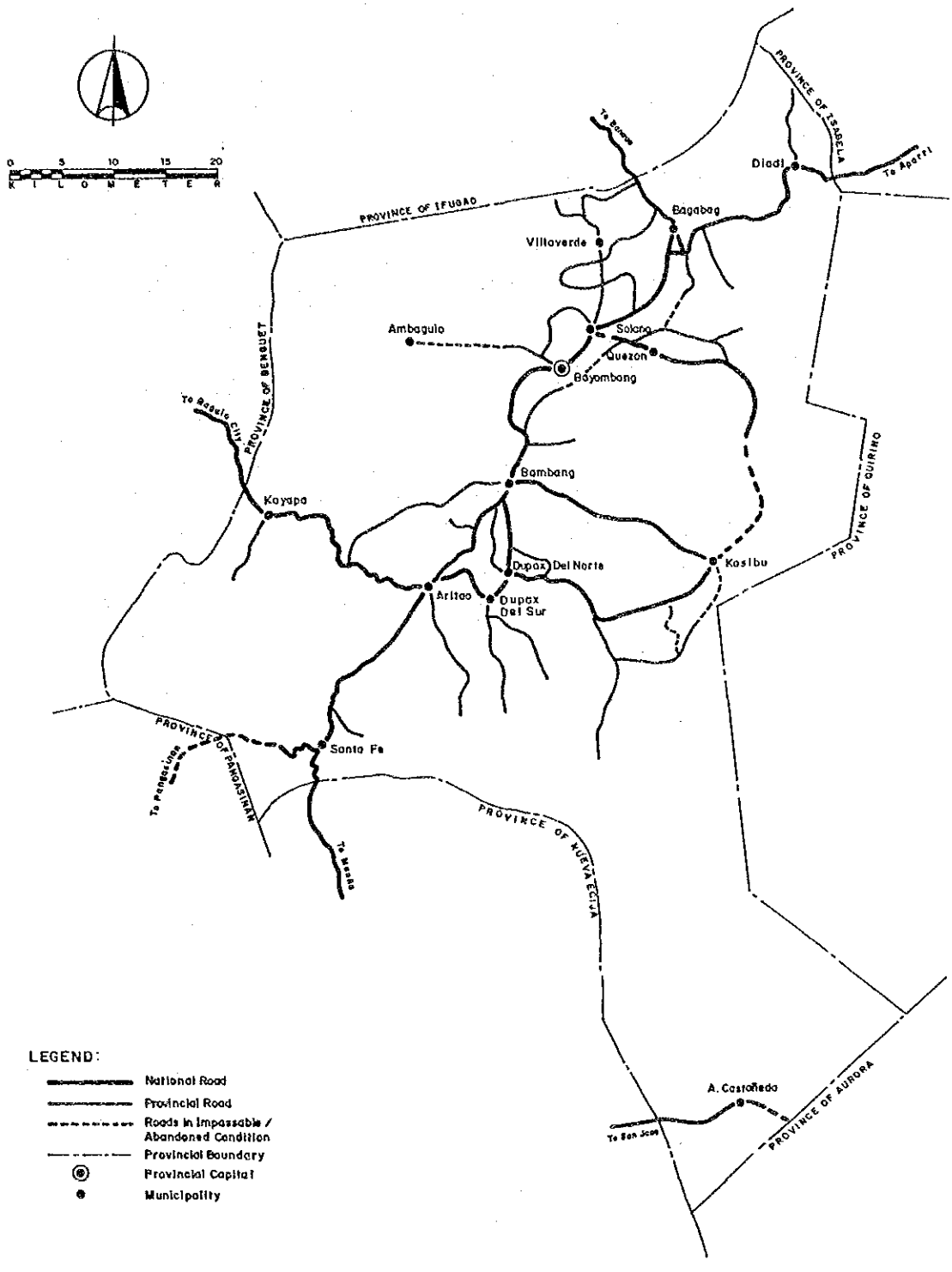

FIGURE 2.2-1 EXISTING ROAD MAP

2.3 GENERAL DIRECTION OF ROAD NETWORK DEVELOPMENT

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

- Although development level in terms of road extension is in quite high level, quality of all classes of roads is still in very poor level.
- Some remote municipal towns are not accessed by land transportation, therefore, the basic road network is not yet completed.

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

(1) Priority should be given to improvement of existing roads, particularly national and provincial roads.

(2) Projects to construct new roads could be defered.

(3) Currently impassable/abandoned national and provincial roads should be carefully studied for their improvement. Technical and economic viability as well as maintenance capability of the District/ Provincial Engineering Offices concerned should be assessed.

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

$$\text{Accessibility} \qquad AC = \sum pl$$

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

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			●		●
S t r e e t		. 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 Nueva Vizcaya was proposed as shown in Figure 2.4-1. For establishing the major road network, the following were taken into consideration:

- Present network of fish-bone type with the main axis of Pan-Philippine Highway was basically considered.
- The inaccessible municipal town of A. Castaneda should be provided with access by a major road, however, due to topographical constraints and farness from Pan-Philippine Highway, it was judged in practical to link the said municipal town from Pan-Philippine Highway. Instead, the said municipal town should be accessed from the Province of Aurora.
- Currently impassable national road which connects Kasibu and Aurora Province was not included in the major road network system, due to low demand of traffic and topographical constraints. However, in the long range planning, it should be considered as one link of major road network system.
- Existing national roads were mostly included in major road network.
- As existing national and provincial roads are extensive in length, no new links were considered necessary.

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 288.9 kms. and composed of the following roads.

National Road	243.7 kms.	(78 % of total national roads)
Provincial Road	45.2 kms.	(12 % of total provincial roads)
Total	288.9 kms.	

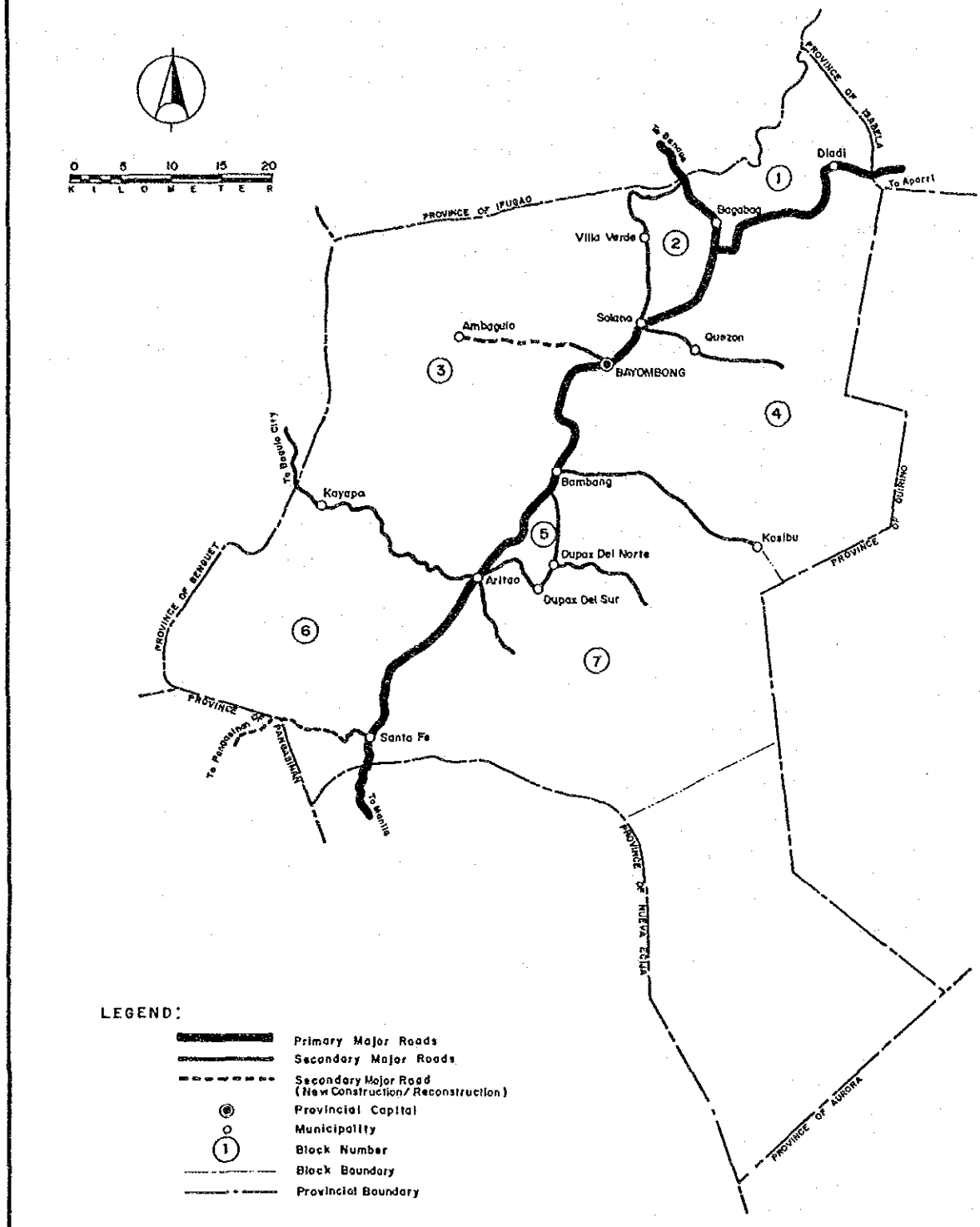

FIGURE 2.4-1 PROPOSED MAJOR ROAD NETWORK

Table 2.4-2

NETWORK VALUE/ACCESSIBILITY
Province of Nueva Vizcaya

Block No.	Population (1990)	Land Area (km^2)	Road Length (km)	Network Value	Access (p.km)	Average Access. (km.)
1	16,730	159.00	33.4	0.648	30,443	1.820
2	28,377	71.15	37.2	0.828	16,829	0.593
3	84,426	877.95	131.9	0.484	177,120	2.098
4	88,608	722.77	117.5	0.464	171,632	1.937
5	13,673	28.83	32.2	1.622	7,938	0.581
6	22,282	395.78	77.8	0.828	46,188	2.073
7	56,795	1,011.03	122.1	0.510	205,621	3.620
Ave.	44,413	466.64	78.9	0.548	93,682	2.109

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.

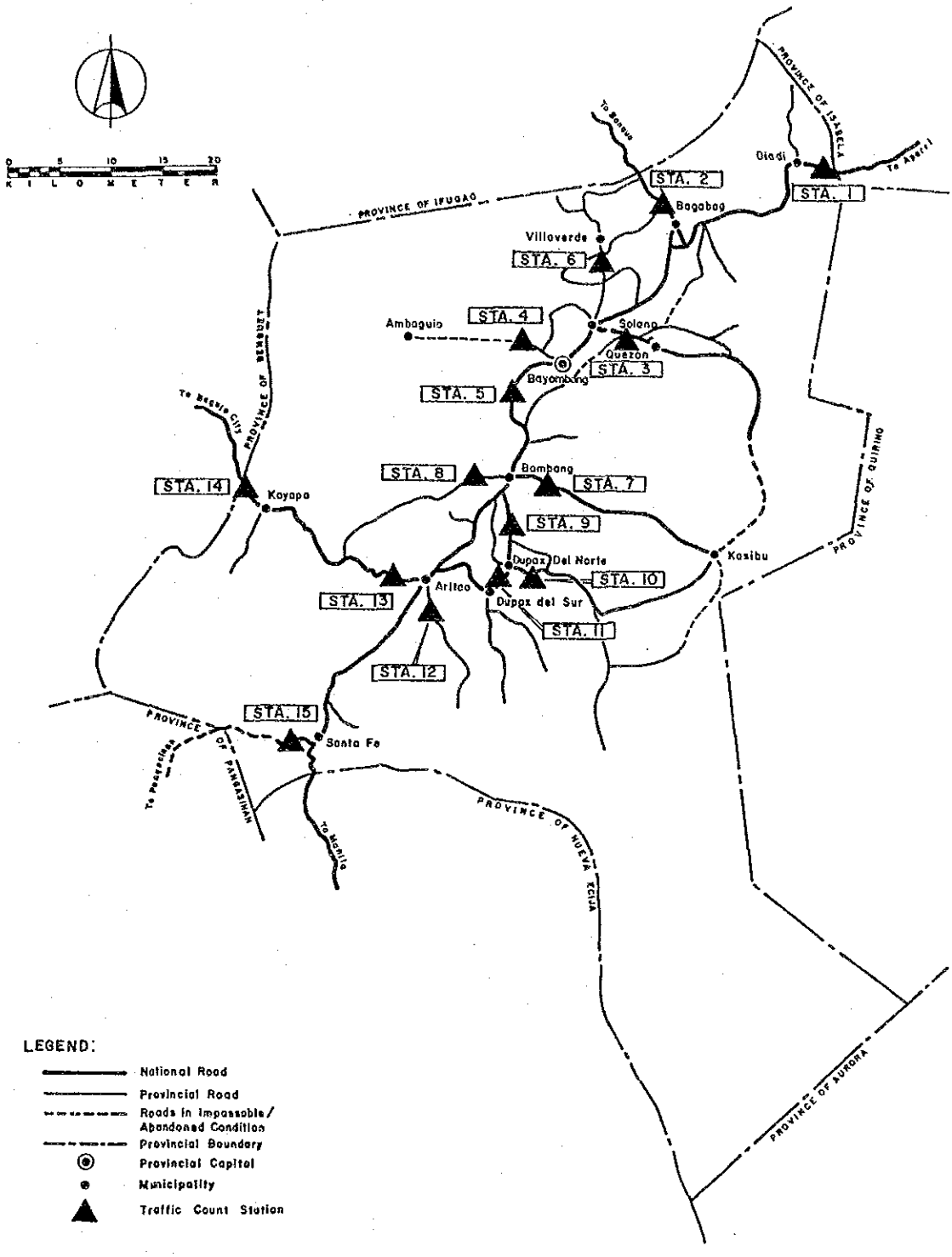

FIGURE 3.1-1 TRAFFIC COUNT STATIONS

TABLE 3.1-1 SUMMARY OF TRAFFIC SURVEY RESULTS
- NUEVA VIZCAYA -

(ADT as of May, 1990)

Station No.	Car	Jeep	Pickup /Van	Jeepney	Bus	Truck	Sub-Total	Tri-cycle	Motor-cycle	Animal Drawn	Total
1	103	100	176	360	220	446	1404	14	70	0	1488
2	30	47	126	584	16	73	875	271	152	21	1318
3	7	17	24	27	1	37	114	217	63	1	394
4	0	7	6	20	0	10	42	74	8	1	125
5	252	163	478	925	193	486	2497	273	259	1	3030
6	42	71	62	216	0	43	434	550	196	10	1190
7	0	29	1	144	0	46	220	242	39	12	513
8	0	31	8	122	7	8	177	273	48	3	501
9	31	54	67	320	6	107	585	334	157	2	1078
10	1	14	4	94	4	14	132	122	62	8	323
11	6	37	42	144	0	18	247	122	85	0	454
12	2	14	10	94	0	25	145	212	52	2	411
13	1	20	12	20	0	22	75	62	15	0	152
14	1	10	8	49	7	7	82	0	0	0	82
15	0	7	1	39	0	0	47	7	0	0	54

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.

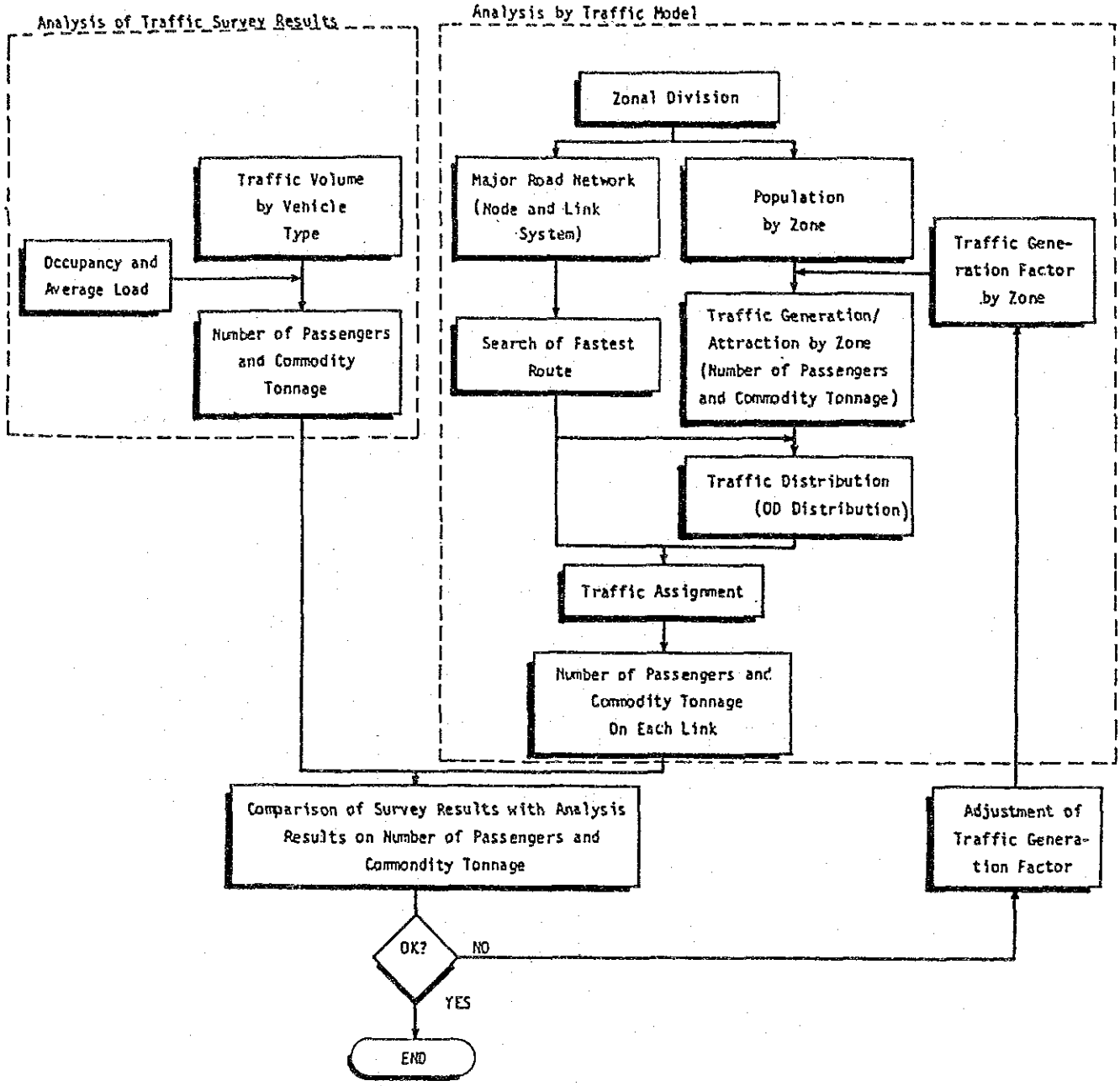

FIGURE 3.2-1
PROCEDURE OF ANALYSIS OF PRESENT TRAFFIC ON MAJOR ROAD NETWORK

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 Nueva Vizcaya

	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	25.30	1.00
Truck	5.00	3.00
Motor-tricycle	2.90	0.30
Motorcycle	1.60	0.10
Animal Drawn	3.00	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

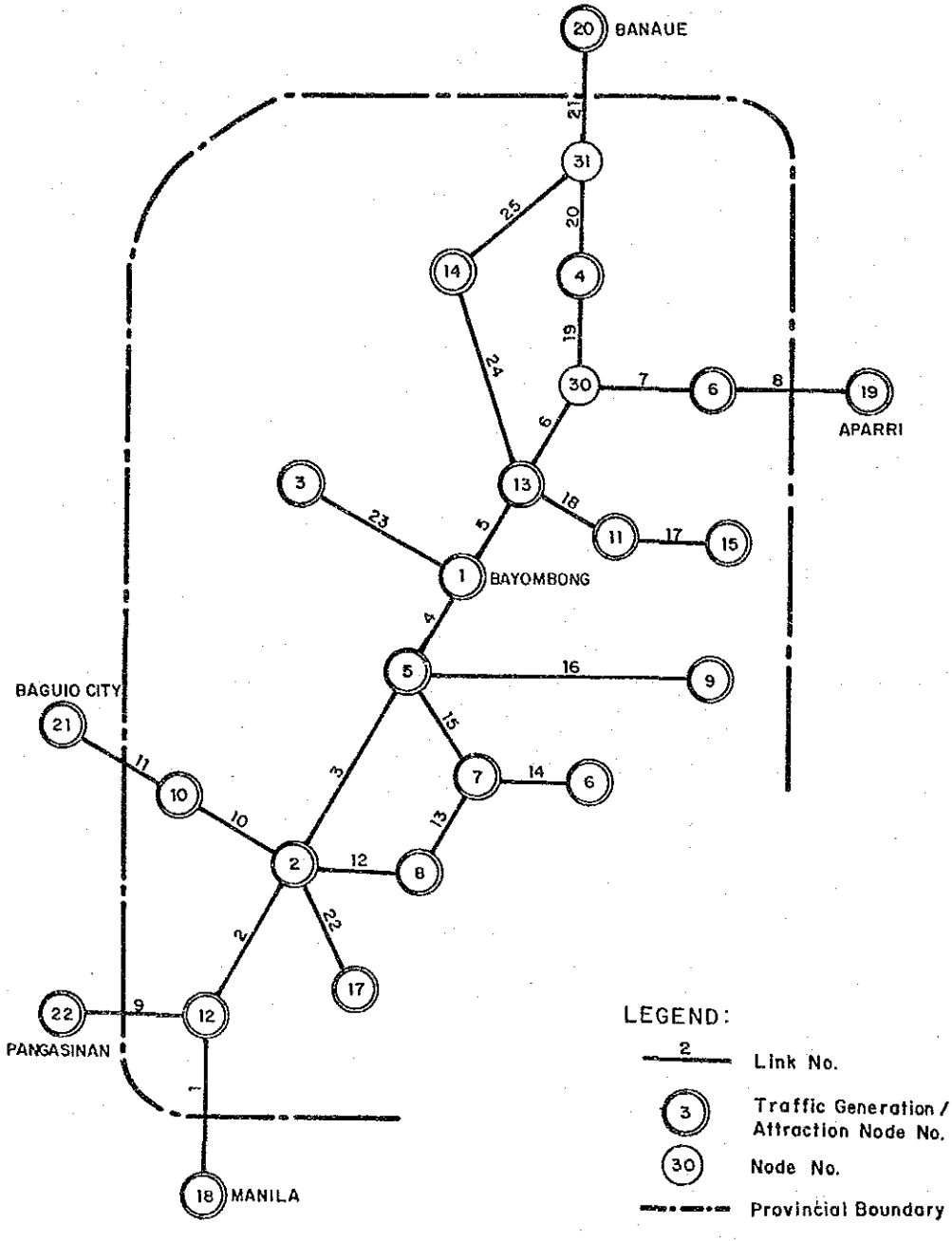

FIGURE 3.2-2 LINK / NODE SYSTEM
PROVINCE OF NUEVA VIZCAYA

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 Nueva Vizcaya

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.042 - 0.209	4.8 - 23.9
Mean Value	0.148	17.0

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.

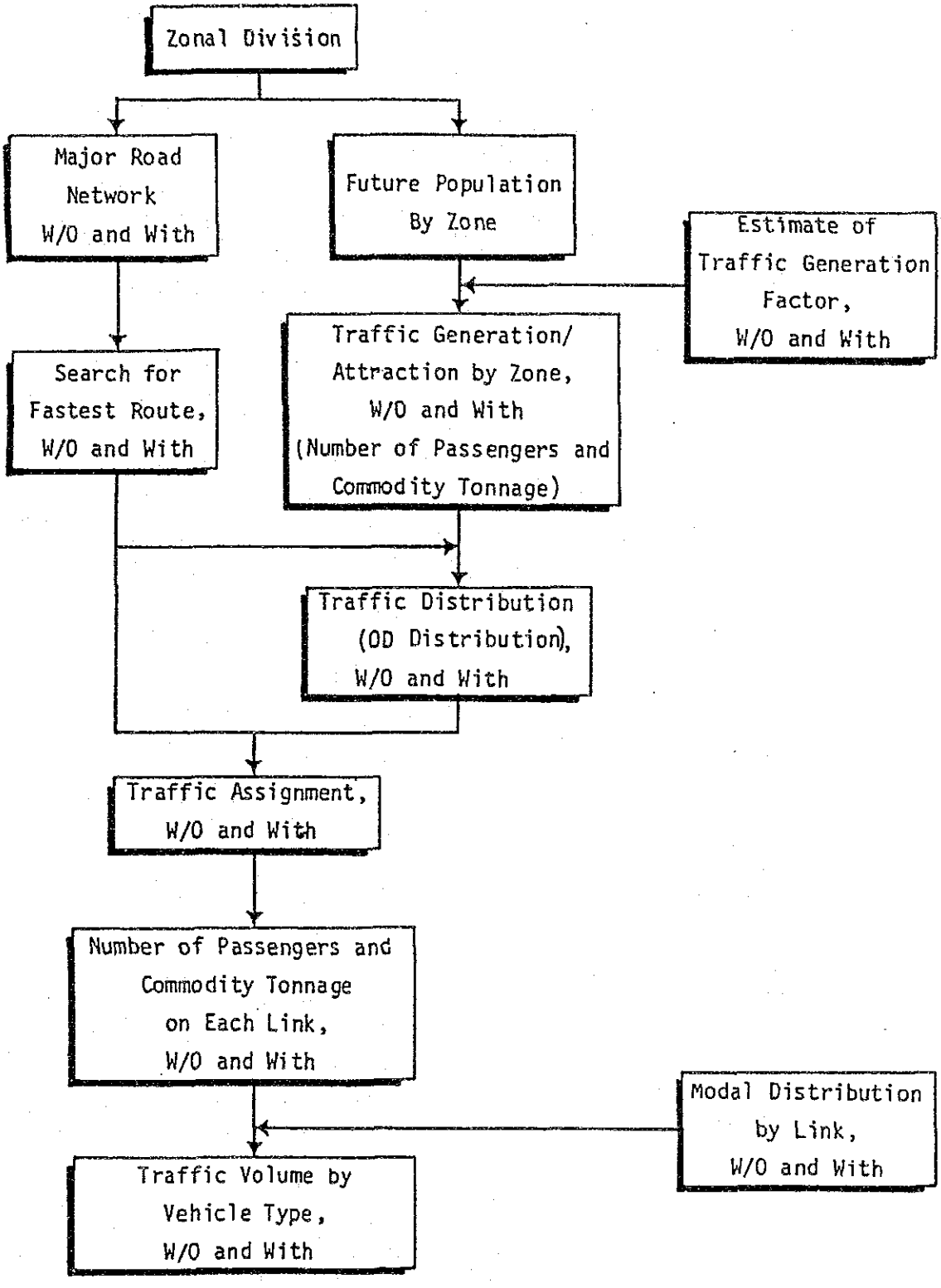

FIGURE 3.2-3
PROCEDURE OF FORECASTING TRAFFIC ON MAJOR ROAD NETWORK

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 Nueva Vizcaya

	Passenger Movement (trip/person/day)	Commodity (kg/person/day)
Range	0.084 - 0.209	9.5 - 23.9
Mean Value	0.167	19.1

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.

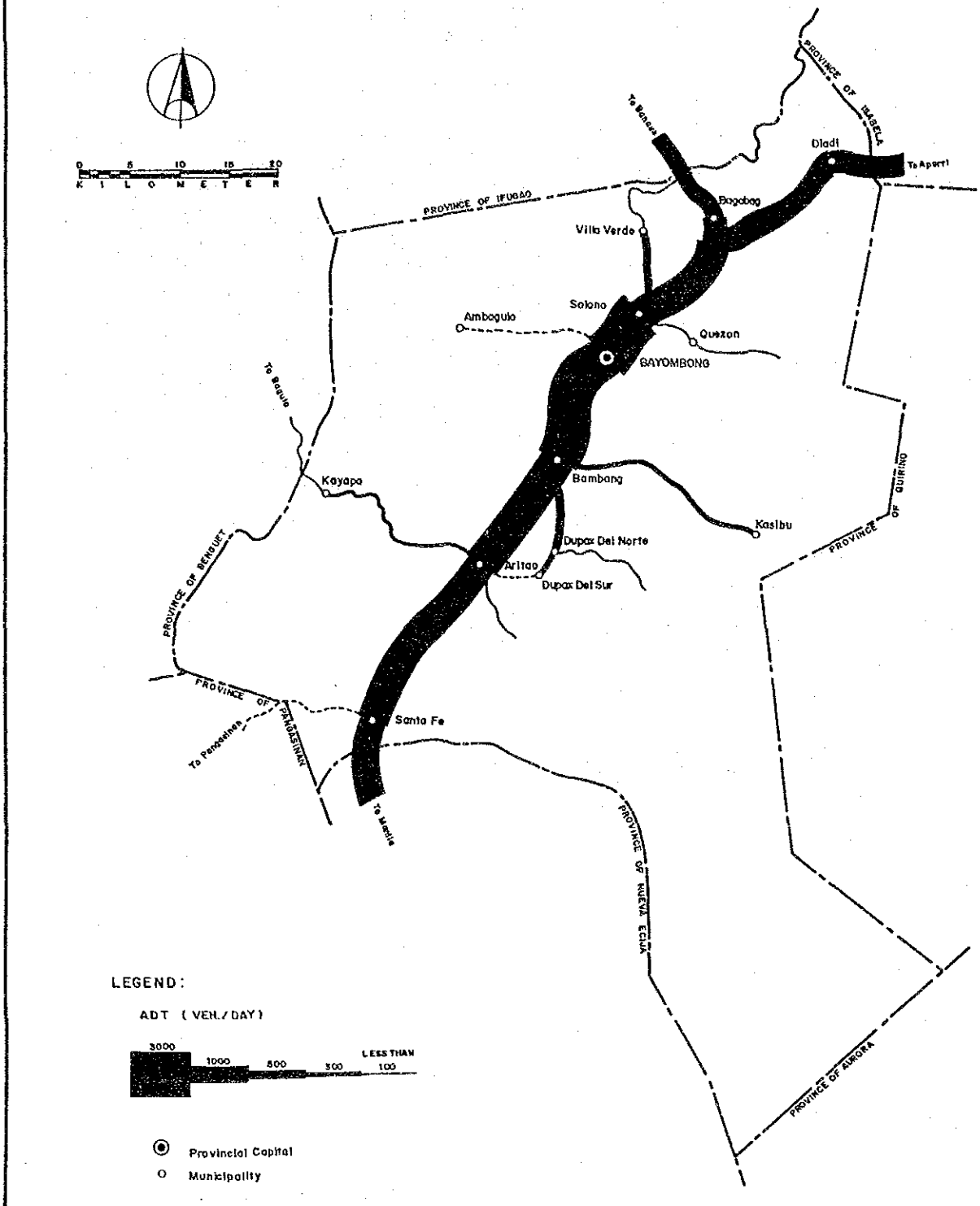

FIGURE 3.2-4 ESTIMATED TRAFFIC VOLUME(1990)

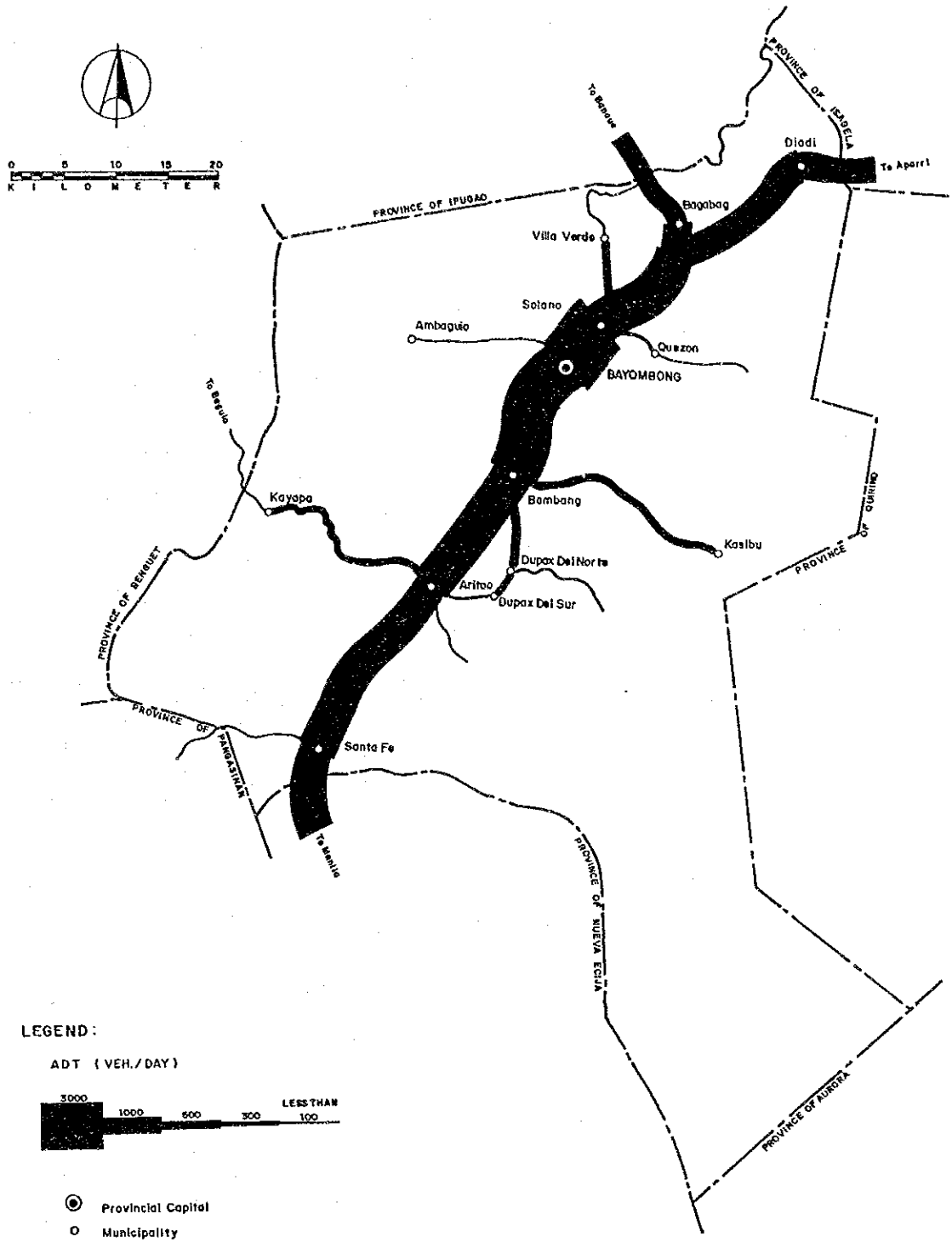

FIGURE 3.2-5 ESTIMATED TRAFFIC VOLUME(1993)
"WITH PROJECT" CASE

TRAFFIC PROJECTION NUEVA VIZCAYA

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	11423				11423	2325.74				2325.74
	1993	13553	-	3	-	13556	2680.18	-	-1.05	-	2679.13
	1997	17023	-	4	-	17027	3238.21	-	-1.30	-	3236.91
	2007	28930	-	6	-	28936	4994.34	-	-2.13	-	4992.21
	2017	47294	-	8	-	47302	7409.35	-	-3.29	-	7406.05
2	1990	12204				12204	2369.72				2369.72
	1993	14471	-	-22	321	14770	2730.31	-	-3.76	35.49	2762.04
	1997	18164	-	-28	1157	19293	3297.97	-	-4.60	123.17	3416.54
	2007	30812	-	-49	1787	32551	5082.83	-	-7.21	172.53	5248.16
	2017	50274	-	-80	2687	52881	7535.07	-	-10.75	235.62	7759.93
3	1990	14258				14258	2502.26				2502.26
	1993	16894	-472	-147	487	16763	2882.37	-65.84	-13.73	53.96	2856.77
	1997	21185	-587	-184	1849	22263	3480.78	-78.86	-16.57	196.86	3582.21
	2007	35835	-972	-308	3141	37696	5359.29	-118.76	-25.24	303.44	5518.73
	2017	58299	-1548	-493	5054	61312	7935.40	-172.08	-36.65	443.21	8169.88
4	1990	14348				14348	2447.32				2447.32
	1993	17004	-	-50	474	17427	2817.95	-	-4.63	52.45	2865.77
	1997	21329	-	-59	1873	23144	3401.16	-	-5.07	199.56	3595.65
	2007	36109	-	-84	3545	39570	5230.15	-	-5.71	342.77	5567.21
	2017	58794	-	-109	6322	65007	7735.80	-	-5.40	554.47	8284.87
5	1990	18869				18869	2923.82				2923.82
	1993	22312	-	-50	404	22666	3361.27	-	-3.75	44.76	3402.28
	1997	27904	-	-60	1616	29460	4048.33	-	-4.21	172.21	4216.34
	2007	46871	-	-91	3126	49906	6191.05	-	-5.03	302.46	6488.47
	2017	75755	-	-128	5658	81285	9109.51	-	-5.11	496.28	9600.69
6	1990	13952				13952	2372.13				2372.13
	1993	16485	-	44	247	16777	2727.01	-	7.57	27.41	2761.99
	1997	20601	-	61	1001	21663	3284.73	-	10.03	106.82	3401.58
	2007	34624	-	124	1982	36729	5031.96	-	18.79	191.83	5242.58
	2017	56114	-	234	3632	59980	7425.18	-	32.28	319.06	7776.52
7	1990	9886				9886	1757.00				1757.00
	1993	11772	-	42	247	12062	2029.32	-	1.64	27.41	2058.37
	1997	14863	-	54	1001	15918	2459.60	-	2.14	106.82	2568.57
	2007	25562	-	92	1982	27636	3821.26	-	3.97	191.84	4017.06
	2017	42205	-	153	3632	45991	5703.80	-	6.81	319.06	6029.66
8	1990	9179				9179	1678.93				1678.93
	1993	10890	-	42	-	10932	1934.66	-	.82	-	1935.47
	1997	13677	-	53	-	13730	2337.20	-	1.01	-	2338.21
	2007	23241	-	89	-	23330	3603.81	-	1.63	-	3605.43
	2017	37989	-	144	-	38133	5345.35	-	2.49	-	5347.85

TRAFFIC PROJECTION NUEVA VIZCAYA

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	-				-	-				-
	1993	-	-	-	321	321	-	-	-	35.49	35.49
9	1997	-	-	-	1157	1157	-	-	-	123.17	123.17
	2007	-	-	-	1787	1787	-	-	-	172.53	172.53
	2017	-	-	-	2687	2687	-	-	-	235.62	235.62
	1990	1406				1406	150.83				150.83
	1993	1631	-	-52	557	2135	169.28	-	-3.54	61.63	227.36
10	1997	1989	-	-63	1993	3918	197.54	-	-4.11	212.22	405.65
	2007	3165	-	-99	3010	6077	281.98	-	-5.75	290.73	566.97
	2017	4912	-	-149	4457	9219	393.05	-	-7.85	390.83	776.03
	1990	602				602	48.78				48.78
	1993	714	-	2	-	717	56.22	-	-	-	56.21
11	1997	897	-	3	-	900	67.92	-	-	-	67.91
	2007	1525	-	5	-	1530	104.74	-	-	-	104.74
	2017	2493	-	8	-	2501	155.37	-	-	-	155.37
	1990	-				-	-				-
	1993	-	472	196	125	793	-	65.84	20.39	13.78	100.01
12	1997	-	587	244	434	1265	-	78.86	24.36	46.17	149.38
	2007	-	972	402	611	1985	-	118.76	36.36	58.93	214.05
	2017	-	1548	636	844	3028	-	172.08	52.17	74.02	298.26
	1990	2082				2082	237.61				237.61
	1993	2454	122	-75	180	2681	271.96	16.30	-7.02	19.91	301.15
13	1997	3054	152	-94	677	3790	325.62	19.49	-8.38	72.07	408.81
	2007	5059	250	-154	1141	6296	489.44	29.25	-12.49	110.16	616.35
	2017	8055	397	-244	1841	10049	707.20	42.24	-17.91	161.35	892.89
	1990	625				625	71.28				71.28
	1993	736	-	-	163	900	81.58	-	-	18.07	99.65
14	1997	916	-	-	610	1526	97.67	-	-	64.91	162.58
	2007	1518	-	-	1011	2528	146.79	-	-	97.68	244.48
	2017	2416	-	-	1610	4026	212.10	-	.01	141.09	353.20
	1990	2998				2998	356.54				356.54
	1993	3536	-472	-67	133	3130	408.51	-65.84	-7.16	14.72	350.23
15	1997	4407	-587	-84	533	4269	489.78	-78.86	-8.61	56.75	459.06
	2007	7324	-972	-141	1019	7229	738.83	-118.76	-13.06	98.40	705.40
	2017	11700	-1548	-228	1798	11722	1071.27	-172.08	-19.00	157.56	1037.75
	1990	1581				1581	180.59				180.59
	1993	1991	-	4	443	2438	220.80	-	-	48.98	269.79
16	1997	2706	-	6	1805	4516	288.67	-	-	192.06	480.74
	2007	5430	-	11	3619	9060	525.69	-	.02	349.57	875.28
	2017	10063	-	20	6703	16786	884.15	-	.04	587.43	1471.61

TRAFFIC PROJECTION NUEVA VIZCAYA

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
17	1990	364				364	41.40				41.40
	1993	459	-	-	228	687	50.69	-	.05	25.29	76.03
	1997	625	-	-	933	1558	66.40	-	.06	99.35	165.81
	2007	1260	-	-	1879	3139	121.46	-	.10	182.32	303.88
	2017	2345	-	-2	3492	5836	205.00	-	.14	306.27	511.41
18	1990	592				592	73.78				73.78
	1993	734	-	253	275	1262	88.96	-	24.57	30.48	144.01
	1997	977	-	354	1112	2443	114.08	-	33.25	118.41	265.74
	2007	1865	-	756	2192	4813	198.65	-	65.10	212.05	475.80
	2017	3316	-	1468	4020	8804	321.84	-	115.52	352.44	789.80
19	1990	8332				8332	1288.24				1288.24
	1993	9788	-	-3	-	9785	1475.62	-	-1.12	-	1474.50
	1997	12138	-	-2	-	12136	1769.11	-	-1.13	-	1767.98
	2007	20046	-	5	-	20050	2681.93	-	-.92	-	2681.01
	2017	32017	-	18	-	32035	3924.32	-	-.32	-	3924.00
20	1990	5392				5392	1019.26				1019.26
	1993	6398	-	-17	-	6381	1174.76	-	-3.60	-	1171.16
	1997	8037	-	-21	-	8017	1419.62	-	-4.27	-	1415.35
	2007	13667	-	-33	-	13633	2190.67	-	-6.26	-	2184.41
	2017	22355	-	-52	-	22303	3251.71	-	-8.84	-	3242.86
21	1990	5592				5592	1051.40				1051.40
	1993	6634	-	8	-	6643	1211.58	-	.10	-	1211.68
	1997	8333	-	10	-	8343	1463.75	-	.12	-	1463.87
	2007	14160	-	17	-	14177	2257.27	-	.20	-	2257.47
	2017	23147	-	26	-	23173	3348.43	-	.31	-	3348.74
22	1990	834				834	95.17				95.17
	1993	983	-	-	47	1030	108.92	-	-.01	5.19	114.10
	1997	1223	-	-	175	1398	130.39	-	-.01	18.64	149.02
	2007	2025	-	-	289	2315	195.99	-	-.02	28.00	223.97
	2017	3226	-	1	461	3687	283.26	-	-.03	40.48	323.72
23	1990	-				-	-				-
	1993	-	-	-	218	218	-	-	-	24.17	24.17
	1997	-	-	-	880	880	-	-	-	93.80	93.80
	2007	-	-	-	1726	1726	-	-	-	166.87	166.87
	2017	-	-	-	3142	3142	-	-	-	275.65	275.65
24	1990	2585				2585	285.58				285.58
	1993	3019	-	-31	-	2988	323.81	-	-3.72	-	320.10
	1997	3712	-	-39	-	3673	382.88	-	-4.41	-	378.47
	2007	5985	-	-63	-	5922	559.87	-	-6.49	-	553.37
	2017	9328	-	-99	-	9229	791.33	-	-9.20	-	782.13

TRAFFIC PROJECTION NUEVA VIZCAYA

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	200				200	32.14				32.14
	1993	237	-	25	-	261	36.82	-	3.70	-	40.52
25	1997	295	-	31	-	326	44.13	-	4.39	-	48.52
	2007	493	-	50	-	543	66.60	-	6.45	-	73.05
	2017	792	-	78	-	870	96.72	-	9.15	-	105.87

TRAFFIC PROJECTION NUEVA VIZCAYA

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
	1990	615	407	271	643	1936	-	-	-	1936								
	1993	720	479	321	742	2262	-	-	-	2262	720	479	321	741	2262	-	-	-	2262
1	1997	889	595	404	896	2784	-	-	-	2784	889	595	404	896	2783	-	-	-	2783
	2007	1450	985	686	1382	4503	-	-	-	4503	1450	985	686	1381	4503	-	-	-	4503
	2017	2280	1573	1122	2050	7024	-	-	-	7024	2280	1573	1122	2049	7024	-	-	-	7024
	1990	643	429	289	656	2017	-	-	-	2017								
	1993	753	504	343	755	2356	-	-	-	2356	766	514	350	764	2394	-	-	-	2394
2	1997	930	627	431	912	2900	-	-	-	2900	977	661	458	945	3042	-	-	-	3042
	2007	1516	1037	731	1406	4691	-	-	-	4691	1587	1090	772	1452	4901	-	-	-	4901
	2017	2383	1655	1192	2085	7315	-	-	-	7315	2487	1732	1254	2147	7620	-	-	-	7620
	1990	720	488	338	692	2238	-	-	-	2238								
	1993	843	574	401	797	2614	-	-	-	2614	836	569	398	790	2593	-	-	-	2593
3	1997	1041	713	502	963	3219	-	-	-	3219	1085	745	528	991	3349	-	-	-	3349
	2007	1697	1179	850	1483	5209	-	-	-	5209	1771	1234	894	1527	5426	-	-	-	5426
	2017	2667	1879	1383	2195	8124	-	-	-	8124	2784	1967	1454	2260	8465	-	-	-	8465
	1990	985	987	198	522	2692	-	-	-	2692								
	1993	1148	1159	235	601	3144	-	-	-	3144	1172	1185	241	611	3209	-	-	-	3209
4	1997	1410	1436	295	726	3867	-	-	-	3867	1508	1546	320	767	4141	-	-	-	4141
	2007	2265	2363	500	1116	6243	-	-	-	6243	2444	2568	547	1188	6747	-	-	-	6747
	2017	3508	3746	813	1650	9718	-	-	-	9718	3817	4107	899	1767	10591	-	-	-	10591
	1990	1227	1260	261	624	3372	-	-	-	3372								
	1993	1429	1477	309	717	3932	-	-	-	3932	1449	1499	314	726	3987	-	-	-	3987
5	1997	1752	1827	386	864	4828	-	-	-	4828	1836	1921	408	899	5064	-	-	-	5064
	2007	2803	2990	648	1321	7761	-	-	-	7761	2960	3170	690	1384	8204	-	-	-	8204
	2017	4323	4715	1048	1943	12030	-	-	-	12030	4599	5037	1125	2048	12808	-	-	-	12808
	1990	695	473	331	656	2155	-	-	-	2155								
	1993	812	555	391	754	2513	-	-	-	2513	825	565	398	764	2551	-	-	-	2551
6	1997	1000	688	489	909	3085	-	-	-	3085	1045	721	514	941	3221	-	-	-	3221
	2007	1622	1132	821	1392	4967	-	-	-	4967	1709	1196	871	1450	5227	-	-	-	5227
	2017	2541	1798	1331	2054	7724	-	-	-	7724	2697	1914	1422	2152	8185	-	-	-	8185
	1990	502	339	234	486	1561	-	-	-	1561								
	1993	590	401	279	561	1831	-	-	-	1831	602	410	286	569	1867	-	-	-	1867
7	1997	732	501	352	680	2266	-	-	-	2266	776	533	378	711	2398	-	-	-	2398
	2007	1210	841	606	1057	3715	-	-	-	3715	1295	903	655	1111	3965	-	-	-	3965
	2017	1926	1358	1001	1578	5863	-	-	-	5863	2076	1471	1091	1668	6306	-	-	-	6306
	1990	471	317	218	465	1471	-	-	-	1471								
	1993	552	374	258	535	1720	-	-	-	1720	554	375	259	535	1723	-	-	-	1723
8	1997	683	465	324	647	2118	-	-	-	2118	684	466	326	647	2123	-	-	-	2123
	2007	1116	771	551	997	3435	-	-	-	3435	1119	773	553	998	3443	-	-	-	3443
	2017	1759	1233	901	1479	5372	-	-	-	5372	1763	1237	904	1480	5384	-	-	-	5384

TRAFFIC PROJECTION NUEVA VIZCAYA

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	-	-	-	-	-	-	-	-	-									
	1993	-	-	-	-	-	-	-	-	-	1	10	1	2	15	-	-	229	244
9	1997	-	-	-	-	-	-	-	-	-	12	106	14	25	156	-	-	-	156
	2007	-	-	-	-	-	-	-	-	-	17	158	21	35	231	-	-	-	231
	2017	-	-	-	-	-	-	-	-	-	24	230	32	47	333	-	-	-	333
	1990	51	129	11	25	216	-	44	-	260									
	1993	58	148	13	28	246	-	51	-	297	59	195	20	40	314	-	44	-	358
10	1997	69	177	16	33	295	-	62	-	357	41	354	46	81	522	-	-	-	522
	2007	103	272	25	47	447	-	99	-	546	57	531	72	113	773	-	-	-	773
	2017	151	409	39	66	664	-	153	-	818	78	780	109	155	1122	-	-	-	1122
	1990	19	50	5	8	82	-	19	-	101									
	1993	22	59	6	9	96	-	22	-	118	16	59	7	10	92	-	15	-	107
11	1997	27	74	7	11	119	-	28	-	147	7	74	11	14	105	-	-	-	105
	2007	43	122	12	17	195	-	48	-	242	10	122	18	21	172	-	-	-	172
	2017	68	194	20	26	308	-	78	-	386	16	195	30	31	271	-	-	-	271
	1990	-	-	-	-	-	-	-	-	-									
	1993	-	-	-	-	-	-	-	-	-	31	76	-	12	119	8	8	142	277
12	1997	-	-	-	-	-	-	-	-	-	30	126	-	28	185	37	40	-	261
	2007	-	-	-	-	-	-	-	-	-	43	194	-	41	278	56	62	-	395
	2017	-	-	-	-	-	-	-	-	-	60	291	-	57	407	82	95	-	584
	1990	90	192	-	36	317	111	130	-	559									
	1993	104	224	-	41	369	130	153	-	652	97	252	-	49	398	121	140	-	658
13	1997	126	276	-	49	451	160	191	-	801	82	371	-	78	530	106	118	-	755
	2007	197	444	-	73	714	256	316	-	1286	123	603	-	117	844	170	197	-	1211
	2017	295	689	-	106	1090	396	503	-	1989	179	945	-	170	1293	263	314	-	1870
	1990	27	58	-	11	95	33	39	-	168									
	1993	31	67	-	12	111	39	46	-	196	32	84	-	16	133	40	47	-	220
14	1997	38	83	-	15	135	48	57	-	240	33	149	-	31	212	43	48	-	303
	2007	59	133	-	22	214	77	95	-	386	49	242	-	46	337	68	79	-	484
	2017	89	207	-	32	327	119	151	-	597	71	378	-	67	515	105	126	-	746
	1990	133	280	-	53	466	163	187	-	816									
	1993	154	327	-	61	542	190	221	-	953	112	294	-	57	464	141	163	-	767
15	1997	187	403	-	73	663	234	275	-	1172	92	417	-	87	596	120	133	-	849
	2007	292	650	-	111	1053	376	458	-	1887	141	692	-	134	968	195	226	-	1389
	2017	440	1011	-	161	1612	582	731	-	2925	208	1102	-	197	1506	306	366	-	2178
	1990	41	157	-	42	240	-	49	-	290									
	1993	51	196	-	52	299	-	62	-	361	51	244	-	64	360	-	61	-	421
16	1997	69	264	-	67	400	-	85	-	485	51	464	-	120	634	-	56	-	691
	2007	132	519	-	123	774	-	170	-	944	97	912	-	219	1228	-	113	-	1341
	2017	236	944	-	206	1387	-	314	-	1702	172	1660	-	368	2200	-	210	-	2410

TRAFFIC PROJECTION NUEVA VIZCAYA

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
	1990	8	31	-	8	48	26	23	-	96								
	1993	10	39	-	10	59	32	29	-	120	15	62	-	15	92	39	36	-	166
17	1997	14	53	-	13	79	43	39	-	162	33	152	-	32	217	43	49	-	309
	2007	26	104	-	23	153	85	79	-	317	61	300	-	58	419	85	98	-	601
	2017	45	190	-	40	274	153	147	-	574	102	547	-	97	747	152	182	-	1081
	1990	15	52	-	14	81	44	37	-	162								
	1993	18	64	-	17	99	54	46	-	199	29	114	-	28	171	72	66	-	309
18	1997	23	85	-	22	130	70	61	-	261	53	239	-	50	343	69	76	-	488
	2007	41	158	-	38	237	130	117	-	484	95	462	-	90	648	131	150	-	929
	2017	68	275	-	62	405	224	207	-	836	158	829	-	150	1137	231	275	-	1643
	1990	345	823	46	245	1459	57	104	-	1620								
	1993	397	959	54	280	1690	68	122	-	1880	397	958	54	280	1689	67	122	-	1879
19	1997	478	1177	67	336	2058	84	152	-	2294	478	1176	67	336	2058	84	152	-	2293
	2007	735	1895	111	510	3251	138	251	-	3640	735	1896	111	509	3250	138	251	-	3639
	2017	1091	2956	177	746	4969	221	400	-	5590	1091	2957	177	746	4970	221	400	-	5592
	1990	266	569	30	194	1059	37	67	-	1164								
	1993	308	669	35	223	1235	44	80	-	1359	307	667	35	223	1232	44	80	-	1355
20	1997	374	829	44	270	1517	55	100	-	1673	373	827	44	269	1513	55	100	-	1668
	2007	584	1365	76	416	2441	94	171	-	2706	583	1361	75	415	2434	94	170	-	2699
	2017	879	2166	124	618	3787	154	279	-	4220	877	2161	123	616	3777	154	279	-	4210
	1990	275	589	31	200	1095	39	70	-	1203								
	1993	318	692	37	230	1277	46	83	-	1405	318	693	37	230	1277	46	83	-	1406
21	1997	386	858	46	278	1568	57	104	-	1729	386	858	46	278	1568	58	104	-	1730
	2007	602	1411	78	429	2521	98	177	-	2796	603	1413	78	429	2523	98	177	-	2798
	2017	906	2239	128	636	3910	160	289	-	4358	907	2241	128	636	3912	160	290	-	4361
	1990	19	72	-	18	110	60	52	-	221								
	1993	22	84	-	21	127	69	61	-	258	23	93	-	22	138	58	54	-	249
22	1997	27	104	-	25	156	85	76	-	317	30	136	-	28	195	39	44	-	277
	2007	41	168	-	38	247	137	127	-	510	45	221	-	43	309	62	72	-	443
	2017	61	262	-	55	378	211	202	-	790	65	346	-	62	472	96	115	-	683
	1990	-	-	-	-	-	-	-	-	-									
	1993	-	-	-	-	-	-	-	-	-	2	8	-	2	11	-	5	156	172
23	1997	-	-	-	-	-	-	-	-	-	22	92	-	19	133	-	55	-	188
	2007	-	-	-	-	-	-	-	-	-	42	174	-	33	250	-	108	-	358
	2017	-	-	-	-	-	-	-	-	-	74	309	-	55	438	-	196	-	634
	1990	162	200	-	38	399	229	162	-	790									
	1993	186	231	-	43	460	264	189	-	913	159	241	-	48	448	226	156	-	830
24	1997	224	281	-	51	556	320	232	-	1108	130	325	-	69	524	190	115	-	828
	2007	344	442	-	75	860	496	374	-	1731	198	512	-	101	811	296	185	-	1293
	2017	512	672	-	106	1289	746	583	-	2019	292	782	-	143	1218	449	288	-	1955

TRAFFIC PROJECTION NUEVA VIZCAYA

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	16	17	-	4	37	21	13	-	71									
	1993	18	20	-	5	43	25	15	-	83	17	24	-	6	47	23	14	-	84
25	1997	22	25	-	6	53	30	18	-	101	14	32	-	9	55	19	10	-	85
	2007	34	40	-	9	84	48	31	-	162	23	51	-	13	87	31	17	-	135
	2017	52	63	-	13	128	73	50	-	251	34	80	-	19	134	48	27	-	208

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 Nueva Vizcaya

Existing Road Condition	Passenger Movement (trip/person/day)		Non-Agricultural Commodity (kg/person/day)	
	w/o	with	w/o	with
Paved/Gravel				
Good/Fair	0.12	0.12	2.0	2.0
Bad	0.10	0.11	1.6	1.8
Very Bad	0.08	0.11	0.6	1.0
Earth Road	0.03	0.06	0.5	1.0
Impassable to motoried vehicle	0.01	0.03	0.4	1.0

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

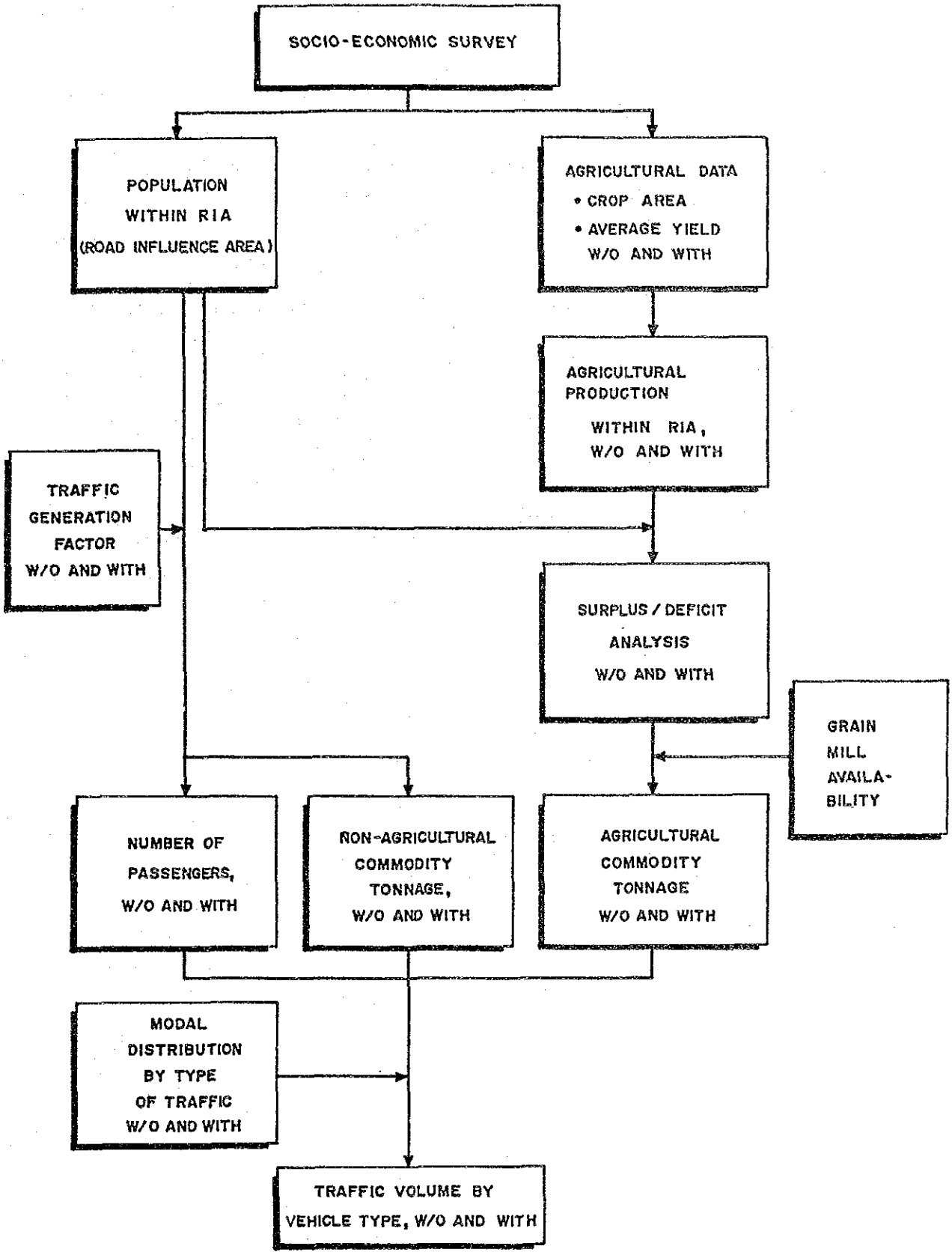

FIGURE 3.3-1
PROCEDURE OF TRAFFIC FORECAST FOR DEVELOPMENT PROJECTS

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 NUEVA VIZCAYA

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
Second'y	Rehab/	P19	-	-	-	-	-	-	-	-	-	-	2	8	-	2	11	0	5	156	-	-
Major	Imp-1	N5-2	104	224	-	41	369	130	153	-	-	-	97	252	-	49	398	121	140	-	-	-
		N5-1	-	-	-	-	-	-	-	-	-	-	31	76	-	12	119	8	8	142	-	-
		N7-4	18	64	-	17	99	54	46	-	-	-	29	114	-	28	171	72	66	-	-	-
		N5-3	31	67	-	12	111	39	46	-	-	-	32	84	-	16	133	40	47	-	-	-
		N7-3	10	39	-	10	59	32	29	-	-	-	15	62	-	15	92	39	36	-	-	-

TABLE 3.4 - 1 (2)

Traffic Volume by Vehicle Type NUEVA VIZCAYA

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
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P42	-	49	-	-	49	125	-	26	335	-	4	70	-	-	74	84	64	-	67	-
		P1	5	50	-	1	56	19	17	-	-	-	4	49	-	0	54	19	17	-	-	-
		P7	6	41	-	1	48	33	30	-	-	-	4	43	-	3	50	18	16	-	-	-
		P59	-	9	-	-	9	40	1	28	150	-	6	14	-	1	21	2	1	-	-	-
		P6	-	7	-	-	7	24	-	9	67	-	2	11	-	0	13	8	7	-	-	-
		P14	3	22	-	-	25	46	-	-	119	-	3	28	-	-	31	34	22	-	48	-
		P52-1	-	-	-	-	-	54	29	32	196	-	3	17	-	-	19	35	-	-	92	-
		P33	3	33	-	-	35	72	-	-	168	-	3	44	-	-	47	52	39	-	48	-
		P43	-	-	-	-	-	11	2	10	32	-	-	2	-	-	2	4	2	5	39	-
		P36	-	2	-	-	2	8	-	5	24	-	1	5	-	0	5	4	4	-	-	-
		P51	-	2	-	-	2	26	3	27	96	-	2	9	-	-	11	11	4	-	35	-
		N5-4	6	14	-	-	20	28	-	-	75	-	4	7	-	4	15	0	0	-	-	-
		P13-2	-	6	-	-	6	16	-	9	64	-	2	11	-	0	13	3	3	-	-	-
		P21	-	24	-	-	24	39	20	23	115	-	2	27	-	-	29	36	20	7	75	-
		P3	-	-	-	-	-	13	10	10	64	-	1	7	-	0	8	5	5	-	-	-
		P52-3	-	-	-	-	-	1	1	12	21	-	0	2	-	-	2	3	-	-	10	-
		P10	5	46	-	-	51	99	-	-	242	-	5	47	-	-	52	102	-	-	247	-
		P47	-	1	-	-	1	1	1	1	9	-	0	1	-	-	1	1	-	-	4	-
	Imp-2/ Widen	P49	-	23	-	-	23	61	-	18	181	-	3	40	-	-	43	25	14	-	45	-
	New Const.	N7-2	-	10	-	-	10	27	9	20	171	-	4	19	-	-	23	37	-	-	107	-
		P58	-	-	-	-	-	-	-	37	78	-	2	6	-	-	8	11	-	-	36	-
		P52-2	-	-	-	-	-	11	5	7	39	-	1	4	-	-	4	7	-	-	19	-

TABLE 3.4 - 1 (3)

Traffic Volume by Vehicle Type NUEVA VIZCAYA

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
Minor (Barangay)	Rehab/Imp-1	B10-1	-	-	-	-	-	-	-	17	32	-	-	1	-	-	1	4	1	9	32	-
		B4-1	-	14	-	-	14	10	20	13	223	-	2	19	-	-	21	40	-	-	98	-
		B5-4	-	-	-	-	-	-	-	9	35	-	-	1	-	-	1	2	2	2	24	-
		B5-1	-	-	-	-	-	34	23	16	133	-	-	9	-	-	9	6	13	8	142	-
		B4-5	-	5	-	-	5	7	6	9	96	-	1	9	-	-	11	12	6	-	23	-
		B14-2	-	6	-	-	6	6	9	4	91	-	1	8	-	-	9	18	-	-	41	-
		B10-2	-	-	-	-	-	6	-	6	101	-	-	4	-	-	4	3	7	4	71	-
		B0-1	-	1	-	-	1	3	0	4	20	-	1	2	-	-	2	2	-	-	10	-
		B2-4	-	2	-	-	2	4	2	6	42	-	1	3	-	-	4	6	-	-	20	-
		B12-2	-	-	-	-	-	-	-	5	37	-	-	1	-	-	1	1	2	3	26	-
	New Const.	B9-2	-	-	-	-	-	24	9	18	80	-	1	7	-	-	9	14	-	-	41	-
		B9-5	-	-	-	-	-	-	-	29	48	-	1	4	-	-	5	6	-	-	23	-
		B8-3	-	-	-	-	-	9	-	10	39	-	-	2	-	-	2	4	2	5	39	-

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 Nueva Vizcaya

	Road Class	National Roads	Prov'l/City Roads	Barangay Roads	Total
Surveyed Road	Major Rd.	234.7	45.2	-	279.9
	Minor Rd.	5.0	194.8	-	199.8
	Total	239.7	240.0	-	470.7
Rd. Proj. Proposed by Local Officials	Major Rd.	36.0	24.9	-	60.9
	Minor Rd.	52.7	401.4	213.4	667.5
	Total	88.7	426.3	213.4	728.4
Studied Road	Major Rd.	243.7	45.2	-	288.9
	Minor Rd.	57.7	427.7	213.4	698.8
	Total	301.4	472.9	213.4	987.7

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 Nueva Vizcaya

Road Class		National Road	Prov'l/City Road	Barangay Road	Total
Major Road	Length (kms.)	77.7	24.9	-	102.6
	(% to Studied Roads)	(32%)	(55%)	-	(36%)
Minor Road	Length (kms.)	52.7	401.4	213.0	667.5
	(% to Studied Roads)	(91%)	(94%)	(100%)	(96%)
Total	Length (kms.)	130.4	426.3	213.4	770.1
	(% to Studied Roads)	(43%)	(90%)	(100%)	(78%)

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 Nueva Vizcaya

Category	Road Class	Type of Improvement	IRR	Priority Group	Road Length	No. of Road Links
1	Primary	A	7.5 ≤ IRR	MA-1	-	-
2	Secondary	A	7.5 ≤ IRR	MA-1	91.3	7
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	11.3	2
7	Primary	B	IRR<15.0	MA-3	-	-
8	Secondary	B	IRR<15.0	MA-3	-	-
	Total				102.6	9

Table 4.2-7 PRIORITY OF IDENTIFIED MINOR ROADS
Province of Nueva Vizcaya

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	241.0	17
2	Barangay	A	7.5 ≤ MPI	MI-1	105.0	23
3	Nat'l/Provi/	A	MPI < 7.5	MI-2	213.1	26
4	Barangay	A	MPI < 7.5	MI-2	108.4	28
	Total				667.5	94

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	53.8 kms.	(6 projects)
Minor Road	327.2 kms.	(35 projects)
Total	381.0 kms.	(41 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

	Road Section	Existing Pavement		Proposed	Pavement Structure (cm)	
Type of Improvement	Type	Type	Condition	Pavement Type	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 NUEVA VIZCAYA

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 Condition	Proposed Improvement	Proposed Bridge (Number/Total Length)	Cost (Million Peso) Road	Cost (Million Peso) Bridge	Cost (Million Peso) Total	IRR (%)
Rehab/ Imp-1	P19	18.4	0	11	.5	6.0	BT Fair	-	1-lane Br (n= 2,L=130m)	28.18	6.47	34.65	30.2 (T)
					12.5	3.6-4.5	GRV Bad/V.Bad	Rehab(6.0-GRV)					
					5.4		None	New-C(6.0-GRV)					
	N5-2	2.9	369	398	2.4	6.1	PCC Good	-	2-lane Br (n= 1,L=210m)	.88	13.27	14.15	26.2 (T)
					.5	5.5	GRV Bad	Imp-1(6.0-BMP)					
	N5-1	8.5	0	119	4.5	6.1	PCC Good	-	2-lane Br (n= 2,L=206m)	6.22	13.50	19.72	20.3 (T)
					4.0	3.6	GRV Bad	Rehab(6.0-GRV)					
	N7-4	5.8	99	171	.9	6.1	PCC Fair	-	2-lane Br (n= 2,L= 40m)	3.39	3.97	7.36	12.3 (T)
					4.9	5.5	GRV Bad	Rehab(6.0-GRV)	2-cell BC (n= 1,L= 6m)				
	N5-3	8.1	111	133	.3	5.5	GRV Fair	Widen(6.0-GRV)	2-lane Br (n= 4,L= 62m)	6.32	5.87	12.19	9.2 (T)
					7.8	5.5	GRV Bad	Rehab(6.0-GRV)					
	N7-3	10.1	59	92	.3	6.0	BT Bad	Rehab(6.0-BMP)	2-lane Br (n= 4,L=255m)	9.50	17.30	26.80	8.1 (T)
					9.2	3.6-6.0	GRV Bad	Rehab(6.0-GRV)					
					.6	5.5	GRV Fair	Widen(6.0-GRV)					

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

TABLE 5.1 - 2 (2)

Summary of Proposed Improvement NUEVA VIZCAYA

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	F42	12.5	49	74	7.1	4.5-5.0	GRV Bad	Rehab(6.0-GRV)	2-lane Br (n= 1,L= 10m)	13.88	3.02	16.90	16.9 (D)
					5.4	4.5	GRV Fair	Widen(6.0-GRV)	2-lane Sp (n= 2,L=100m)				
	P1	14.9	56	54	8.5	4.0	GRV Fair	-	1-lane Sp (n= 1,L= 30m)	3.49	.40	3.88	16.2 (D)
					4.8	4.0	GRV V.Bad	Rehab(4.0-GRV)					
					1.6	4.0	EAR Impas	Imp-1(4.0-GRV)					
	P7	20.4	48	50	13.6	4.0-4.5	GRV Bad/V.Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 10m)	10.50	.99	11.49	13.9 (D)
					6.8	3.6	EAR V.Bad	Imp-1(4.0-GRV)	1-lane Sp (n= 1,L= 10m)				
	P59	22.7	9	21	1.5	4.0	GRV Bad	Rehab(4.0-GRV)	2-cell BC (n= 1,L= 6m)	12.66	.49	13.15	10.4 (D)
					15.2	4.0	EAR Bad/Impas	Imp-1(4.0-GRV)					
					6.0		None	New-C(4.0-GRV)					
	P6	9.3	7	13	5.8	4.0	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 20m)	4.98	2.66	7.64	7.6 (D)
					3.5	3.2-3.6	EAR Bad	Imp-1(4.0-GRV)	1-lane Sp (n= 4,L=110m)				
	P14	6.6	25	31	5.4	4.0	GRV Fair	-	2-cell BC (n= 2,L= 10m)	.63	.97	1.60	7.2 (D)
					1.2	4.0	GRV Bad	Rehab(4.0-GRV)					
	P52-1	9.6	0	19	6.6	4.0	GRV Fair/Bad	Rehab(4.0-GRV)		14.77	.00	14.77	6.8 (D)
					3.0	4.5	EAR Impas	Imp-1(4.0-GRV)					
	P33	9.9	36	47	5.3	4.5-6.0	GRV Fair	-	2-cell BC (n= 1,L= 6m)	2.58	.53	3.10	5.9 (D)
					4.6	4.0	GRV Bad	Rehab(4.0-GRV)					
	P43	4.8	0	2	4.8	4.0	EAR Impas	Imp-1(4.0-GRV)		2.40	.00	2.40	5.3 (D)
	P36	1.2	2	5	.4	5.5	GRV Fair	-		.43	.00	.43	4.2 (D)
					.8	4.0	GRV Bad	Rehab(4.0-GRV)					
	P51	13.8	2	11	2.5	4.0	GRV Bad	Rehab(4.0-GRV)		7.51	.00	7.51	2.9 (D)
					4.8	4.0	EAR Impas	Imp-1(4.0-GRV)					
					6.5		None	New-C(4.0-GRV)					
	N5-4	20.3	20	15	1.2	5.0	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 30m)	12.44	1.56	14.01	2.8 (D)
					19.1	4.0	EAR Impas	Imp-1(4.0-GRV)					
	P13-2	11.2	6	13	5.8	4.0	GRV Fair	-	2-cell BC (n= 1,L= 7m)	2.74	.49	3.23	1.7 (D)
					5.4	4.0	GRV Bad	Rehab(4.0-GRV)					
	P21	10.0	24	29	.6	7.0	BT Fair	-		1.89	.00	1.89	1.7 (D)
					5.1	4.0-5.5	GRV Fair	-					
					3.0	3.2	GRV Bad	Rehab(4.0-GRV)					
					1.3	6.9	PCC Good	-					
	P3	5.1	0	8	5.1	3.2	GRV Bad	Rehab(4.0-GRV)	1-lane Br (n= 1,L= 50m)	3.51	2.88	6.39	.0 (D)
									1-lane Sp (n= 1,L= 30m)				
	P52-3	11.9	0	2	1.9	3.6	GRV Fair	Widen(4.0-GRV)	1-lane Sp (n= 1,L= 20m)	6.30	.26	6.56	.0 (D)
					4.3	3.2	EAR Impas	Imp-1(4.0-GRV)					
					2.7	3.2-4.0	GRV Fair/Impas	Rehab(4.0-GRV)					
					3.0		None	New-C(4.0-GRV)					

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

TABLE 5.1 - 2 (3)

Summary of Proposed Improvement NUEVA VIZCAYA

Minor(National/Provincial)(Continued)

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	P10	8.1	51	52	2.0	6.0	GRV Fair	-		9.16	.00	9.16	.0 (D)
					3.7	4.0-6.0	GRV Bad	Rehab(6.0-GRV)					
					2.4	6.0	BT Fair	-					
	P47	12.3	1	1	7.3	4.0	GRV Fair	-		2.11	.00	2.11	.0 (D)
					5.0	4.0	GRV Bad	Rehab(4.0-GRV)					
Imp-2/ Widen	P49	10.5	23	43	3.9	3.2-3.6	GRV Fair	Widen(4.0-GRV)		3.28	.00	3.28	25.0 (D)
					4.4	4.5	GRV Fair	-					
					2.2	4.5	GRV Bad	Rehab(4.0-GRV)					
New Const.	N7-2	29.6	10	23	8.4	3.2-4.5	EAR Impas	Imp-1(4.0-GRV)	1-lane Sp (n= 9,L=380m)	18.66	5.54	24.21	12.6 (D)
					3.2	4.5	GRV Impas	Rehab(4.0-GRV)	2-cell BC (n= 1,L= 8m)				
					18.0		None	New-C(4.0-GRV)					
	P58	20.5	0	8	3.3	3.6-4.0	GRV Bad/Impas	Rehab(4.0-GRV)	1-lane Sp (n= 2,L= 20m)	16.50	.26	16.76	5.3 (D)
					17.2		None	New-C(4.0-GRV)					
	P52-2	6.5	0	4	2.0	4.0-4.5	GRV Fair	-		2.75	.00	2.75	4.7 (D)
					4.5		None	New-C(4.0-GRV)					

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

TABLE 5.1 - 2 (4)

Summary of Proposed Improvement NUEVA VIZCAYA

Minor(Barangay)

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	B10-1	4.0	0	1	4.0	3.6	EAR Impas	Imp-1(4.0-GRV)		1.90	.00	1.90	7.3 (D)
	B4-1	2.7	14	21	1.2 .2 1.3	5.5 6.1 4.5	GRV Fair PCC Good GRV Bad	- - Rehab(6.0-GRV)		3.30	.00	3.30	5.9 (D)
	B5-4	1.3	0	1	1.0 .3	2.4-3.2	GRV Bad None	Rehab(4.0-GRV) New-C(4.0-GRV)	1-lane Sp (n= 1,L= 20m)	.65	.26	.92	3.9 (D)
	B5-1	3.7	0	9	1.2 1.3 1.2	3.2 3.2 3.6	GRV Fair GRV Bad EAR V.Bad	Widen(4.0-GRV) Rehab(4.0-GRV) Imp-1(4.0-GRV)	1-lane Sp (n= 1,L= 20m)	1.77	.26	2.03	3.8 (D)
	B4-5	5.0	5	11	.8 4.2	3.2 4.0	GRV Fair GRV Fair/Bad	Widen(4.0-GRV) Rehab(4.0-GRV)		2.56	.00	2.56	3.6 (D)
	B14-2	2.8	6	9	.6 1.9 .3	4.5 4.0 4.0	GRV Fair GRV V.Bad EAR Impas	- Rehab(4.0-GRV) Imp-1(4.0-GRV)	1-lane Sp (n= 1,L= 15m)	1.17	.20	1.37	3.4 (D)
	B10-2	2.0	0	4	2.0	3.2	EAR Bad/Impas	Imp-1(4.0-GRV)		.92	.00	.92	1.5 (D)
	B0-1	6.9	1	2	1.4 2.6 2.9	3.2 2.4-3.2 5.5	GRV Fair GRV Bad GRV Fair	Widen(4.0-GRV) Rehab(4.0-GRV) -	1-lane Sp (n= 2,L= 35m)	1.93	.46	2.39	.0 (D)
	B2-4	3.4	2	4	.4 2.1 .9	4.2 3.2-4.0 4.5	PCC Good GRV Fair/Bad GRV Fair	- Rehab(4.0-GRV) -	1-lane Br (n= 1,L=300m) 1-cell BC (n= 1,L= 4m)	1.98	11.41	13.40	.0 (D)
	B12-2	3.0	0	1	1.5 1.5	3.2	GRV V.Bad None	Rehab(4.0-GRV) New-C(4.0-GRV)		1.93	.00	1.93	.0 (D)
New Const.	B9-2	9.6	0	9	4.6 5.0	3.2	GRV V.Bad/Impa None	Rehab(4.0-GRV) New-C(4.0-GRV)	1-lane Sp (n= 1,L=200m)	6.03	2.64	8.67	10.2 (D)
	B9-5	5.1	0	5	2.4 2.7	3.2	EAR Impas None	Imp-1(4.0-GRV) New-C(4.0-GRV)		3.62	.00	3.62	9.6 (D)
	B8-3	6.0	0	2	.1 5.9	2.8	EAR V.Bad None	Imp-1(4.0-GRV) New-C(4.0-GRV)		4.26	.00	4.26	7.1 (D)

(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 NUEVA VIZCAYA

		Unit	P19	N5-2	N5-1	N7-4	N5-3	N7-3	P42	P1	P7	P59	P6
Total Road Length		km	18.4	2.9	8.5	5.8	8.1	10.1	12.5	14.9	20.4	22.7	9.3
Improvement Length		km	17.9	.5	4.0	4.9	8.1	10.1	12.5	6.4	20.4	22.7	9.3
Proposed Pavement Type			6.0-GRV	6.0-BMP	6.0-GRV	6.0-GRV	6.0-GRV	6.0-BMP 6.0-GRV	6.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV
Quantity													
100	Clearing & Grubbing	m2	135000	-	-	-	-	-	-	-	-	72000	-
	Stripping	m3	14580	-	-	-	-	-	-	-	-	7200	-
102	Roadway & Drainage Excavation	m3	138730	375	39375	3675	3095	28854	35521	9000	34466	37313	12713
104	Borrow	m3	13447	-	3240	2769	5694	2472	15748	3076	4126	6944	5113
200	Aggregate Subbase	m3	11814	1047	2640	3234	5181	6480	5820	2944	9384	10442	4278
	Preparation of Prev.Road(Grvl)	m2	61340	5210	15550	32340	51190	50370	66590	28000	88400	74390	39220
	Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	1800	-	-	-	-	-
	Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
	Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202	Crushed Aggregate Base Course	m3	-	512	-	-	-	307	-	-	-	-	-
300	Crushed Aggr. Surface Course	m3	15660	-	3600	4410	7290	8820	11250	3780	12240	13500	5580
301	Bituminous Prime Coat	M.T.	-	4	-	-	-	2	-	-	-	-	-
302	Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305	Bituminous Macadam Pavement	m2	-	3000	-	-	-	1800	-	-	-	-	-
310	Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304	Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1	PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2	PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3	PCC Pavement (t=18 cm)	m2	3000	-	-	-	-	-	-	400	-	800	-
500	RCPC (dia.910mm)	m	750	15	150	150	240	300	465	104	328	456	152
	Headwall for RCPC (dia.910mm)	Set	50	1	10	10	16	20	31	13	41	57	19
504	Grouted Riprap	m3	893	-	514	-	-	-	2099	-	-	-	-
	Side Ditch (Grouted Riprap)	m	12710	-	1750	-	2150	3800	4150	-	-	-	-
	Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
	Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Superstructure	m	-	210	206	40	62	255	10	-	-	-	-
	1-lane Bridge,Superstructure	m	130	-	-	-	-	-	-	-	10	-	20
	2-lane Bridge,Abutment	Each	-	2	4	4	8	8	2	-	-	-	-
	1-lane Bridge,Abutment	Each	4	-	-	-	-	-	-	-	2	-	2
	2-lane Bridge,Pier	Each	-	8	7	-	-	7	-	-	-	-	-
	1-lane Bridge,Pier	Each	4	-	-	-	-	-	-	-	-	-	-
	2-lane Spillway	m	-	-	-	-	-	-	100	-	-	-	-
	1-lane Spillway	m	-	-	-	-	-	-	-	30	10	-	110
	1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
	2-cell RCBC	m	-	-	-	11	-	-	-	-	-	8	-
	Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
	Wingwall for 2-cell RCBC	Set	-	-	-	1	-	-	-	-	-	1	-
	Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost		M.p.	28.18	.88	6.22	3.39	6.32	9.50	13.88	3.49	10.50	12.66	4.98
Bridge Construction Cost		M.p.	6.47	13.27	13.50	3.97	5.87	17.30	3.02	.40	.99	.49	2.66
Total Construction Cost		M.p.	34.65	14.15	19.72	7.36	12.19	26.80	16.90	3.88	11.49	13.15	7.64
Road Construction Cost/Impr't km		M.p.	1.57	1.76	1.55	.69	.78	.94	1.11	.54	.51	.56	.54
Total Construction Cost/Total km		M.p.	1.88	4.88	2.32	1.27	1.51	2.65	1.35	.26	.56	.58	.82

TABLE 5.1 - 4 (2)

Quantity and Construction Cost NUEVA VIZCAYA

		Unit	P14	P52-1	P33	P43	P36	P51	N5-4	P13-2	P21	P3	P10
Total Road Length		km	6.6	9.6	9.9	4.8	1.2	13.8	20.3	11.2	10.0	5.1	8.1
Improvement Length		km	1.2	9.6	4.6	4.8	.8	13.8	20.3	5.4	3.0	5.1	3.7
Proposed Pavement Type			4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	6.0-GRV
Quantity													
100	Clearing & Grubbing	m2	-	-	-	-	-	78000	-	-	-	-	-
	Stripping	m3	-	-	-	-	-	7800	-	-	-	-	-
102	Roadway & Drainage Excavation	m3	2250	10810	3000	6973	1500	14908	34350	8248	-	8775	-
104	Borrow	m3	267	39945	5219	972	162	5338	4281	1154	6195	3693	24616
200	Aggregate Subbase	m3	552	4140	2116	2208	368	6348	9338	2484	1380	2346	2442
	Preparation of Prev.Road(Grvl)	m2	5520	43800	19880	20640	3440	32140	88040	24300	12000	17740	19300
	Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-	-	-
	Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
	Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202	Crushed Aggregate Base Course	m3	-	-	-	-	-	-	-	-	-	-	-
300	Crushed Aggr. Surface Course	m3	720	5760	2760	2880	480	8280	10866	3240	1800	3060	3330
301	Bituminous Prime Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
302	Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305	Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	-	-	-
310	Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304	Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1	PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2	PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3	PCC Pavement (t=18 cm)	m2	-	-	-	-	-	-	8760	-	-	-	-
500	RCPC (dia.910mm)	m	16	312	72	80	16	328	328	88	48	104	315
	Headwall for RCPC (dia.910mm)	Set	2	39	9	10	2	41	41	11	6	13	21
504	Grouted Riprap	m3	-	7703	-	-	-	-	-	-	-	781	5392
	Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-	-	-	-
	Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-	-	-	-
	Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-	-	-	-
	2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-	-	-	-
	1-lane Bridge,Superstructure	m	-	-	-	-	-	-	30	-	-	50	-
	2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-	-	-	-
	1-lane Bridge,Abutment	Each	-	-	-	-	-	-	2	-	-	2	-
	2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	-	-
	1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-	-	1	-
	2-lane Spillway	m	-	-	-	-	-	-	-	-	-	-	-
	1-lane Spillway	m	-	-	-	-	-	-	-	-	-	30	-
	1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
	2-cell RCBC	m	16	-	9	-	-	-	-	8	-	-	-
	Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
	Wingwall for 2-cell RCBC	Set	2	-	1	-	-	-	-	1	-	-	-
	Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost		M.p.	.63	14.77	2.58	2.40	.43	7.51	12.44	2.74	1.89	3.51	9.16
Bridge Construction Cost		M.p.	.97	.00	.53	.00	.00	.00	1.56	.49	.00	2.88	.00
Total Construction Cost		M.p.	1.60	14.77	3.10	2.40	.43	7.51	14.01	3.23	1.89	6.39	9.16
Road Construction Cost/Impr't km		M.p.	.53	1.54	.56	.50	.53	.54	.61	.51	.63	.69	2.48
Total Construction Cost/Total km		M.p.	.24	1.54	.31	.50	.36	.54	.69	.29	.19	1.25	1.13

TABLE 5.1 - 4 (3)
Quantity and Construction Cost NUEVA VIZCAYA

	Unit	P52-3	P47	P49	N7-2	P58	P52-2	B10-1	B4-1	B5-4	B5-1	B4-5
Total Road Length	km	11.9	12.3	10.5	29.6	20.5	6.5	4.0	2.7	1.3	3.7	5.0
Improvement Length	km	11.9	5.0	6.1	29.6	20.5	4.5	4.0	1.3	1.3	3.7	5.0
Proposed Pavement Type		4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	6.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV
Quantity												
100 Clearing & Grubbing	m2	36000	-	-	270000	258000	54000	-	-	3000	-	-
Stripping	m3	3600	-	-	27000	25800	5400	-	-	300	-	-
102 Roadway & Drainage Excavation	m3	17813	1750	9506	61544	47275	4500	3000	-	764	6387	112
104 Borrow	m3	3990	650	1299	10460	8455	2543	1410	8535	751	623	6686
200 Aggregate Subbase	m3	4330	2300	1462	13616	9430	2070	1840	858	598	1318	1630
Preparation of Prev.Road(Grvl)	m2	30640	23000	23560	48710	15180	-	18400	7800	3690	12690	21340
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	-	-	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	7020	3000	3300	17760	12300	2700	2400	1170	780	2220	3000
301 Bituminous Prime Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	800	-	2400	-	-	-	-	-	-	-	-
500 RCPC (dia.910mm)	m	240	80	96	760	608	144	64	120	24	56	80
Headwall for RCPC (dia.910mm)	Set	30	10	12	95	76	18	8	8	3	7	10
504 Grouted Riprap	m3	-	-	-	-	-	-	-	2003	-	-	-
Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-	-	-	-
Slope Protection (Cut Slope)	m	-	-	-	-	100	-	-	-	-	-	-
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	20	-	-	380	20	-	-	-	20	20	-
1-cell RCBC	m	-	-	-	-	-	-	-	-	-	-	-
2-cell RCBC	m	-	-	-	9	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	-	-	-	-	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	1	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	6.30	2.11	3.28	18.66	16.50	2.75	1.90	3.30	.65	1.77	2.56
Bridge Construction Cost	M.p.	.26	.00	.00	5.54	.26	.00	.00	.00	.26	.26	.00
Total Construction Cost	M.p.	6.56	2.11	3.28	24.21	16.76	2.75	1.90	3.30	.92	2.03	2.56
Road Construction Cost/Impr't km	M.p.	.53	.42	.54	.63	.80	.61	.47	2.54	.50	.48	.51
Total Construction Cost/Total km	M.p.	.55	.17	.31	.82	.82	.42	.47	1.22	.70	.55	.51

TABLE 5.1 - 4 (4)

Quantity and Construction Cost NUEVA VIZCAYA

	Unit	B14-2	B10-2	B2-4	B12-2	B0-1	B9-2	B9-5	B8-3
Total Road Length	km	2.8	2.0	3.4	3.0	6.9	9.6	5.1	6.0
Improvement Length	km	2.2	2.0	2.1	3.0	4.0	9.6	5.1	6.0
Proposed Pavement Type		4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV	4.0-GRV
Quantity									
100 Clearing & Grubbing	m2	-	-	-	22500	-	75000	40500	88500
Stripping	m3	-	-	-	2250	-	7500	4050	8850
102 Roadway & Drainage Excavation	m3	1853	1575	866	6000	7500	21125	11250	14938
104 Borrow	m3	1113	435	5726	1108	663	3007	1607	2469
200 Aggregate Subbase	m3	1012	920	874	1380	1392	4416	2346	2760
Preparation of Prev.Road(Grvl)	m2	10120	8480	8880	5600	11160	15180	7920	280
Preparation of Prev.Road(Asph)	m2	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(PCC)	m2	-	-	-	-	-	-	-	-
Preparation of Pave.Surf.(AC)	m2	-	-	-	-	-	-	-	-
202 Crushed Aggregate Base Course	m3	-	-	-	-	-	-	-	-
300 Crushed Aggr. Surface Course	m3	1266	1200	1260	1740	2400	5706	2760	3600
301 Bituminous Prime Coat	M.T.	-	-	-	-	-	-	-	-
302 Bituminous Tack Coat	M.T.	-	-	-	-	-	-	-	-
305 Bituminous Macadam Pavement	m2	-	-	-	-	-	-	-	-
310 Bitum.Concrete Surface Course	M.T.	-	-	-	-	-	-	-	-
304 Double Bitum.Surface Treatment	m2	-	-	-	-	-	-	-	-
311-1 PCC Pavement (t=23 cm)	m2	-	-	-	-	-	-	-	-
311-2 PCC Pavement (t=20 cm)	m2	-	-	-	-	-	-	-	-
311-3 PCC Pavement (t=18 cm)	m2	360	-	-	400	-	360	2000	-
500 RCPC (dia.910mm)	m	32	32	48	72	64	232	128	192
Headwall for RCPC (dia.910mm)	Set	4	4	6	9	8	29	16	24
504 Grouted Riprap	m3	-	-	616	-	-	-	-	-
Side Ditch (Grouted Riprap)	m	-	-	-	-	-	-	-	-
Slope Protection (Cut Slope)	m	-	-	-	-	-	-	-	-
Slope Protection (Embank't Sl)	m	-	-	-	-	-	-	-	-
2-lane Bridge,Superstructure	m	-	-	-	-	-	-	-	-
1-lane Bridge,Superstructure	m	-	-	300	-	-	-	-	-
2-lane Bridge,Abutment	Each	-	-	-	-	-	-	-	-
1-lane Bridge,Abutment	Each	-	-	2	-	-	-	-	-
2-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-
1-lane Bridge,Pier	Each	-	-	-	-	-	-	-	-
2-lane Spillway	m	-	-	-	-	-	-	-	-
1-lane Spillway	m	15	-	-	-	35	200	-	-
1-cell RCBC	m	-	-	9	-	-	-	-	-
2-cell RCBC	m	-	-	-	-	-	-	-	-
Wingwall for 1-cell RCBC	Set	-	-	1	-	-	-	-	-
Wingwall for 2-cell RCBC	Set	-	-	-	-	-	-	-	-
Miscellaneous	l.s.	1	1	1	1	1	1	1	1
Road Construction Cost	M.p.	1.17	.92	1.98	1.93	1.93	6.03	3.62	4.26
Bridge Construction Cost	M.p.	.20	.00	11.41	.00	.46	2.64	.00	.00
Total Construction Cost	M.p.	1.37	.92	13.40	1.93	2.39	8.67	3.62	4.26
Road Construction Cost/Impr't km	M.p.	.53	.46	.94	.64	.48	.63	.71	.71
Total Construction Cost/Total km	M.p.	.49	.46	3.94	.64	.35	.90	.71	.71

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 Nueva Vizcaya
- Major Roads -

	Type of Improvement			
	Rehabilitation/ Improvement - 1	Improvement-2/ Widening	New Construction	Total
Primary Major Roads				
1. No. of Links	-	-	-	-
2. Total Length (km)	-	-	-	-
3. Improvement Length (km)	-	-	-	-
4. Construction Cost (million P)	-	-	-	-
5. Const. Cost/Imp. Length (MP/km)	-	-	-	-
Secondary Major Roads				
1. No. of Links	6	-	-	6
2. Total Length (km)	53.8	-	-	53.8
3. Improvement Length (km)	45.5	-	-	45.5
4. Construction Cost (million P)	114.9	-	-	114.9
5. Const. Cost/Imp. Length (MP/km)	2.53	-	-	2.53
Major Roads Total				
1. No. of Links	6	-	-	6
2. Total Length (km)	53.8	-	-	53.8
3. Improvement Length (km)	45.5	-	-	45.5
4. Construction Cost (million P)	114.9	-	-	114.9
5. Const. Cost/Imp. Length (MP/km)	2.53	-	-	2.53

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

	Type of Improvement		
	Rehabilitation/ Improvement-1&2/ Widening	New Construction	Total
Minor Roads (National/ Provincial/City)			
1. No. of Links	19	3	22
2. Total Length (km)	215.1	56.6	271.7
3. Improvement Length (km)	166.6	54.6	221.2
4. Construction Cost (million P)	129.5	43.7	173.2
5. Const. Cost/Imp. Length (MP/km)	0.78	0.80	0.78
Minor Roads (Barangay)			
1. No. of Links	10	3	13
2. Total Length (km)	34.8	20.7	55.5
3. Improvement Length (km)	28.6	20.7	49.3
4. Construction Cost (million P)	30.7	16.5	47.2
5. Const. Cost/Imp. Length (MP/km)	1.07	0.80	0.96
Minor Roads Total			
1. No. of Links	29	6	35
2. Total Length (km)	249.9	77.3	327.2
3. Improvement Length (km)	195.2	75.3	270.5
4. Construction Cost (million P)	160.2	60.2	220.4
5. Const. Cost/Imp. Length (MP/km)	0.82	0.80	0.82

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 NUEVA VIZCAYA

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	P42	12.5	7220	578	520	470(Palay) 30(Vege.) 20(Banan)	49	74	16.9
		P1	14.9	4745	318	400	280(Palay) 120(Vege.)	56	54	16.2
		P7	20.4	5336	262	780	700(Palay) 80(Vege.)	48	50	13.9
		P59	22.7	650	29	1450	900(Palay) 280(Vege.) 270(Corn)	9	21	10.4
		P6	9.3	1321	142	310	280(Palay) 30(Vege.)	7	13	7.6
		P14	6.6	2670	405	430	400(Palay) 30(Banan)	25	31	7.2
		P52-1	9.6	2575	268	680	450(Palay) 180(Corn) 50(Banan)	0	19	6.8
		P33	9.9	4686	473	1050	900(Palay) 150(Corn)	35	47	5.9
		P43	4.8	1205	251	200	160(Palay) 40(Vege.)	0	2	5.3
		P36	1.2	444	370	130	100(Palay) 20(Corn) 10(Banan)	2	5	4.2
		P51	13.8	1588	115	710	450(Palay) 180(Corn) 80(Vege.)	2	11	2.9
		N5-4	20.3	240	12	1450	950(Palay) 300(Corn) 200(Vege.)	20	15	2.8
		P13-2	11.2	730	65	300	300(Palay)	6	13	1.7
		P21	10.0	2220	222	740	660(Palay) 80(Coco.)	24	29	1.7
		P3	5.1	675	132	130	110(Palay) 20(Vege.)	0	8	.0
		P52-3	11.9	200	17	320	150(Palay) 90(Vege.) 80(Banan)	0	2	.0
		P10	8.1	5667	700	780	780(Palay)	51	52	.0
		P47	12.3	85	7	90	50(Corn) 40(Banan)	1	1	.0
	Imp-2/ Widen	P49	10.5	2988	285	880	800(Corn) 50(Vege.) 30(Palay)	23	43	25.0
	New Const.	N7-2	29.6	11378	384	1230	910(Palay) 170(Vege.) 150(Banan)	10	23	12.6
		P58	20.5	2475	121	560	300(Palay) 160(Root) 100(Corn)	0	8	5.3
		P52-2	6.5	819	126	390	150(Palay) 120(Vege.) 120(Banan)	0	4	4.7
Minor (Baran-gay)	Rehab/ Imp-1	B10-1	4.0	843	211	370	160(Palay) 150(Corn) 60(Vege.)	0	1	7.3
		B4-1	2.7	2220	822	220	200(Palay) 20(Coco.)	14	21	5.9
		B5-4	1.3	230	177	160	120(Palay) 40(Vege.)	0	1	3.9
		B5-1	3.7	1830	495	170	170(Palay)	0	9	3.8
		B4-5	5.0	795	159	310	230(Palay) 80(Vege.)	5	11	3.6
		B14-2	2.8	1503	537	140	100(Palay) 30(Vege.) 10(Banan)	6	9	3.4
		B10-2	2.0	2219	1110	90	40(Palay) 30(Vege.) 20(Corn)	0	4	1.5
		B0-1	6.9	30	4	350	250(Palay) 100(Vege.)	1	2	.0
		B2-4	3.4	200	59	190	180(Palay) 10(Vege.)	2	4	.0
		B12-2	3.0	676	225	30	30(Vege.)	0	1	.0
	New Const.	B9-2	9.6	1572	164	620	280(Vege.) 250(Corn) 90(Palay)	0	9	10.2
		B9-5	5.1	1049	206	310	180(Palay) 130(Vege.)	0	5	9.6
		B8-3	6.0	1187	198	360	160(Vege.) 120(Palay) 80(Corn)	0	2	7.1

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.

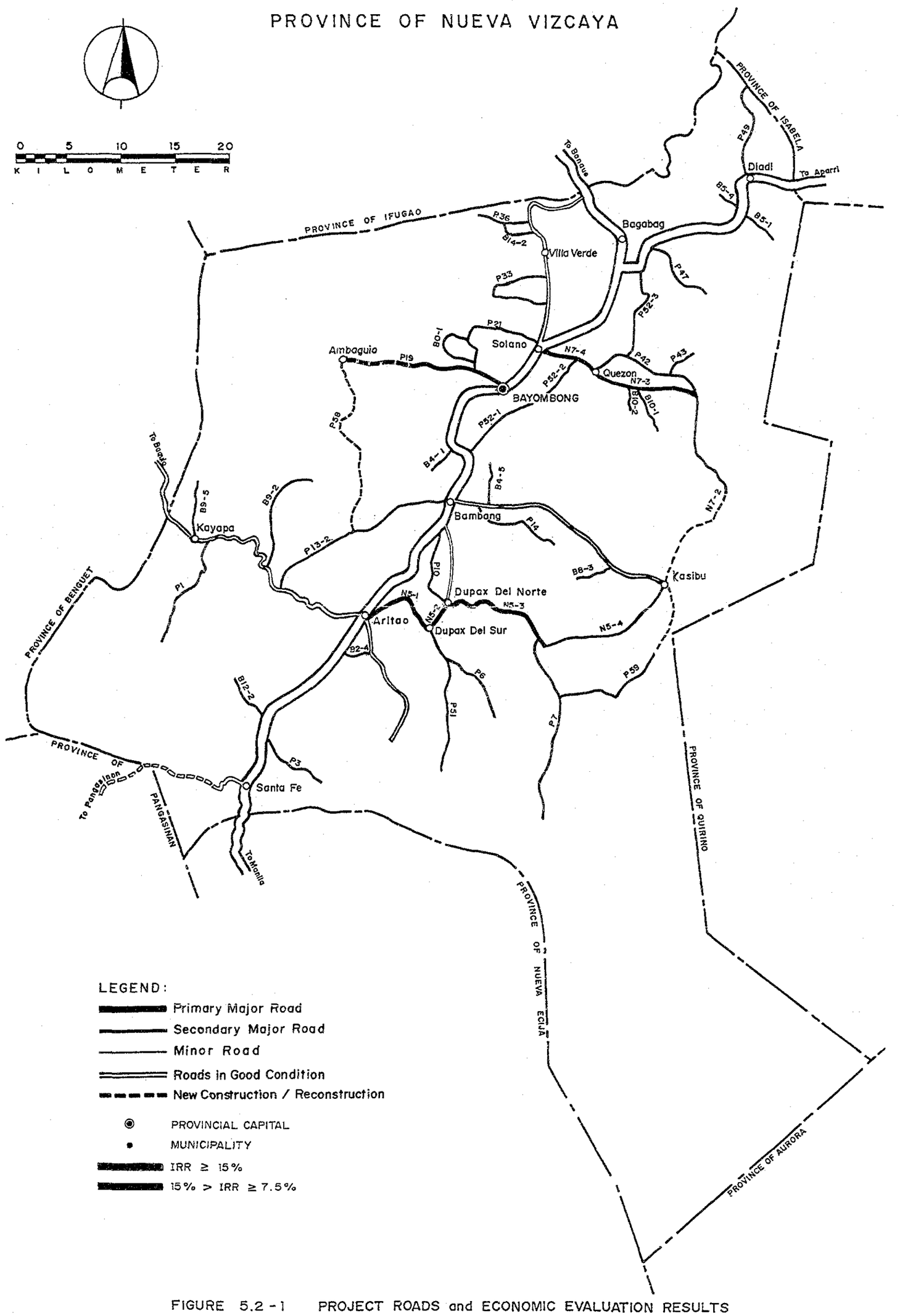

FIGURE 5.2 - 1 PROJECT ROADS and ECONOMIC EVALUATION RESULTS

TABLE 5.2 - 9 (1)
Road Length and Construction Cost NUEVA VIZCAYA

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<	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Second'y Major	15<	3	29.8	22.4	35.3	33.2	68.5	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	1	5.8	4.9	3.4	4.0	7.4	-	-	-	-	-	-	-	-	-	-	-	-
	7.5-10	2	18.2	18.2	15.8	23.2	39.0	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	6	53.8	45.5	54.5	60.4	114.9	-	-	-	-	-	-	-	-	-	-	-	-
Minor (Nat'l/ Prov'l)	15<	2	27.4	18.9	17.4	3.4	20.8	1	10.5	6.1	3.3	-	3.3	-	-	-	-	-	-
	10-15	2	43.1	43.1	23.2	1.5	24.6	-	-	-	-	-	-	1	29.6	29.6	18.7	5.5	24.2
	7.5-10	1	9.3	9.3	5.0	2.7	7.6	-	-	-	-	-	-	-	-	-	-	-	-
	<7.5	13	124.8	89.2	66.5	6.7	73.2	-	-	-	-	-	-	2	27.0	25.0	19.2	.3	19.5
	Total	18	204.6	160.5	112.0	14.3	126.2	1	10.5	6.1	3.3	-	3.3	3	56.6	54.6	37.9	5.8	43.7
Minor (Baran-gay)	15<	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-15	-	-	-	-	-	-	-	-	-	-	-	-	1	9.6	9.6	6.0	2.6	8.7
	7.5-10	-	-	-	-	-	-	-	-	-	-	-	-	1	5.1	5.1	3.6	-	3.6
	<7.5	10	34.8	28.6	18.1	12.6	30.7	-	-	-	-	-	-	1	6.0	6.0	4.3	-	4.3
	Total	10	34.8	28.6	18.1	12.6	30.7	-	-	-	-	-	-	3	20.7	20.7	13.9	2.6	16.5
Total	15<	5	57.2	41.3	52.7	36.7	89.3	1	10.5	6.1	3.3	-	3.3	-	-	-	-	-	-
	10-15	3	48.9	48.0	26.5	5.4	32.0	-	-	-	-	-	-	2	39.2	39.2	24.7	8.2	32.9
	7.5-10	3	27.5	27.5	20.8	25.8	46.6	-	-	-	-	-	-	1	5.1	5.1	3.6	-	3.6
	<7.5	23	159.6	117.8	84.6	19.3	103.9	-	-	-	-	-	-	3	33.0	31.0	23.5	.3	23.8
	Total	34	293.2	234.6	184.6	87.2	271.8	1	10.5	6.1	3.3	-	3.3	6	77.3	75.3	51.8	8.4	60.3

TABLE 5.2 - 9 (2)
Road Length and Construction Cost NUEVA VIZCAYA

Class of Road	Range of IRR	Total					
		No.	Total Length	Improv Length	Road Cost	Bridge Cost	Total Cost
Primary Major	15<	-	-	-	-	-	-
	10-15	-	-	-	-	-	-
	7.5-10	-	-	-	-	-	-
	<7.5	-	-	-	-	-	-
	Total	-	-	-	-	-	-
Second'y Major	15<	3	29.8	22.4	35.3	33.2	68.5
	10-15	1	5.8	4.9	3.4	4.0	7.4
	7.5-10	2	18.2	18.2	15.8	23.2	39.0
	<7.5	-	-	-	-	-	-
	Total	6	53.8	45.5	54.5	60.4	114.9
Minor (Nat'l/ Prov'l)	15<	3	37.9	25.0	20.6	3.4	24.1
	10-15	3	72.7	72.7	41.8	7.0	48.8
	7.5-10	1	9.3	9.3	5.0	2.7	7.6
	<7.5	15	151.8	114.2	85.7	7.0	92.7
	Total	22	271.7	221.2	153.2	20.1	173.2
Minor (Baran-gay)	15<	-	-	-	-	-	-
	10-15	1	9.6	9.6	6.0	2.6	8.7
	7.5-10	1	5.1	5.1	3.6	-	3.6
	<7.5	11	40.8	34.6	22.4	12.6	35.0
	Total	13	55.5	49.3	32.0	15.2	47.3
Total	15<	6	67.7	47.4	55.9	36.7	92.6
	10-15	5	88.1	87.2	51.2	13.6	64.9
	7.5-10	4	32.6	32.6	24.4	25.8	50.3
	<7.5	26	192.6	148.8	108.1	19.6	127.6
	Total	41	381.0	316.0	239.7	95.7	335.4

TABLE 5.2 - 10 (1)
Summary of Economic Analysis NUEVA VIZCAYA

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	Benefit (Mp/km) Diverted	Benefit (Mp/km) Generated	Benefit (Mp/km) Develop't	Benefit (Mp/km) Maint sav'g	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Second'y	Rehab/	P19	0	11	18.4	17.9(6.0-GRV)	1.61	.25	1.86	-	-	4.61	-	-.04	4.57	48.5	2.5	30.2
Major	Imp-1	N5-2	369	398	2.9	.5(6.0-BMP)	23.52	.66	24.19	42.16	-	3.68	-	.07	45.91	10.9	1.9	26.2
		N5-1	0	119	8.5	4.0(6.0-GRV)	4.10	.29	4.39	-	3.20	2.75	-	-.04	5.91	6.1	1.3	20.3
		N7-4	99	171	5.8	4.9(6.0-GRV)	1.25	.45	1.70	.82	-	.57	-	.04	1.43	-1.3	.8	12.3
		N5-3	111	133	8.1	8.1(6.0-GRV)	1.25	.32	1.57	.77	-	.23	-	.09	1.09	-3.9	.7	9.2
		N7-3	59	92	10.1	.3(6.0-BMP)	2.21	.34	2.55	.84	-	.58	-	.03	1.45	-11.1	.6	8.1
						9.8(6.0-GRV)												

TABLE 5.2 - 10 (2)

Summary of Economic Analysis NUEVA VIZCAYA

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 savg	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Minor (Nat'l/ Prov'l)	Rehab/ Imp-1	P42	49	74	12.5	12.5(6.0-GRV)	1.12	.23	1.36	1.43	-	.01	.02	.04	1.51	2.0	1.1	16.9
		P1	56	54	14.9	6.4(4.0-GRV)	.50	.13	.63	.43	-	.02	.19	.04	.67	.3	1.1	16.2
		P7	48	50	20.4	20.4(4.0-GRV)	.47	.14	.60	.41	-	.05	.08	.03	.56	-.8	.9	13.9
		P59	9	21	22.7	22.7(4.0-GRV)	.48	.11	.60	.28	-	.01	.16	-.01	.44	-3.5	.7	10.4
		P6	7	13	9.3	9.3(4.0-GRV)	.68	.11	.80	.37	-	.03	.06	.01	.47	-3.0	.6	7.6
		P14	25	31	6.6	1.2(4.0-GRV)	1.11	.11	1.23	.72	-	.00	.00	.02	.75	-.6	.6	7.2
		P52-1	0	19	9.6	9.6(4.0-GRV)	1.28	.11	1.39	.55	-	.06	.09	.00	.70	-6.6	.5	6.8
		P33	35	47	9.9	4.6(4.0-GRV)	.56	.13	.69	.33	-	.01	.00	.02	.36	-1.5	.5	5.9
		P43	0	2	4.8	4.8(4.0-GRV)	.42	.11	.53	.14	-	.05	.08	.01	.27	-1.2	.5	5.3
		P36	2	5	1.2	.8(4.0-GRV)	.44	.11	.56	.17	-	.00	.08	.01	.27	-.2	.5	4.2
		P51	2	11	13.8	13.8(4.0-GRV)	.45	.11	.57	.16	-	.01	.09	-.01	.25	-4.4	.4	2.9
		N5-4	20	15	20.3	20.3(4.0-GRV)	.57	.11	.69	.10	-	.00	.15	.00	.26	-8.6	.4	2.8
		P13-2	6	13	11.2	5.4(4.0-GRV)	.50	.11	.61	.16	-	.00	.09	.01	.26	-1.9	.4	1.7
		P21	24	29	10.0	3.0(4.0-GRV)	.52	.12	.64	.25	-	.00	.00	.03	.28	-1.1	.4	1.7
		P3	0	8	5.1	5.1(4.0-GRV)	1.04	.11	1.16	.22	-	.01	.06	.01	.30	-4.4	.3	.0
		P52-3	0	2	11.9	11.9(4.0-GRV)	.46	.11	.57	.06	-	.00	.06	.00	.12	-5.3	.2	.0
		P10	51	52	8.1	3.7(6.0-GRV)	2.06	.21	2.27	.07	-	.00	.00	.06	.13	-7.9	.1	.0
		P47	1	1	12.3	5.0(4.0-GRV)	.35	.11	.47	.02	-	.00	.00	.01	.03	-2.2	.1	.0
	Imp-2/ Widen	P49	23	43	10.5	6.1(4.0-GRV)	.45	.13	.58	.83	-	.01	.10	.02	.96	2.3	1.7	25.0
	New Const.	N7-2	10	23	29.6	29.6(4.0-GRV)	.68	.12	.80	.38	-	.23	.09	-.02	.67	-3.7	.8	12.6
		P58	0	8	20.5	20.5(4.0-GRV)	.68	.11	.79	.28	-	.10	.02	-.02	.38	-8.5	.5	5.3
		P52-2	0	4	6.5	4.5(4.0-GRV)	.51	.11	.62	.05	-	.01	.22	-.02	.25	-1.7	.4	4.7

TABLE 5.2 - 10 (3)

Summary of Economic Analysis NUEVA VIZCAYA

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 savg	Benefit (Mp/km) Total	Econom. Indicator NPV (Mp)	B/C	IRR (%)
Minor (Barangay)	Rehab/ Imp-1	B10-1	0	1	4.0	4.0(4.0-GRV)	.39	.11	.51	.07	-	.02	.18	.01	.29	-.9	.6	7.3
		B4-1	14	21	2.7	1.3(6.0-GRV)	2.11	.18	2.29	.71	-	.02	.24	.01	.97	-1.7	.4	5.9
		B5-4	0	1	1.3	1.3(4.0-GRV)	.59	.11	.70	.15	-	.01	.13	.00	.29	-.5	.4	3.9
		B5-1	0	9	3.7	3.7(4.0-GRV)	.46	.11	.57	.19	-	.02	.04	.01	.25	-1.2	.4	3.8
		B4-5	5	11	5.0	5.0(4.0-GRV)	.43	.11	.54	.05	-	.00	.16	.01	.23	-1.6	.4	3.6
		B14-2	6	9	2.8	2.2(4.0-GRV)	.52	.11	.63	.14	-	.01	.10	.01	.26	-.8	.4	3.4
		B10-2	0	4	2.0	2.0(4.0-GRV)	.38	.11	.49	.04	-	.01	.12	.01	.17	-.6	.4	1.5
		B0-1	1	2	6.9	4.0(4.0-GRV)	.50	.11	.61	.05	-	.00	.10	.01	.17	-1.8	.3	.0
		B2-4	2	4	3.4	2.1(4.0-GRV)	5.30	.11	5.42	.39	-	.00	.02	.01	.42	-10.5	.1	.0
		B12-2	0	1	3.0	3.0(4.0-GRV)	.53	.11	.65	.05	-	.02	.06	-.01	.12	-1.6	.2	.0
	New Const.	B9-2	0	9	9.6	9.6(4.0-GRV)	.75	.11	.86	.29	-	.06	.26	-.01	.60	-2.5	.7	10.2
		B9-5	0	5	5.1	5.1(4.0-GRV)	.59	.11	.70	.22	-	.02	.24	-.01	.47	-1.2	.7	9.6
		B8-3	0	2	6.0	6.0(4.0-GRV)	.59	.11	.70	.14	-	.04	.21	-.02	.37	-2.0	.5	7.1