2.3 POPULATION

2.3.1 National and Regional Demographic Trend

The country's total population showed a phenomenal growth in the last 20 years. From 27.1 million in 1960, it grew to 48.1 million in 1980. A 21 million increase or 2.9% of average annual growth rate was recorded in the 20-year span. However, the national population indicated a decreasing trend in terms of growth rate. From an annual growth of 3.1% in 1960-70, it went down to 2.8% in 1970-75 and then to 2.7% in 1975—80.

Regional figures showed variations. The least populated region for all the censal years is Region II, while the highest is Region IV. In terms of growth it could be observed that regional population growth rates generally follows a declining trend following the national level. Region XI registered the highest growth rate of 5.0% in 1960-70, 4.3% in 1970-75 and 4.3% in 1975-80 expanding faster than national level of 3.1%, 2.8% and 2.7%, respectively. Next is National Capital Region (NCR) with growth rates also above the national level. The regions exhibiting a slow growth, especially during 1970-75 and 1975-1980 periods, turned out to be Region I, V, VIII and XII with growth rates ranging from 1.3% to 1.9%, which are much lower than the national level. However, Region II,III and IV have growth rates relatively of the same level with the national figure. Table 2.3-1 presents the more details of the above information.

2.3.2 Population Distribution

The Philippines total population is unevenly distributed among its regions. In 1980, a major concentration of population is observed in three regions, Regions III, IV and NCR, each holding a share of 10.0%, 12.7% and 12.3% of the total population,respectively.

From 1960 to 1980, these three regions exhibited an increasing population share, from 9.1% to 12.3% for NCR, from 9.3% to 10.0%, for Region III and from 11.4% to 12.7% for Region IV. However, Regions I, II, VI, VII, VIII and XII showed a decreasing trend of population share to national total.

Density wise, NCR, being the major center, is of course the most densely populated region in 1980 with 9,317.4 persons per km² despite the fact that it has the smallest land area of 636 km² or 0.2% of the country's total land area. Region II, on the other hand, is the least densely populated region having only 60.9 persons per km², although it has the third largest land area among regions. Regions I, IV, V and VIII have densities higher than the national level, while region IV, the most populated and with the largest land area, is less densely populated than the national level.

TABLE 2.3-1 PAST POPULATION TREND (1960-1980)

	Population				Annual Growth Rate (%)		
	1960	1970	1975	1980	1960-70	1970-75	1975-80
N C R	2,462	3,967	4,970	5,926	4.9	4.6	3.6
Region I	2,428	2,991	3,269	3,541	2.1	1.8	1.6
Region II	1,202	1,691	1,933	2,215	3.5	2.7	2.8
Region III	2,525	3,615	4,210	4,803	3.6	3.1	2.7
Region IV	3,081	4,457	5,214	6,119	3.8	3.2	3.2
Region V	2,363	2,967	3,194	3,477	2.3	1.5	1.7
Region VI	3,078	3,618	4,146	4,526	1.6	2.8	1.8
Region VII	2,523	3,033	3,387	3,787	1.8	2.2	2.3
Region VIII	2,041	2,381	2,600	2,799	1.5	1.8	1.5
Region IX	1,351	1,869	2,048	2,528	3.3	1.8	4.3
Region X	1,297	1,953	2,314	2,759	4.2	3.4	3.5
Region XI	1,353	2,201	2,715	3,347	5.0	4.3	4.3
Region XII	1,383	1,941	2,070	2,271	3.4	1.3	1.9
P h i l i p p i n e s	27,088	36,684	42,071	48,098	3.1	2.8	2.7

Note: Population is in thousand.

TABLE 2.3-2 POPULATION DISTRIBUTION (1960-1980)

	Land Area		% Distribution of Population				Population Density (Person/Km^2)			
	Km^2	%	1960	1970	1975	1980	1960	1970	1975	1980
N C R	636.0	0.2	9.1	10.8	11.8	12.3	3,871.8	6,236.9	7,814.5	9,317.4
Region I	21,568.4	7.2	9.0	8.1	7.8	7.4	112.6	138.7	151.6	164.2
Region II	36,403.1	12.1	4.4	4.6	4.6	4.6	33.0	46.5	53.1	60.9
Region III	18,230.8	6.1	9.3	9.9	10.0	10.0	138.5	198.3	230.9	263.4
Region IV	46,924.1	15.6	11.4	12.1	12.4	12.7	65.7	95.0	111.1	130.4
Region V	17,632.5	5.9	8.7	8.1	7.6	7.2	134.0	168.3	181.1	197.2
Region VI	20,223.2	6.7	11.4	9.9	9.9	9.4	152.2	178.9	205.0	223.8
Region VII	14,951.5	5.0	9.3	8.3	8.0	7.9	168.7	202.9	226.5	253.3
Region VIII	21,431.5	7.1	7.5	6.5	6.2	5.8	95.2	111.1	121.3	130.6
Region IX	18,685.1	6.2	5.0	5.1	4.9	5.3	72.3	100.0	109.6	135.3
Region X	28,327.8	9.4	4.8	5.3	5.5	5.7	45.8	68.9	81.7	97.4
Region XI	31,692.9	10.6	5.0	6.0	6.4	7.0	42.7	69.4	85.6	105.6
Region XII	23,293.2	7.8	5.1	5.3	4.9	4.7	59.4	83.3	88.9	97.5
Philippines	300,000.0		100.0	100.0	100.0	100.0	90.3	122.3	140.2	160.3

2.4 ECONOMY

2.4.1 National Economy

The decade of the 1970s witnessed substantial growth in the Philippine economy. Real gross national product (GNP) increased at an average yearly rate of 6.2 percent from 1972 to 1980. The 1980 real GNP of ₱92.6 billion was greater than the 1972 level by about 68%. The early 1980s was a period of relatively slower growth, from 4.4% in 1980, real GNP growth rate dropped down to 1.4% in 1983 due to the tight financial bind experienced in 1979-80 attributable to the world wide economic recession and the country's restrictive international trade practices.

Real gross domestic product (GDP) increased by 46% from 1975 to 1983. In current terms, GDP reach ₱384.9 billion in 1983. In terms of growth, GDP decreased from 6.97% in 1975 to 1.13% in 1983.

2.4.2 Regional Economy

Wide disparities in levels of development and rates of growth since 1972 have been experienced by the different geographical regions of the country. Metro Manila (NCR) continuously dominates the largest share among regions. In 1972 NCR's share to total GRDP in constant terms was about 24%, which continuously increased to 32.35% in 1983. The next dominating region is Southern Tagalog (IV) with a 13.58% share in 1972 and 13.86% in 1983. The rest are relatively of the same level which are generally low ranging from 3% to 9% only. Thus, except for NCR and Regions III, IX and XII, all the regions exhibited a decreasing trend of shares during the 1972-1983 period.

In terms of sectoral classification, the service sector remains the dominating industry in the country from 1970 to 1983.Of the total real domestic output in 1983, the service sector got the highest share of 39.27%, followed by the industrial sector with 35.91% share, and the least share goes to agriculture with 24.82%. In general, the national domestic economy is highly dependent on service and industrial activities, although agriculture is still the major industry in terms of being the country's major dollar earner. This is the reason why the government's development programs anchored on the primary sector as the industry to be given the highest priority.

Agriculture maintains its predominance in the regions. As of 1983, the predominantly agricultural regions are Regions IX, XII and VIII with respective shares of 58.76%, 53.34% and 51.88% (at constant prices), which are very much higher than the national level. Among the influence regions, Region V and Region II (aside from Region VIII) dominates with agricultural shares with 48.71% and 45.37%, respectively. The rest are relatively of the same level with the national agricultural share.

TABLE 2.4-1 NATIONAL AND REGIONAL ECONOMIC PERFORMANCE (1970-1983)

	1970[1]	1971	1972	1973	1974	1975	1976[1]	1977[1]	1978	1979	1980	1981	1982	1983[2]
G N P	50,035	54,921	55,526	60,881	64,739	68,530	72,718	77,789	83,070	88,736	92,629	96,041	98,679	100,048
G R D P														
N C R		16,182	16,474	18,989	21,393	20,976			25,729	27,476	29,224	30,521	31,511	32,383
Region I		2,691	2,734	3,036	3,011	3,144			3,021	3,257	3,433	3,646	3,760	3,789
II		1,421	1,685	1,888	1,726	1,809			2,332	2,589	2,615	2,697	2,640	2,586
III		4,664	4,528	4,660	5,012	5,556			6,943	7,355	7,783	8,518	8,795	8,734
IV		6,434	6,351	6,798	7,092	9,617			11,886	12,265	12,951	13,239	13,520	13,877
V		2,032	2,499	2,486	2,494	2,554			2,773	2,901	3,161	3,258	3,046	3,089
VI		5,938	5,986	6,468	6,472	5,837			7,066	7,465	7,642	7,971	8,410	8,290
VII		3,137	3,619	3,942	4,036	4,754			5,921	6,214	6,727	6,990	7,000	7,100
VIII		1,756	1,798	2,018	2,002	2,094			2,097	2,181	2,309	2,391	2,421	2,329
IX		1,589	1,794	1,768	1,937	1,834			2,584	2,862	3,124	3,261	3,293	3,324
X		2,304	2,571	2,758	2,556	2,731			3,903	4,321	4,416	4,382	4,707	4,495
XI		3,552	3,950	4,454	4,363	4,587			5,813	6,184	6,279	6,358	6,337	6,566
XII		1,768	1,987	1,866	1,813	1,962			2,716	2,893	2,973	2,978	3,564	3,556
P h i l i p p i n e s (GDP)		53,528	56,076	60,931	63,907	67,455			82,784	87,963	92,637	96,210	99,004	100,118

Note: [1]/Regional Breakdown of GRDP is not available.

[2]/Advance estimate as of December 1983.

Source: National Economic and Development Authority (NEDA)

CHAPTER 3 PROFILE OF STUDY SECTIONS

CHAPTER 3 STUDY SECTION: PROFILES

3.1 INFLUENCE AREA OF STUDY SECTION

3.1.1 Supplemental Traffic Survey

1) Supplemental Traffic Survey Conducted

In order to obtain current traffic characteristics of each study section, and estimate future traffic volumes based on such characteristics, traffic volumes and the origin-destination (O-D) patterns of vehicles, commodities and passengers are required. Other traffic data, such as average vehicle travel speed on the subject sections as well as alternative routes, and the vehicle delay time caused by road disasters are necessary to estimate traffic benefits.

Various traffic data have already been obtained under the traffic surveys conducted during the Stage-I Study. The supplemental traffic surveys were planned in consideration of making full use of these data (See Table 3.1-1). The roadside origin-destination surveys, the bus-jeepney passenger surveys and the 24-hour roadside traffic counts have been conducted during the Stage-I Study at the Allen-Calbayog Section and the Naguilian Road. Since it was only one year ago that those traffic surveys were conducted, the origin-destination patterns of the trips were believed to remain unchanged. However, the change of the traffic volume on the above two sections during the last one year was expected. At the Lucena-Calauag Section where any traffic surveys were not conducted under the Stage-I Study, various traffic surveys were conducted as shown in Table 3.1-2. For the other two sections, the O-D data collected under the Stage-I Study were up-dated based on the 1984 traffic volume obtained from the 24-hour roadside traffic counts conducted under the Study. The survey stations/routes are given in Figure 3.1-1.

As for the Naguilian Road, the results of the 24-hour roadside traffic count conducted by the Ministry of Public Works and Highways (MPWH) on March 1984 were used in the Study.

2) Results of Traffic Surveys (refer to Appendix 3.1-3)

a) Lucena-Calauag Section

Disaster spots which require urgent countermeasures and are subject to design are located in the mountainous section between Pagbilao and Atimonan (km 153 + 900 -km. 160 + 800; hereinafter called as the Pagbilao-Atimonan Sub-section), the traffic passing through this Sub-section is the main concern for this Study. The roadside O-D survey, the bus/jeepney survey and the roadside traffic counts were conducted near the Pagbilao proper. The traffic which does not pass through

TABLE 3.1-1 SUPPLEMENTAL TRAFFIC SURVEYS CONDUCTED

	Items Surveyed	Section/Route	Remarks
Roadside Origin-Destination Survey	Survey of volume, origin-destination and characteristics of vehicles and cargo passing through disaster points: - Survey station and traffic direction - Type of vehicle - Origin and destination - Trip purpose and number of passengers - Cargo type and weight	Lucena-Calauag Section	12-hour survey. Converted to 24-hour traffic volumes using roadside traffic count results. Survey for Allen-Calbayog section and Naguilian Road were conducted during the Stage I Study.
Bus/ Jeepney Passenger Survey	Survey of trip purpose, origin and destination of public transportation (bus, jeepney) passengers - Survey station and traffic direction - Trip purpose - Origin and destination	Lucena-Calauag Section	Same as above.
Roadside Traffic Count	Survey of number of vehicles passing through by type of vehicle, traffic direction and time period.	Lucena-Calauag Section Allen-Calbayog Section	24-hour traffic count. MPWH data used for Naguilian Road.
Travel Time Survey	Survey of average vehicle running speed on subject section and alternative route.	Lucena-Calauag Section Old Zigzag Road Allen-Calbayog Section Calbayog North Rd.	
Cause of Delay Survey	Survey of vehicle delay time caused by road disasters (especially rockfalls and eroded sections).	3 Subject Sections	

TABLE 3.1-2 TRAFFIC SURVEYS CONDUCTED IN STAGE I AND II STUDY

	Lucena-Calauag Section		Allen-Calauag Section		Naguilian Road	
	Stage I	Stage II	Stage I	Stage II	Stage I	Stage II
Roadside Origin-Destination Survey		●	●		●	
Bus/Jeepney Passenger Survey		●	●		●	
Roadside Traffic Count		●	●	●	●	
Travel Time Survey		●		●	●	
Cause of Delay Survey		●		●		●

the Sub-section such as the intrazonal traffic of Pagbilao, traffic between Lucena and Pagbilao, and traffic heading toward Padre Burgos was included in the result of the surveys. (See Figure 3.1-1). The O-D tables of the traffic only passing through the Sub-section were prepared by analyzing the O-D patterns at Pagbilao. The traffic volume at the survey station and those passing through the Pagbilao-Atimonan Sub-section are shown in Table 3.1-3.

b) Allen-Calbayog Section

Under the Stage-I Study, the roadside O-D and the bus/jeepney passenger surveys were conducted near the center of Calbayog City. Under this Study, a 24-hour roadside traffic count was conducted near the boundary of Northern Samar and Western Samar, for the purpose of obtaining the volume of through traffic at the Allen-Calbayog Section in order to exclude the effect of the intrazonal traffic of Calbayog City. (See Figure 3.1-1).

The 1983 O-D tables of through traffic of the Allen-Calbayog Section were first prepared by excluding intrazonal traffic of Calbayog City. These were updated to make the 1984 O-D tables. Traffic volumes of 1983 (under Stage-1 Study) and 1984 (under this Study) as well as expansion factors are shown in Table 3.1-4.

c) Naguilian Road

The 24-hour traffic count in 1984 was conducted at the same survey station as the Stage-I Study. The results of the traffic count undertaken in 1983 (under the Stage-I Study) and in 1984 are shown in Table 3.1-5.

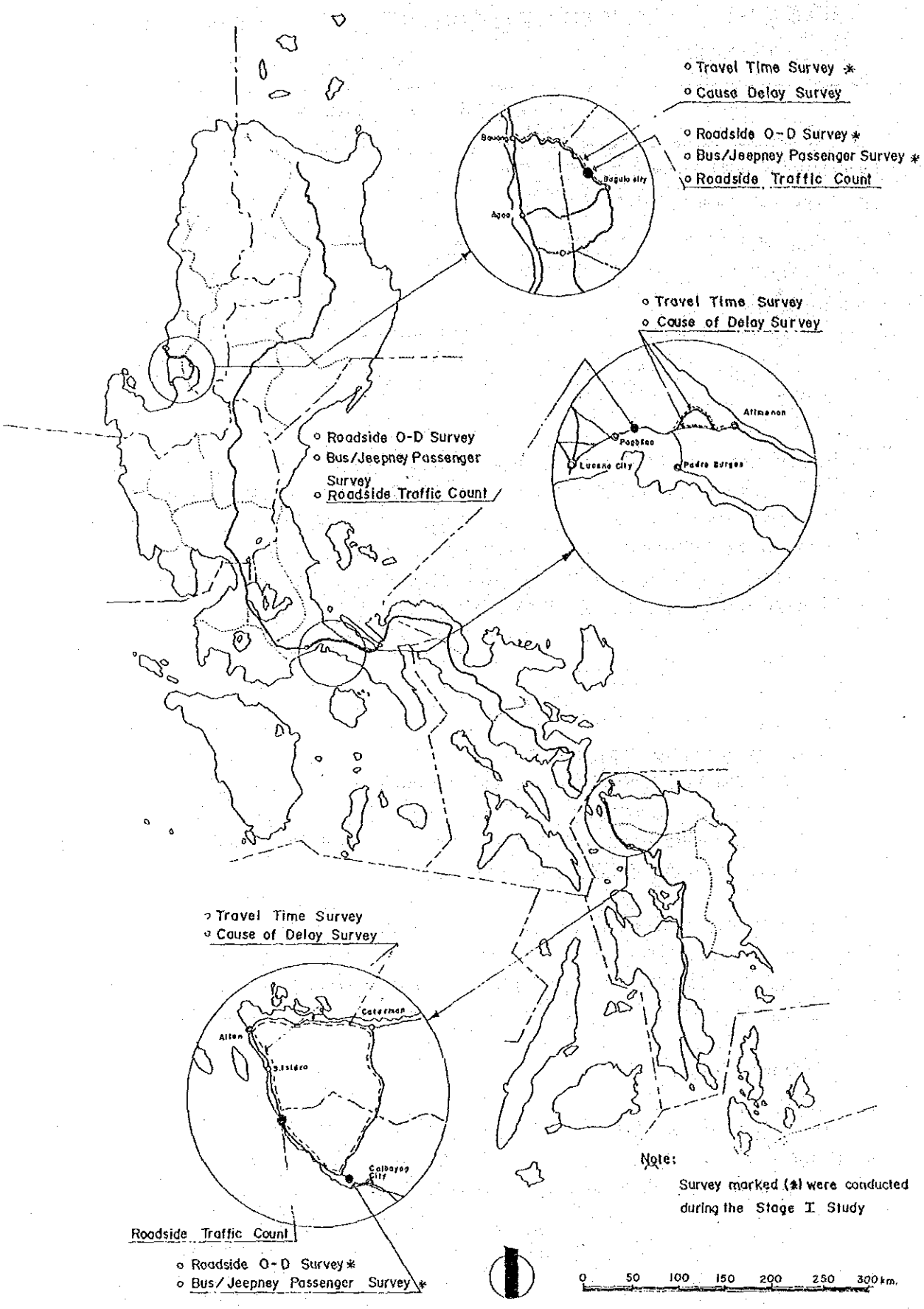


FIGURE 3.1-1 TRAFFIC SURVEY STATIONS/ROUTES

TABLE 3.1-3 EXISTING TRAFFIC VOLUME ON LUCENA-CALAUAG SECTION: 1984

	Traffic Volume (Vehicle/Day)					PUV Passengers (Pass./Day)	Commodity (Ton/Day)
	Car	Jeepney	Bus	Truck	Total		
Survey Station (At Pagbilao)	787	1,243	545	816	3,391	29,439	4,165
Subject Section (Pagbilao-Atimonan Sub-section)	498	115	512	697	1,822	13,233	3,725

Source: The Study Team.

TABLE 3.1-4 EXISTING TRAFFIC VOLUME ON ALLEN-CALBAYOG SECTION: 1984

	Traffic Volume (Veh./Day)				
	Car	Jeepney	Bus	Truck	Total
Stage - I Study (1983)	93	74	46	77	290
Stage - II Study (1984)	120	85	50	73	328
Expansion Factor (1984/1983)	(1.290)	(1.149)	(1.087)	(0.948)	(1.131)

TABLE 3.1-5 EXISTING TRAFFIC VOLUME ON NAGUILIAN ROAD: 1984

	Traffic Volume (Veh./Day)				
	Car	Jeepney	Bus	Truck	Total
Stage - I Study (1983)	455	403	73	265	1,196
Stage - II Study (1984)	465	415	85	274	1,239
Expansion Factor (1984/1983)	(1.022)	(1.030)	(1.164)	(1.034)	(1.036)

3.1.2 Influence Area

1) Lucena-Calauag Section

Traffic volume on the Pagbilao—Atimonan Sub-section is 1,822 vehicles/day. Figure 3.1-2 shows the volumes of traffic generated by each region. Of the total of 1,822 trips, 44% (or 793 trips) either originate or terminate in Lucena City, and 41% (or 756 trips) in Metro Manila. Trips which have trip ends beyond Metro Manila is quite small.

Of the trips bound for Lucena and Metro Manila, 72 percent (or 553 trips) originate in Quezon Province (such as Atimonan, Gumaca and Calauag) and 27% (or 208 trips) in Bicol Region. Trips which have origins in Samar or Leyte account for only 1% (or 11 trips).

Of the trips heading toward Bicol Region from Lucena and Metro Manila, 669 trips (67%) terminte in Quezon Province and 319 trips (30%) in Bicol Region. Only 32 trips (3%) have the destination in Samar or Leyte.

It is concluded that the influence area of the Pagbilao-Atimonan Sub-section covers about 650 kilometers from Metro Manila to the Southern end of Bicol Region. (See Figure 3.1-3).

2) Allen-Calbayog Section

Of the 328 vehicles passing through the Allen-Calbayog Section, 178 vehicles were bound for Calbayog and Leyte from Northern Samar, while the rest of vehicles (150 vehicles/day) were bound for the opposite direction. (See Figure 3.1-4).

In Northern Samar, Allen and Catarman respectively generate or attract 131 trips (40%). Only 60 trips (18%) use the ferry service between Luzon and Samar and, of these, more than a half (or 34 trips) are the long distance buses servicing Metro Manila and Samar/Leyte route.

In Western Samar and Leyte, the largest volume of 201 trips (or 61%) is either generated or attracted in Calbayog City, followed by 64 trips (or 20%) in Tacloban City, 28 trips (or 9%) in Catbalogan, 11 trips (or 3%) in Ormoc City, and 7 trips (or 2%) in Southern Leyte.

The influence area is currently limited to Northern Samar, Western Samar, and Tacloban City (or Northern Leyte). (See Figure 3.1-3).

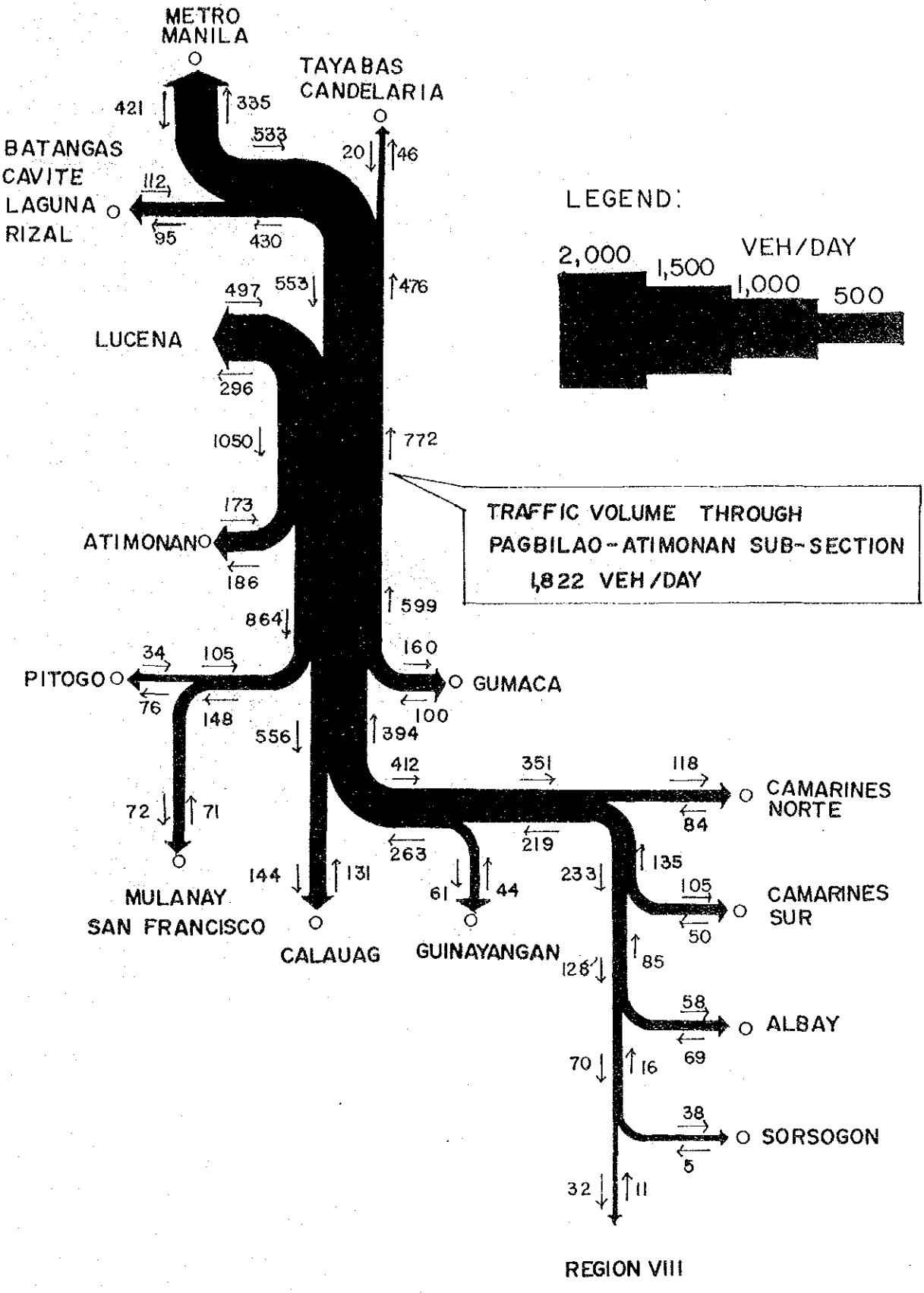


FIGURE 3.1-2 TRAFFIC FLOW IN 1984 THROUGH LUCENA-CALAUAG SECTION (TOTAL VEHICLE TRAFFIC)

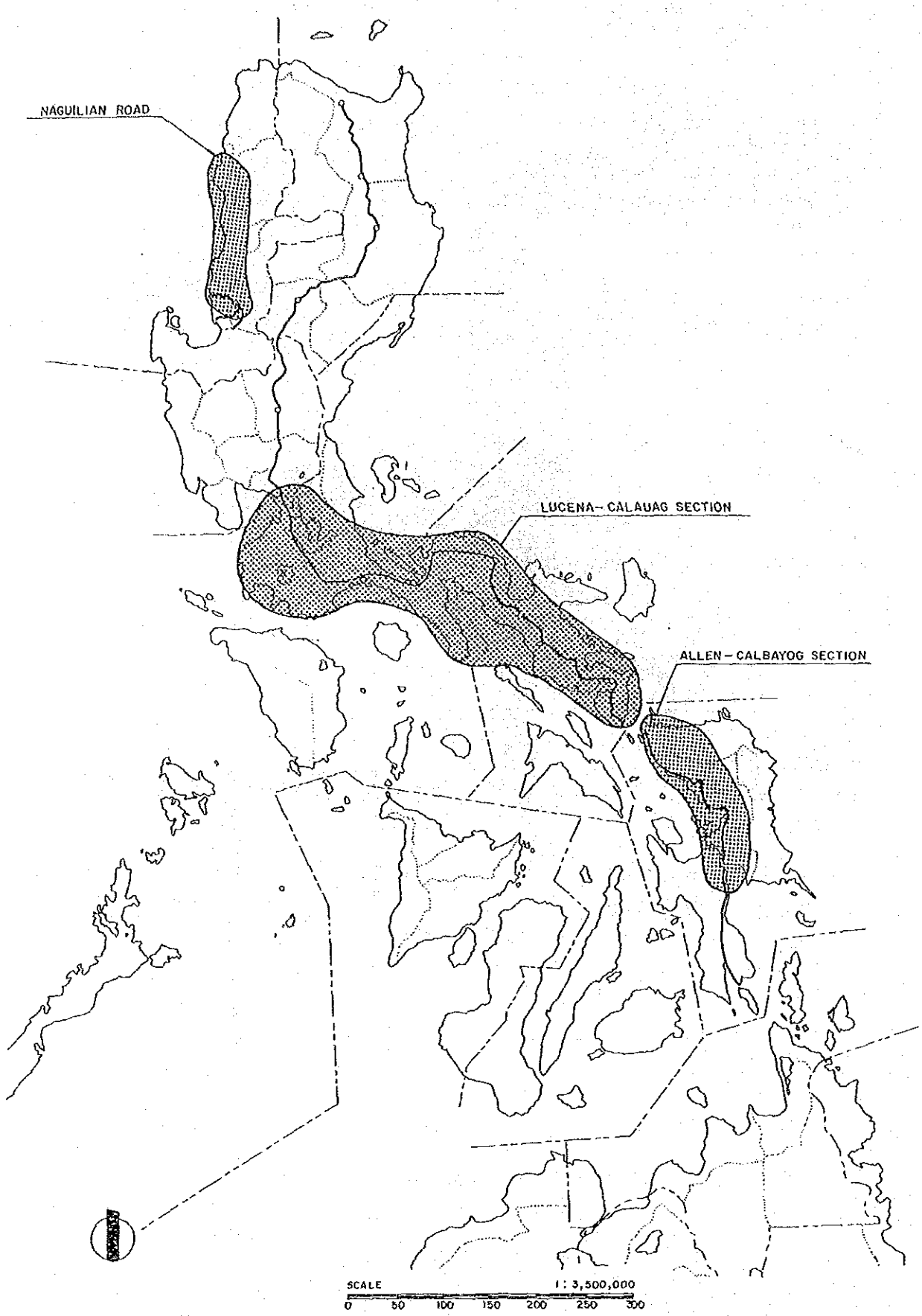


FIGURE 3.1-3 INFLUENCE AREA OF STUDY SECTION

3) Naguilian Road

Traffic volume passing through the Naguilian Road is shown by traffic generating sources in Figure 3.1-5.

There are 1,239 vehicles per day on the Naguilian Road. Of the 1,239 vehicles, 77 percent (or 951 vehicles) represent traffic between Baguio and various municipalities in La Union. San Fernando, La Union which is strongly linked with Baguio, has 617 vehicles of traffic (50% of total traffic) between these two areas. Truck traffic between these two areas accounts for two-thirds of daily truck traffic.

Other O-D partners of Baguio are Bauang and Ilocos with 275 vehicles (22%) and 108 vehicles (9%), respectively. Traffic between Baguio and the areas south of Baguio, such as Pangasinan and Metro Manila, is quite light accounting for only 1.7% (or 21 vehicles) of total traffic. This is because these bulk of the traffic passes through the Kennon Road.

The influence area of the Naguilian Road covers about 190 kilometers from Baguio to Ilocos Norte Province. (See Figure 3.1-3).

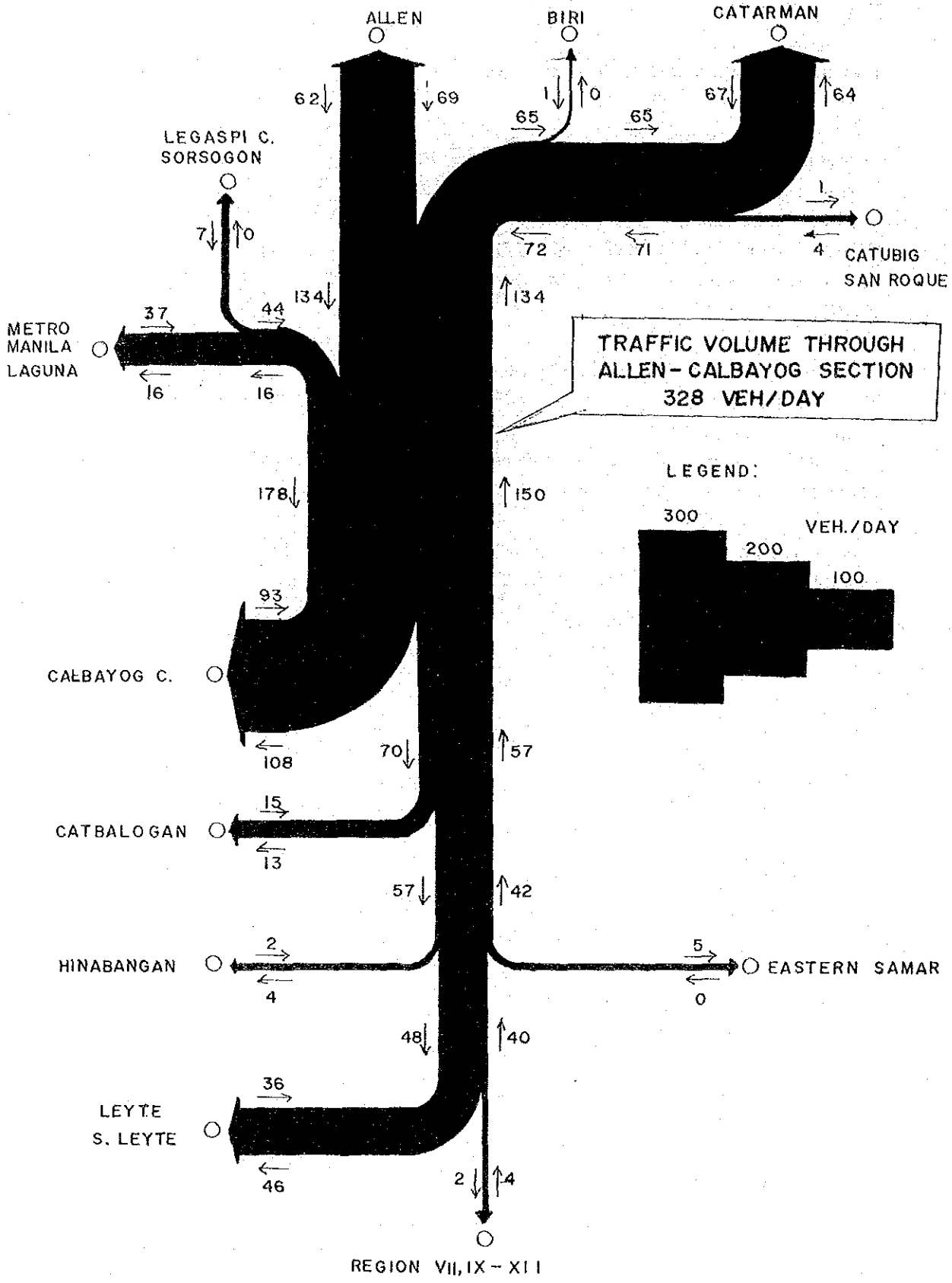


FIGURE 3.1-4 TRAFFIC FLOW IN 1984 THROUGH ALLEN-CALBAYOG SECTION (TOTAL VEHICLE TRAFFIC)

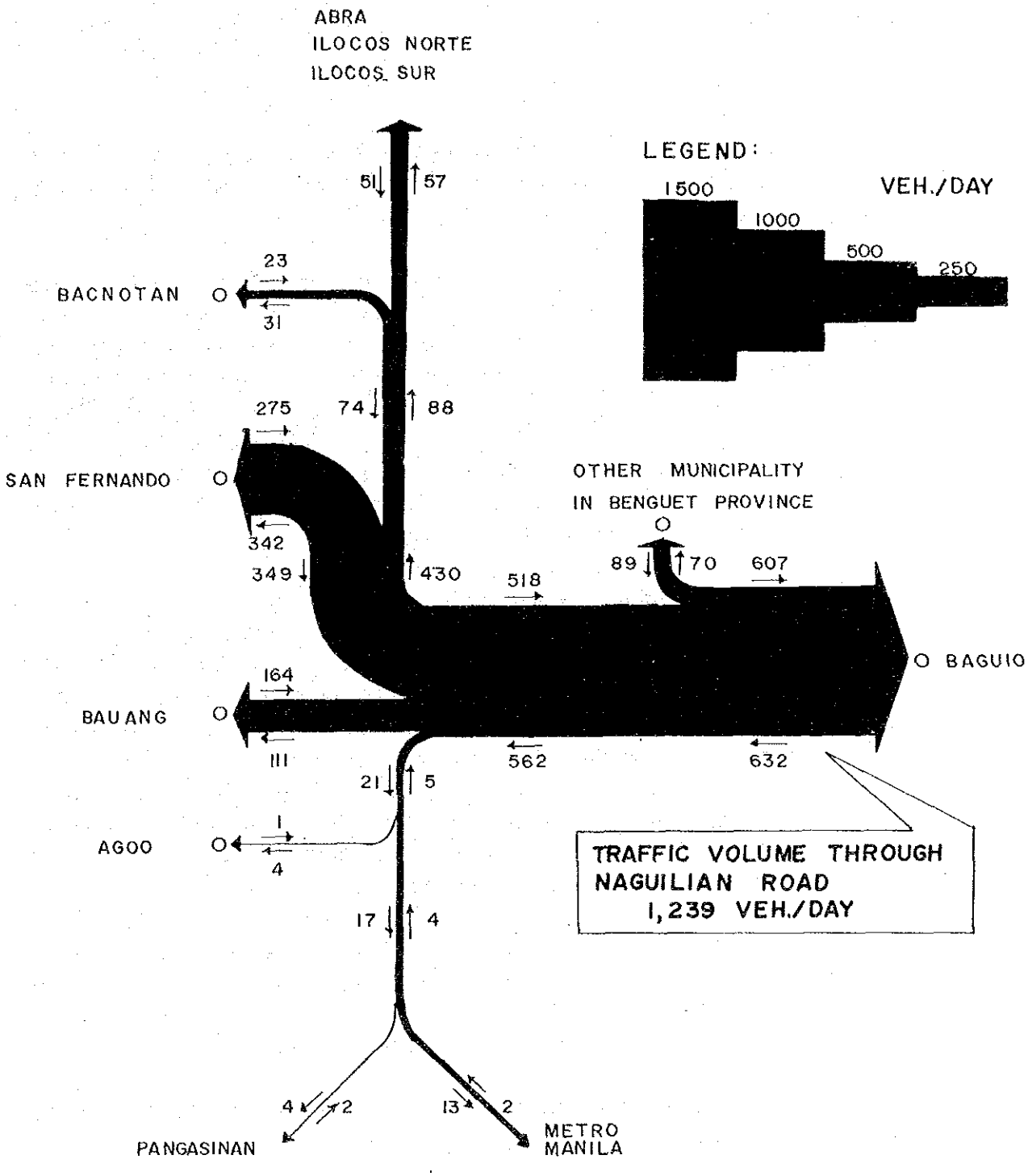


FIGURE 3.1-5 TRAFFIC FLOW IN 1984 THROUGH NAGUILIAN ROAD (TOTAL VEHICLE TRAFFIC)

3.2 LUCENA-CALAUAG SECTION

3.2.1 General Description

The Lucena-Calauag Section of the Maharlika Highway is located in Quezon Province between km. 136 + 407 and km. 232 + 130 south of Metro Manila, and extends for about 95.7 kilometers.

Bordered by two bays, Lamon Bay in the North and Tayabas Bay in the South, the land between Lucena and Calauag is narrow and about 15 kilometers wide. This narrow corridor is strategically situated to connect Metro Manila and the Bicol Region. The only trunk road passing through this corridor is the Maharlika Highway. Although the Main Line South of the Philippine National Railways (PNR) also passes through this corridor, rail transport is gradually losing ground to road transport due to the deteriorated equipment and low service standard. Therefore, passenger and freight movements between Metro Manila and the Bicol Region are highly dependent on the Maharlika Highway.

From Lucena, the Provincial Capital, the Highway runs through flat terrain for about 15.8 kilometers up to the junction with so-called "the Old Zigzag Road" which was the original route of the highway. From this junction, the highway passes through the southern tip of the Southern Sierra Madre Range until it merges with the Old Zigzag Road. This mountainous section which is named the Pagbilao-Atimonan Sub-section in this Study, extends for about 10.0 kilometers and contains a lot of spots with high disaster potential. From the end of the Sub-section to Atimonan, the highway runs through rolling terrain for about 14.5 kilometers. The rest of the Section (about 55.4 kilometers) runs on a flat low land along the coastal line of Lamon Bay. (See Figure 3.2-1).

The Maharlika Highway is a two-lane road with carriageway width of 6.7 meters and road shoulders of 2.5 to 2.0 meters. The full stretch of this Section is paved with portland cement concrete. Traffic volume on this section ranges from about 3,400 veh/day near Pagbilao to 1,800 veh/day near Atimonan.

Predominant land use along the Section is coconut fields. Quarrying of limestone is practiced at several spots.

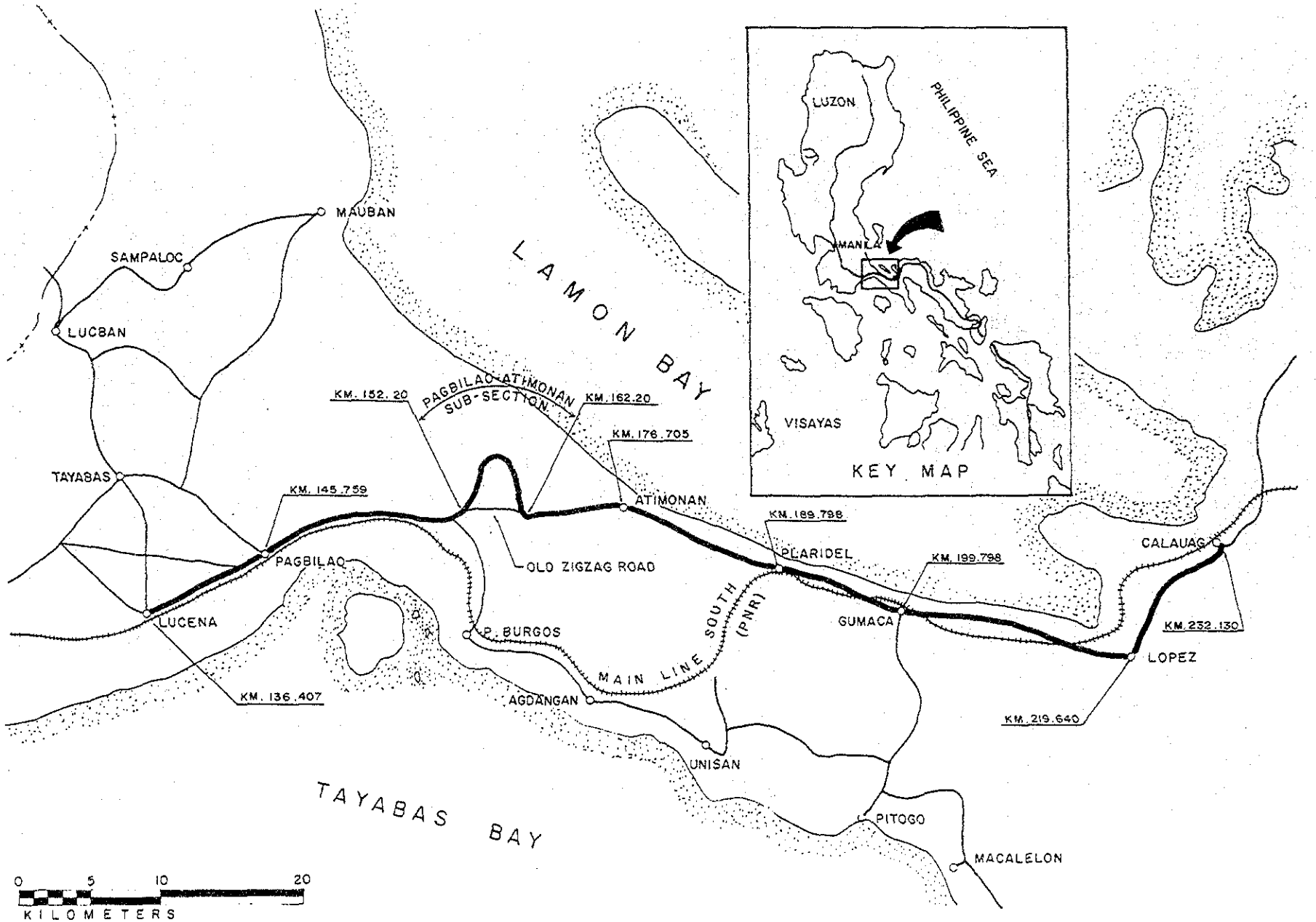


FIGURE 3.2-1 VICINITY MAP OF LUCENA-CALAUAG SECTION

3.2.2 Role

The Maharlika Highway is undoubtedly the most important trunk line in the country's highway network linking the four (4) major islands of Luzon, Samar, Leyte and Mindanao. In general, the role of the highway is to provide a fast, reliable, safe and comfortable means of transport for passenger and freight movements. In addition to these, the highway contributes to the following:

- Development of regional industries to create job opportunities
- Reduction of regional growth disparities
- Land expansion for commercial and industrial use
- Stimulation of socio-economic activities in rural areas
- Discouragement of regionalism and promotion of alliance between regions
- Stimulation of population movement to reduce overpopulation in specific urban areas
- Maintenance of public peace and order

The only road connecting Bicol Region and Metro Manila is the Maharlika Highway. The Lucena-Calauag Section is located at the gateway to the Bicol Region. Although there are other transport modes such as rail, sea and air, none of them are competitive with road transport. About 93% of passenger movement in the Manila-Bicol corridor depend on road transport, in other words on the Maharlika Highway.

TABLE 3.2-1 ANNUAL PASSENGER MOVEMENT IN MANILA-BICOL CORRIDOR, BY MODE 1981

Road							
Economy Bus	A/C Bus	Car and Vans	Sub-Total	Rail	Sea	Air	Total
11,725 (90%)	198 (1%)	260 (2%)	12,183 (93%)	594 (5%)	191 (1%)	115 (1%)	13,083 (100%)

Source: NTPP.

Freight movement in the Manila-Bicol Corridor is also highly dependent on the Maharlika Highway. Agricultural products such as copra, fish and seafood produced in the Bicol Region and Quezon Province are transported to Metro Manila and its neighbouring Provinces. On the other hand, manufactured products such as groceries and soft drinks and building/construction materials produced in Metro Manila and its neighbouring provinces are transported to the Bicol Region and Quezon Province.

This Section is functioning as a major inter-regional trunk road with heavy passenger and commodity movement and is generally serving long distance trips.

3.2.3 Topography / Geology

The Lucena-Calauag Section of Maharlika Highway extends for about 95.7 kilometers from Lucena (Km 136 + 407) to Calauag (Km 232 + 130), or from the southern end of the South Madre Range to the Bondoc Peninsula.

The Philippine Fault runs on the east of the Bondoc Peninsula and by Calauag. With the exception of rolling or mountainous terrain for about 30 kilometers from Pagbilao to Atimonan, the topography of this section is generally flat.

The geology of this section consists of rocks formed during the Oligocene era, when land upheavals and submergences formed the present shape of the Philippines. They are chiefly sandstone and limestone and occasionally andesite and mudstone.

The sandstone, which is from the Palaeogene period, is hard but presents developed cracks under the effect of prolonged diastrophism.

Outcrops of limestone continue from near Km. 156 + 000 to near Km. 161 + 000, and at point Km. 157 + 600, where weathering is particularly severe. Rock falls of which fallen rock size is about 1.5 meters by 2.5 meters have occurred. The limestone is characteristically highly porous. It is believed that intense rain accelerates the weathering, breaking into small rocks, and falling of the limestone. At point Km. 158 + 900, deep cut slope failure is not presently deteriorating except for limestone areas which are weathered into dirt and slided on to road shoulder.

Geologic formation from Km. 177 + 000 to Km 179 + 000 is of sandstone or alternating sandstone and mudstone strata with no failure as yet. At Km. 188 + 900, however, the surface of the alternating strata is weathered and scoured to form gullies. Due to these effects, surface rocks are falling. Alternating strata surface from Km. 177.000 to Km. 179.000 which is also weathered and formed gullies, is feared to similarly collapse in the future. See Figure 3.2-2.

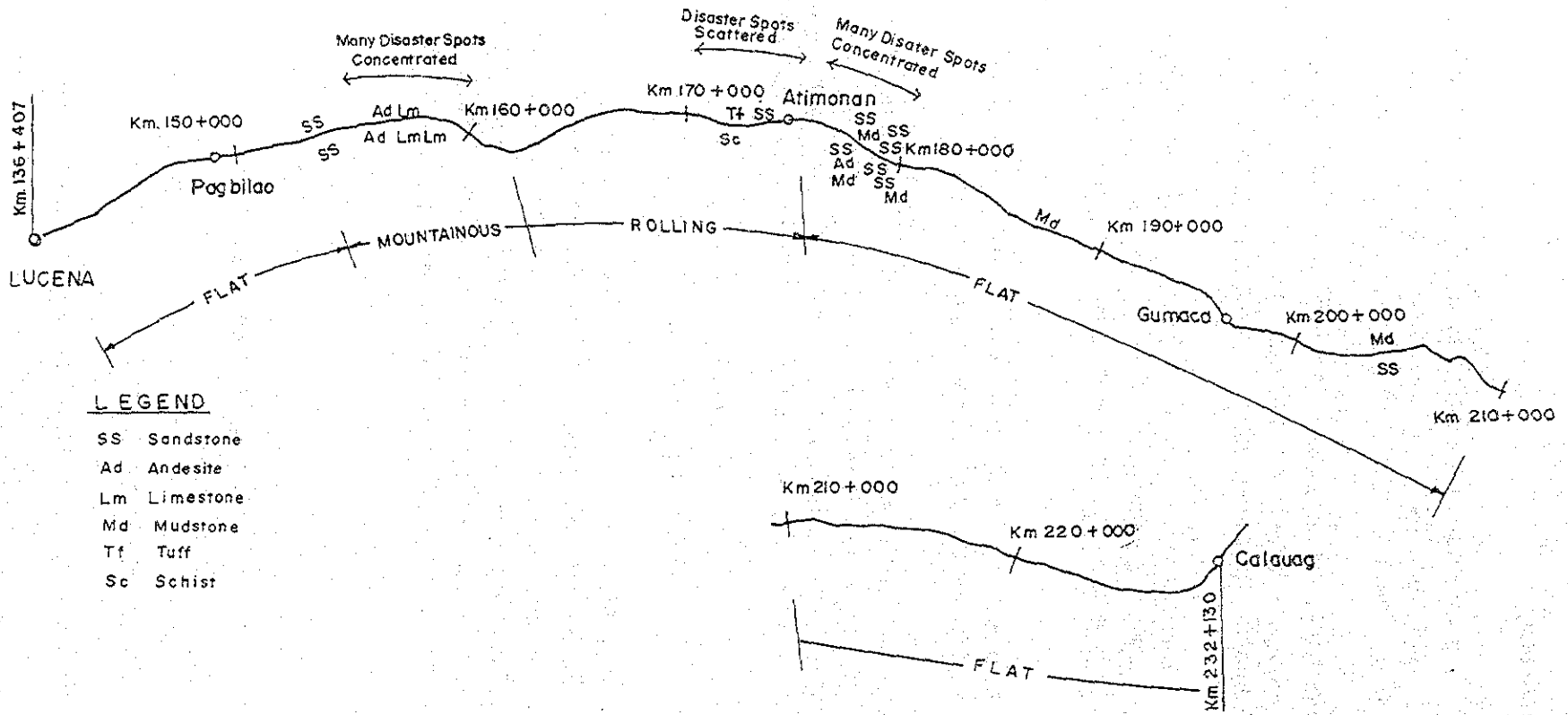


FIGURE 3.2-2 GEOLOGICAL LOCATION
LUCENA-CALAUAG SECTION L = 95.723 km

3.2.4 Traffic

1) Vehicle Traffic

A total of 1,822 vehicles passes daily along the Pagbilao-Atimonan Sub-section. By vehicle type, truck traffic accounts for the highest share of 39%, followed by buses for 28% and cars for 27%. Jeepneys have the smallest share of 6%. (See Table 3.2-2). Vehicle O-D patterns were discussed in "3.1.2 Influence Area."

2) Passenger Traffic

The number of passenger passing through the Sub-section is 15,023 per day. Of the total passengers, 12,750 passengers (or 85%) use buses. Car passengers account for 12%, while jeepney passengers account for only 3%. (See Table 3.2-3). Most of the passengers have long trip lengths, therefore, predominantly use buses.

Trip purpose compositions of car, jeepney and bus passengers are shown in Table 3.2-3. There are obvious differences in trip purpose composition between car passengers and public transportation (jeepney and bus) passengers. The predominant trip purpose of car passengers is "business", accounting for 57%. On the other hand, predominant trip purpose of jeepney and bus passengers is "visiting relatives", accounting for 45% and 35%, respectively.

Cars tend to be used for higher value added trips rather than public transportation.

3) Commodity Flow

A Total of 3,725 tons of commodities is transported daily through the sub-section. Of the total, 60% (or 2,239 tons) are transported towards Metro Manila from the Bicol Region and 40% (or 1,486 tons) in the other direction.

Commodity Flow From the Bicol Region to Metro Manila: 2,239 ton

Although Commodity traffic generating sources are scattered all over the Bicol Region and Quezon Province, the major sources are Camarines Norte Province (532 tons or 24%), Albay Province 339 tons or 15%) and Gumaca in Quezon Province (297 ton or 13%).

TABLE 3.2-2 TRAFFIC VOLUME BY VEHICLE TYPE: 1984 PAGBILAO-ATIMONAN SUB-SECTION

	Traffic Volume (Veh./day)	Share (%)
Car	498	27
PUV Jeepney	115	6
PUV Bus	512	28
Sub-Total	627	34
Truck	697	39
Total	1,822	100

Source: The Study Team.

TABLE 3.2-3 NUMBER OF PASSENGER BY VEHICLE TYPE; 1984 PAGBILAO-ATIMONAN SUB-SECTION

	Passenger (Pass/day)	Share (%)
Car	1,790	12
Jeepney	483	3
Bus	12,750	85
Total	15,023	100

Source: The Study Team.

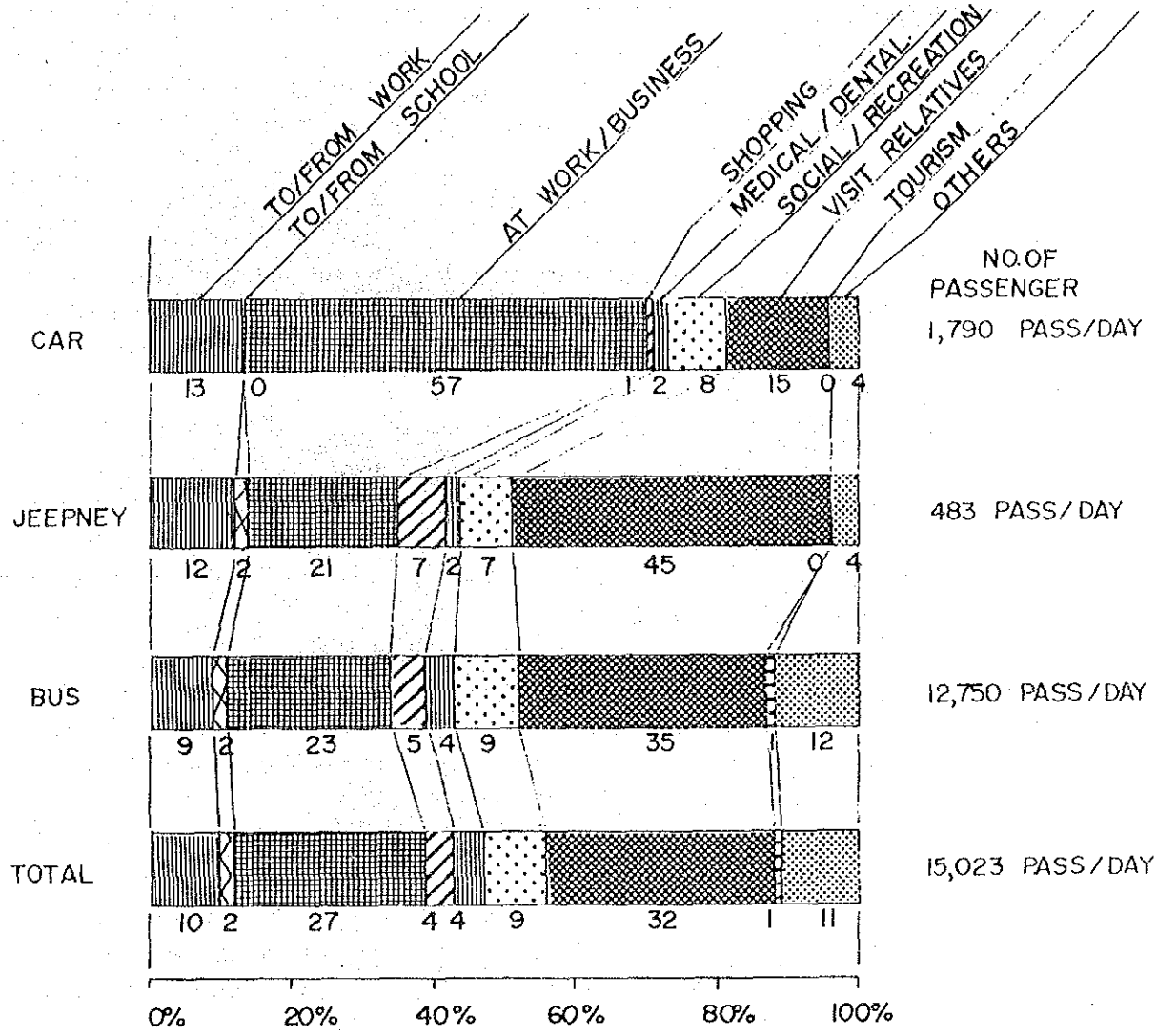


FIGURE 3.2-3 PURPOSE COMPOSITION OF PASSENGER AT LUCENA-CALAUAG SECTION

Commodity traffic generated in the Bicol Region and Quezon Province has two predominant destinations. One is Metro Manila where 47% (or 1,049 tons) of commodities are attracted. The other is the neighboring provinces of Metro Manila such as Cavite, Rizal, Batangas, etc. where 30% (or 678 tons) are attracted.

Major commodities transported through this sub-section are unprocessed agricultural cash crops (mainly copra) which have the largest share of 41% (or 920 tons), unprocessed agricultural foodstuffs such as fish and seafoods which have the second largest share of 17% (or 385 tons) and building and construction materials (mainly gravel and sand) which have a share of 12% (or 269 tons).

Commodity Flow From Metro Manila to the Bicol Region: 1,486 tons.

There are two predominant commodity traffic generating sources. Metro Manila is the biggest source from where 57% (or 841 tons) of commodities are transported. The second source is neighboring Provinces of Metro Manila where 22% (or 321 tons) of commodities are generated.

Commodities generated mostly in Metro Manila and its neighboring provinces are transported to various areas of the Bicol Region and Quezon Province. Major destinations are Camarines Norte (373 tons or 25%), Camarines Sur (330 tons or 22%) and Gumaca in Quezon Province (284 tons or 19%).

Major commodities are manufactured foodstuffs such as groceries, soft drinks, beer, etc. which account for largest share of 51% (or 763 tons), building and construction materials (mainly cement) which have the second largest share of 17% (or 251 tons) and processed agricultural products (mostly milled rice) which have a share of 9% (or 133 tons)

4) Type of Trucks

Of the 697 trucks passing through the sub-section daily, 491 vehicles (70 percent) are two-axle trucks, 157 vehicles (23 percent) are three-axle trucks and 49 vehicles (7 percent) are trailers. Inspite of high proportions of two axle trucks, the average weight of cargo per loaded truck is considerably heavy at 7.5 tons per truck. About 29 percent of the trucks are empty of cargo.

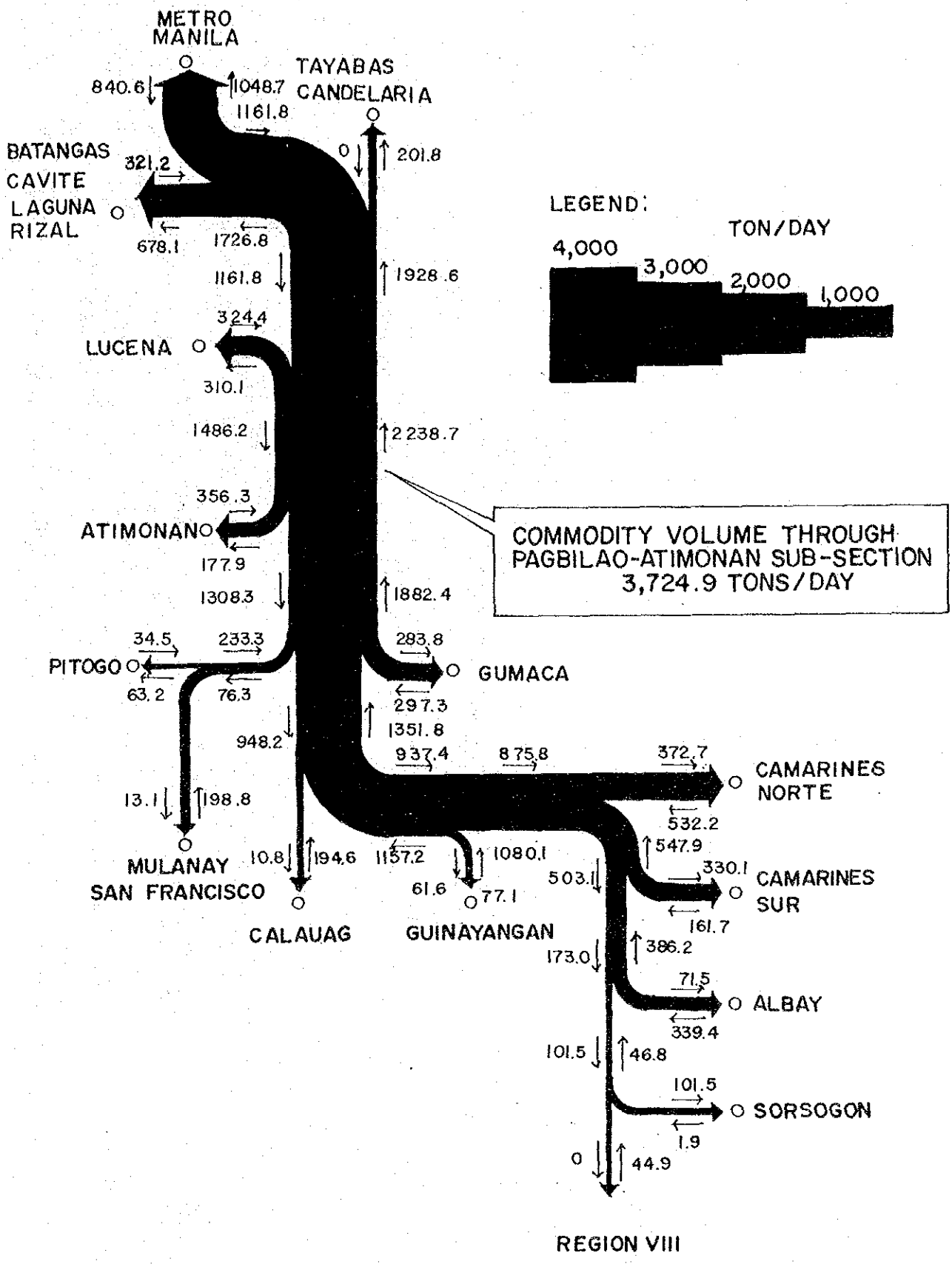


FIGURE 3.2-4 COMMODITY FLOW IN 1984 THROUGH LUCENA-CALAUAG SECTION (TOTAL COMMODITY)

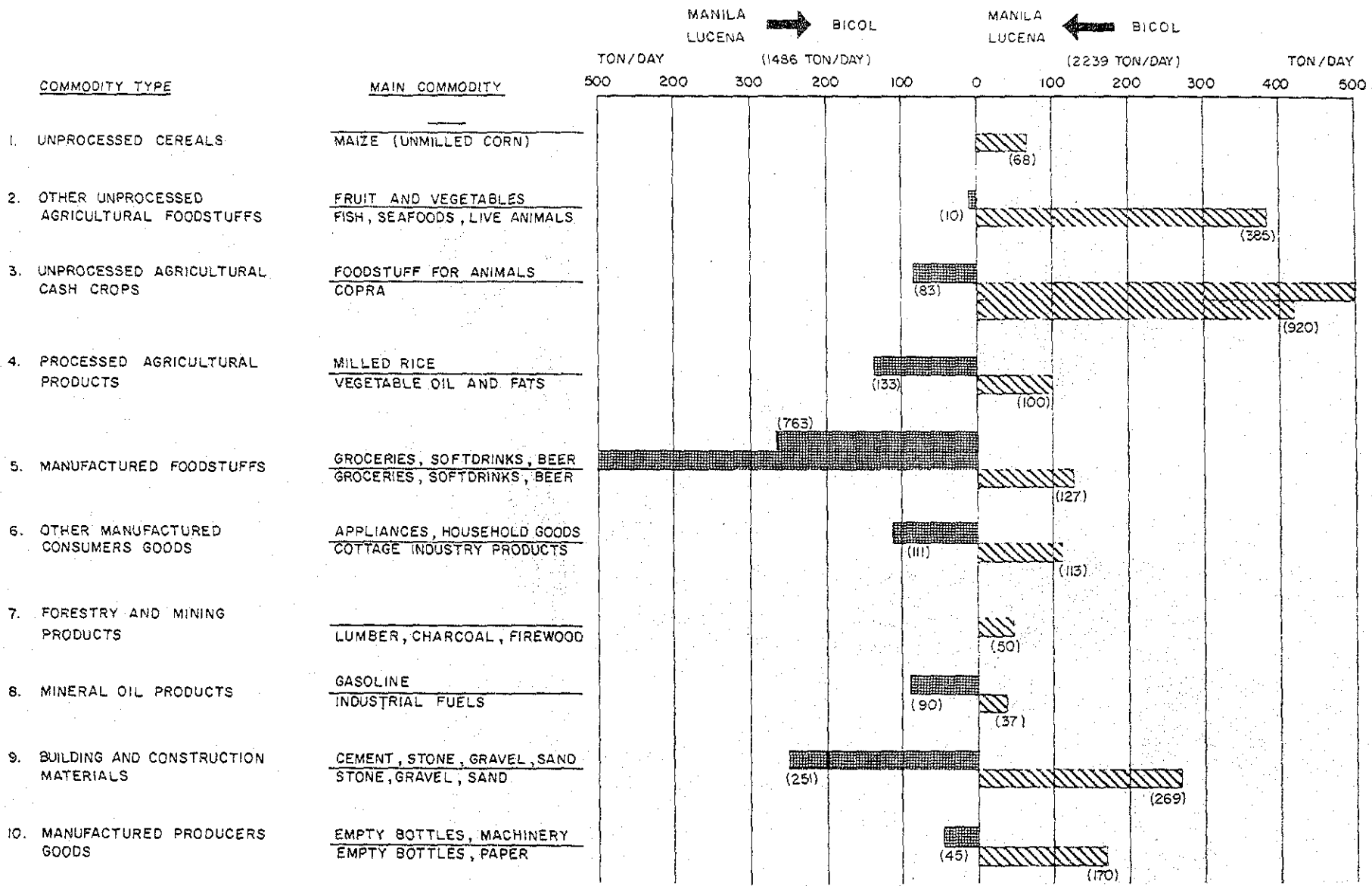


FIGURE 3.2-5 COMMODITY FLOW IN LUCENA-CALAUAG SECTION

3.2.5 Socio-economic Features

The Lucena-Calauag Section of the Maharlika Highway is located in Quezon Province. The total influence area includes Metro Manila, Region IV and Region V.

1) Population

As of the 1980 Census, the total regional population of the influence area are as follows; Metro Manila has 5,925,884; Region IV has 6,118,620 and Region V has 3,476,982.

Throughout the 1975 and 1980 census, Region IV, the Southern Tagalog Region continued to have the largest population representing an average of 39% of the total population of the influence area.

Within the intercensal period between 1975 and 1980, Metro Manila registered a growth rate of 3.6%, Region IV had 1.4% and Region V had 1.7%. Metro Manila is the most densely populated among the influenced regions, with a land area of 636 sq. km. and a population of 5,925,884 in 1980, the population density of Metro Manila is placed at 9,317.4 persons per sq. km. Region IV aand Region V on the other hand, has a 1980 population density of 130.4 and 197.2 persons per sq. km., respectively.

2) Economy

An analysis of the major industrial components of the economy in the influence area reveals that Metro Manila, being the major center of commerce and trade in the country, depends largely on the industry and services sector while the other two regions depend on agriculture.

During the period 1980-1983, these three regions exhibited different economic development (GRDP) trends. Metro Manila showed a continuously increasing economic trend, Region IV likewise, showed an increasing trend, while Region V exhibited a fluctuating trend.

3) Crop Production

The major crops in the influence area, except Metro Manila, includes rice, coconut, corn and sugarcane.

The total area planted to all crops in Region IV and Region V were registered at 1,244,145 hectares and 780,437 hectares, respectively. Of all the crops grown in the region, rice and coconut lead in terms of hectarage both in Region IV and Region V. These crops occupied the largest area planted in Region IV accounting for 30 percent and 44 percent, respectively. In Region V rice and coconut represent 35 percent and 43 percent of its total cropland, respectively.

Other crops grown are sugarcane, corn, tobacco and vegetables. Vegetables account for the smallest area among the crop categories.

3.3 ALLEN-CALBAYOG SECTION

3.3.1 General Description

The Allen-Calbayog Section of the Maharlika Highway extends for about 72.9 kilometers from Allen (kms. 663 + 814) in Northern Samar to Calbayog City (kms. 736 + 750) in Western Samar.

Although the Government has been making great effort to develop road network in the Island, road network development is still below the national average. The Maharlika Highway which runs along the west coast of Samar Island, is the only trunk road in the Island.

The Highway between Luzon Island and Samar Island is connected by ferry boat service. The ferry terminal in Samar Island is located at San Isidro. Currently a ferry boat makes two roundtrips daily.

The Highway is a two-lane road with carriageway width of 6.7 meters and road shoulders of 2.5 to 2.0 meters. Full stretch of this section is paved with portland cement concrete. Traffic volume on this section is about 330 veh./day. Predominant land use along the Section is coconut fields.

3.3.2 Role

Although the Maharlika Highway is the only major trunk road in Samar Island and is situated at important location to link the Island with Luzon and Leyte Islands, traffic on it is still light and is mostly medium distance trips or inter-provincial trips. Therefore, the Section is, at present functioning as a secondary trunk road.

When the Government's efforts to develop currently depressed areas of Samar and Leyte become fruitful and linkage between Metro Manila and Samar/Leyte becomes more vital, the Section will function as a major inter-regional trunk road.

3.3.3 Topography/Geology

The Allen-Calbayog Section of Maharlika Highway extends for about 72.9 kilometers from Allen (km. 663 + 814) to Calbayog (km. 736 + 750).

This section occurs on Samar Island, which consists of hills with the elevation of about 800 meters above sea without any obvious range and a developed coastal terrace. Along this coastal line runs Maharlika Highway.

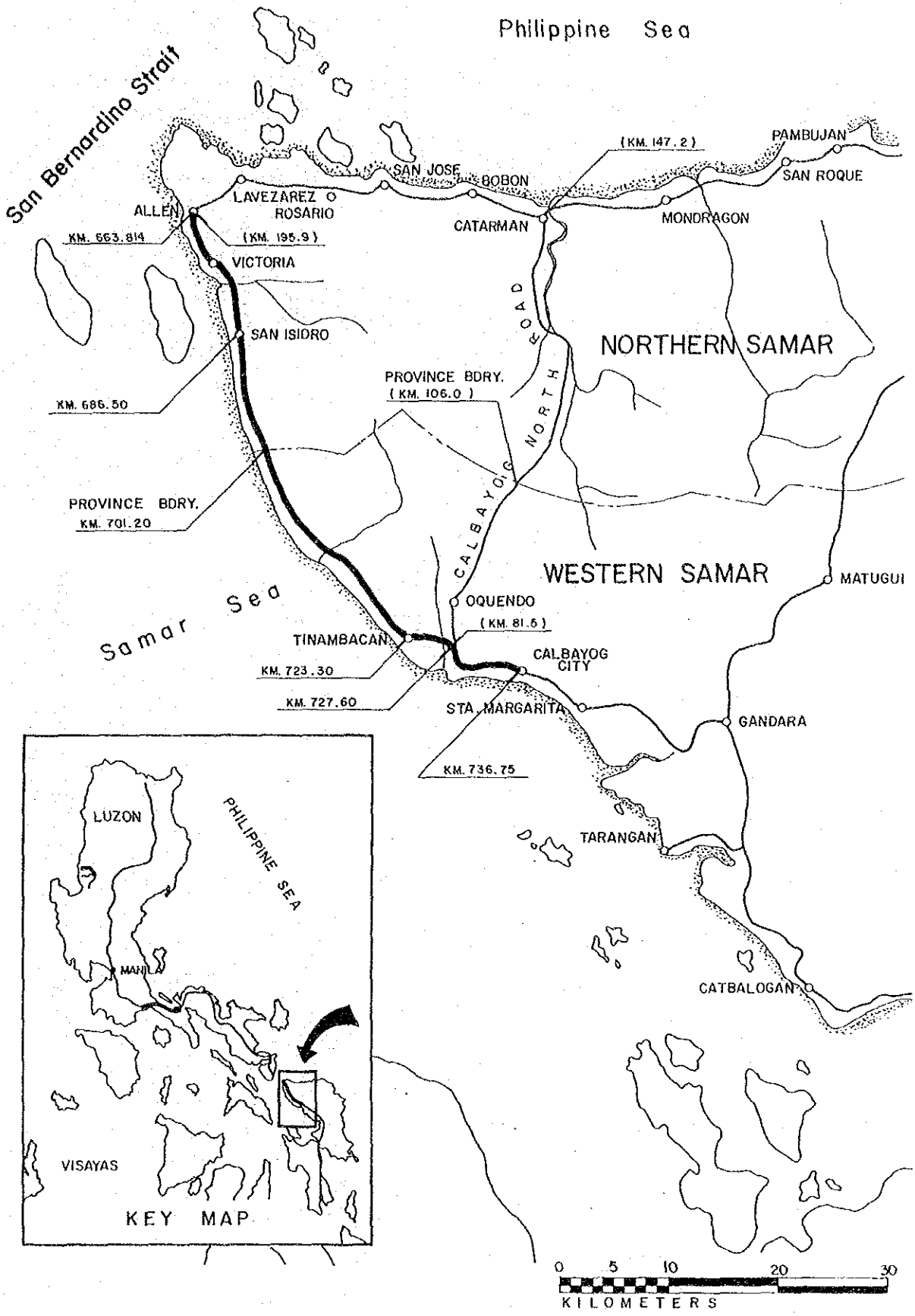


FIGURE 3.3-1 VICINITY MAP OF ALLEN-CALBAYOG SECTION

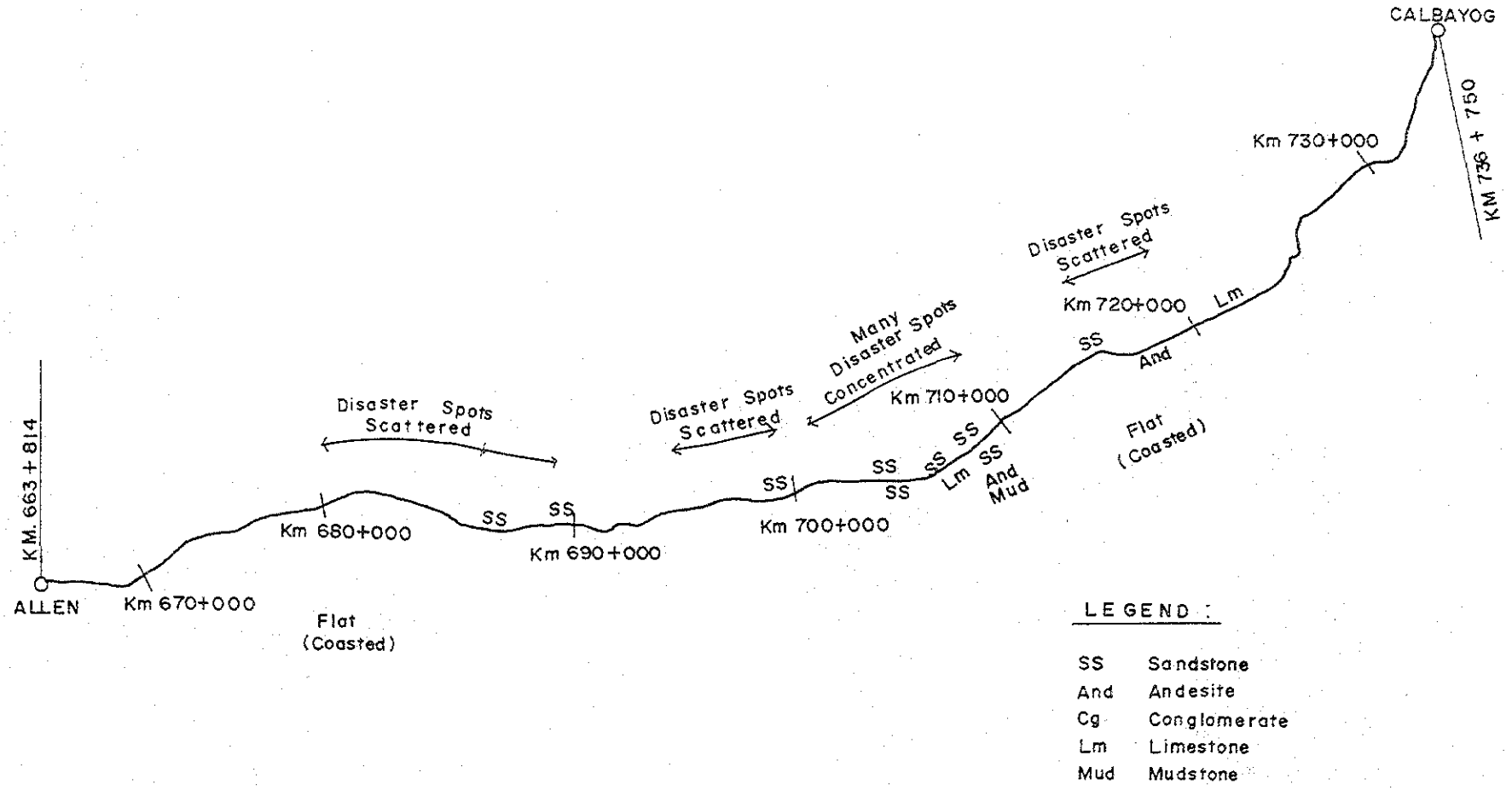


FIGURE 3.3-2 GEOLOGICAL LOCATION
ALLEN-CALBAYOG SECTION L = 72.936 km

The geology is of sedimentary rocks with folds and faults. Of the rocks, sandstone is of an old origin, dating back to the Mesozoic Cretaceous to the Palaeogene, and is therefore hard but has developed cracks caused by the diastrophism which continued for a long time. Thus, the sandstone is prone to fall in large pieces.

A beautiful stratification of sandstone and slate is seen near km. 709 + 000, but the slate is feared to turn to clay by penetrating rainwater and collapse. A sign of such collapse was already seen.

Although hard, andesite rocks outcropping in the vicinity of km. 718 + 300 present developed cracks and joints and (as they presently fall in small pieces) are feared to fall in large pieces in the future.

3.3.4 Traffic

1) Vehicle Traffic

Current traffic volume on this section is still light at 328 veh./day. By vehicle type, cars have the largest share of 37%. Jeepneys, trucks and buses account for 26%, 22% and 15%, respectively (See Table 3.3-1). Of the 50 buses, 34 buses are for long distance services between Metro Manila and Samar or Leyte. As indicated by the expanse of influence area, jeepneys which serve short distance trips have rather high share. Vehicle O-D patterns were discussed in "3.1.2 Influence Area".

2) Passenger Traffic

A total of 3,323 passengers passes through this section daily. About a half of the passengers (or 1,598 passengers) are transported by jeepneys. Buses transport about 41% (or 1,369 passengers). The rest of the passengers (11%) use cars. See Table 3.3-2.

There are obvious differences in trip purpose composition dependent upon vehicle type (See Figure 3.3-3). Cars are used predominantly for "business" trips (29%) and "to/from work" trips (27%). Predominant trip purposes of jeepneys are "shopping" trips (22%), "business" trips (19%) and "Visiting relatives" trips (19%).

The outstanding trip purpose of buses is "visiting relatives" trips (35%), followed by "business" trips (19%).

3) Commodity Flow

A total of 238 tons of commodities is daily transported through this section. Of the total, 59% (or 140 tons) are transported towards Northern Samar from Calbayog/Leyte and 41% (or 98 tons) in the opposite direction.

Commodity Flow From Calbayog/Leyte to Northern Samar: 140 tons

Calbayog City is the biggest commodity traffic generating source from which originates 78% (or 109 tons) of commodities.

TABLE 3.3.-1 TRAFFIC VOLUME BY VEHICLE TYPE: 1984 ALLEN-CALBAYOG SECTION

	Traffic Volume (Veh./day)	Share (%)
Car	120	37
Jeepney	85	26
PUV Bus	50	15
Sub-total	135	41
Truck	73	22
Total	328	100

Source: The Study Team.

TABLE 3.3.2 NUMBER OF PASSENGER BY VEHICLE TYPE 1984 ALLEN-CALBAYOG SECTION

	Passenger (Pass./day)	Share (%)
Car	356	11
Jeepney	1,598	48
Bus	1,369	41
Total	3,323	100

Source: The Study Team.

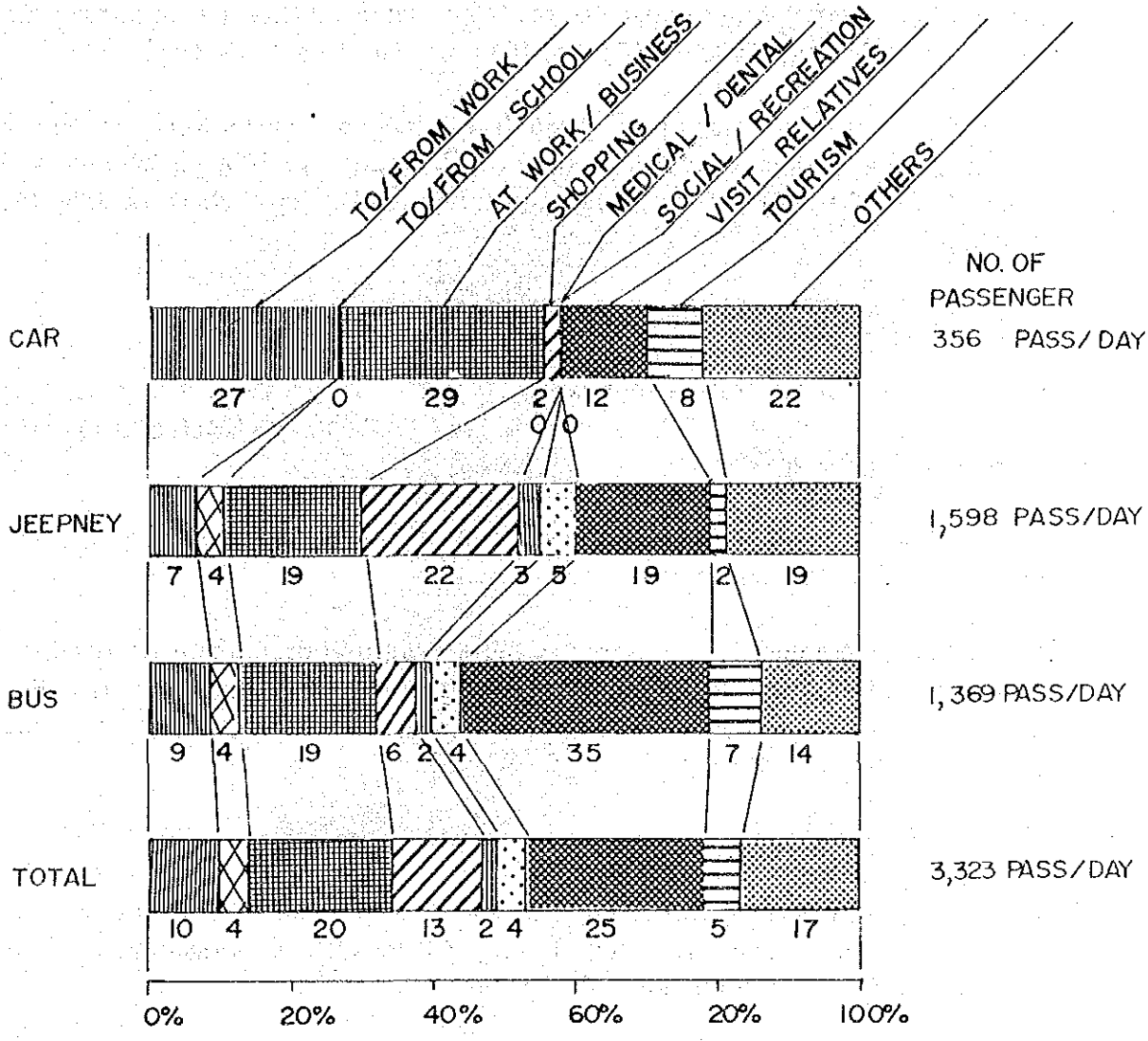


FIGURE 3.3-3 PURPOSE COMPOSITION OF PASSENGER AT ALLEN CALBAYOG SECTION

Destination of commodities generated mainly in Calbayog City are Catarman, the capital town of Northern Samar (72% or 101 tons) and Allen (28% or 39 tons).

Predominant commodities carried through this section towards Northern Samar are mineral oil products (mainly gasoline) which account for 59% (or 82 tons) and manufactured foodstuffs (soft drinks and beers) which have share of 19% (or 27 tons).

Commodity Flow From Northern Samar to Calbayog/Leyte: 98 tons

Major commodity generating sources are Catarman in Northern Samar (37 tons or 38%), Metro Manila (25 tons or 26%) and Legaspi City/Sorsogon in Bicol Region (20 tons or 20%).

Most of the commodities carried towards Calbayog City and Leyte are attracted in Calbayog City (93 tons or 95%).

Predominant commodities are unprocessed agricultural products (mainly copra) which amount at 37 tons (or 38%), processed agricultural products (mainly milled rice) at 22 tons (or 22%) and manufactured consumer goods (mainly household goods) at 20 tons (or 20%).

4) Type of Trucks

All of the trucks passing through the Section are two-axle trucks. The average weight of cargoes per loaded truck is only 4.9 tons/truck, indicating that the small-sized trucks are dominant in this section.

3.3.5 Socio-economic Features

The Allen-Calbayog Section of the Maharlika Highway has an absolute influence on Region VIII. The description of socio-economic features is focused in this Region.

1) Population

Based on the 1980 Census of Population and Housing, the population of Region VIII was 2,800,000 constituting approximately 5.8 percent of the total Philippine Population.

The population of the region increased with the annual growth rate of 1.5 percent from 1975 to 1980. Among the five provinces in the region, Eastern Samar registered the highest growth rate of population from 1975 to 1980 with 2.2 percent. The province of Samar registered the lowest growth rate of 0.9 percent.

Given the land area of the region of about 21,431.7 sq. km. the population density of the region was about 130.9 persons per square kilometer.

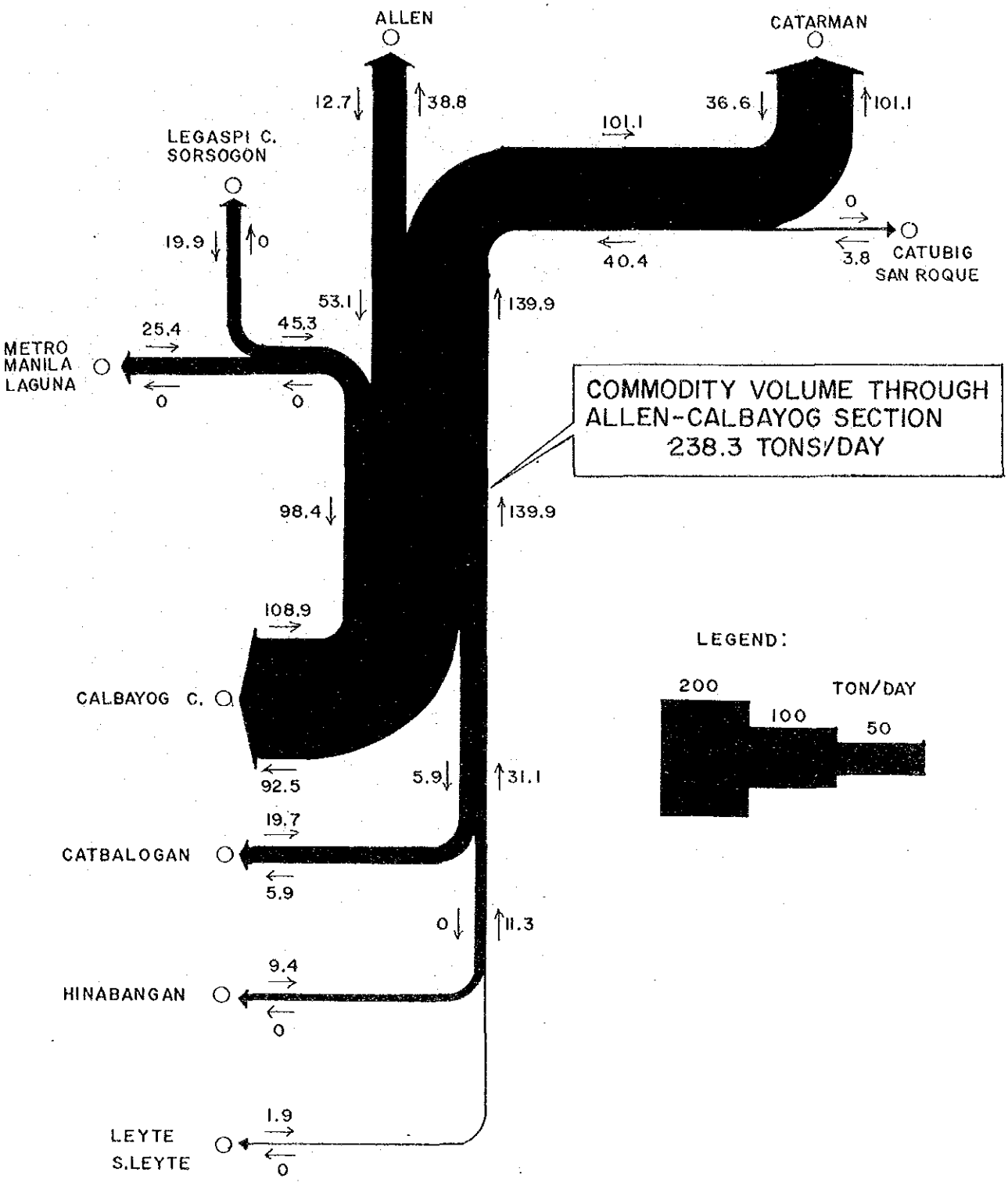


FIGURE 3.3-4 COMMODITY FLOW IN 1984 THROUGH ALLEN-CALBAYOG SECTION (TOTAL COMMODITY)

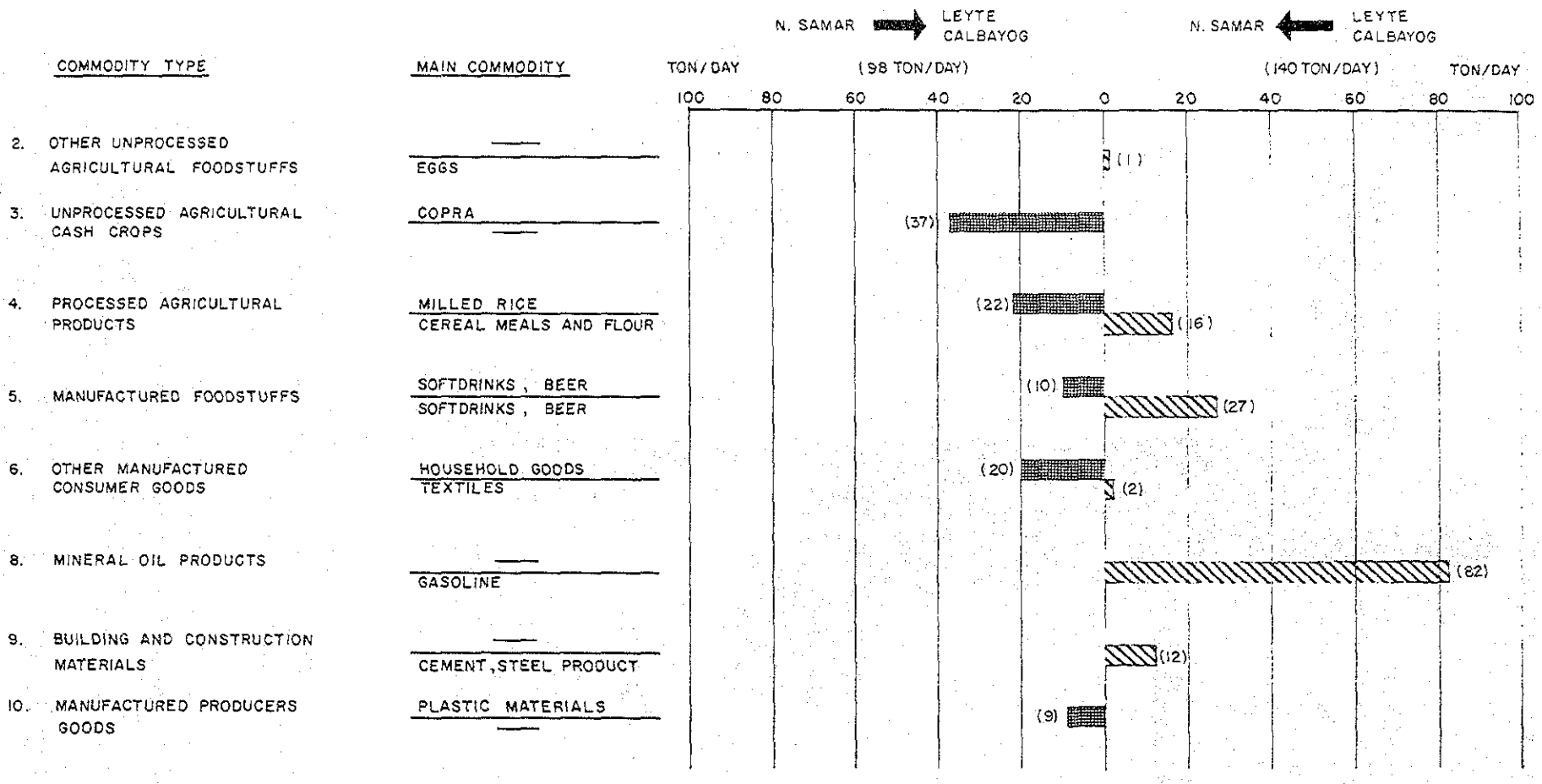


FIGURE 3.3-5 COMMODITY FLOW IN ALLEN-CALBAYOG SECTION

2) Economy

The performance of the regional economy in terms of the gross regional domestic product (GRDP) showed a minimal improvement during the period 1980-1983. From a level of ₱2.31 million GRDP (at 1972 prices), it rose to ₱2.33 million in 1983.

An analysis of the major components of GRDP reveals that agriculture, fishery and forestry showed a sluggish performance during the year 1982 to 1983, while the industry sector had a slight increase during the years from 1980 to 1982 but decreases in 1983. The other major components, the service sector had a minimal improvement from 1980-1983.

3) Crop Production

Agriculture remains the major means of livelihood in the region. It deals mainly with the production of crops. Rice and coconut are the major products in the region followed by other crops like corn, sugar cane and vegetables.

Palay, the leading food crop was harvested from an area of 192,170 hectares in 1983. The next most important food crop was corn planted in an estimated area of 200,890 hectares.

Coconut was the leading commercial crop produced. It also led all agricultural crops in terms of hectarage. This crop was planted to an area of 355,420 hectares.

3.4 NAGUILIAN ROAD

3.4.1 General Description

The Naguilian Road which branches off from the Manila North Road to Bauang (kms. 259 + 230) and leads to Baguio City (kms. 306 + 445) extends for about 47.2 kilometers.

Baguio City is known as a resort and tourist town. Situated about 1,500 meters above sea level, the City is blessed with cool weather all year round, and, moreover, requires only a 4-hour drive from Manila. About 515,000 tourists and vacationers visit the City every year, of which about 200,000 are overseas visitors. Though no accurate figures are available, it is said that the City's population (199,000 in 1980) doubles during the summer season. The City is also noted for its many educational facilties, which includes 13 colleges, 16 high schools and 47 primary schools. About 50 percent of the city's student population are college students (five universities alone accounted for about 39,000 students in 1981). Another characteristic is that the city and its surrounding areas are production centers of various vegetables. The vegetables are transported to Metro Manila for consumption.

Of the three roads leading to Baguio City from Metro Manila, namely the Kennon Road, the Agoo-Baguio Road and the Naguilian Road, the Naguilian Road is situated at the northernmost and is the oldest road. It was opened to traffic in 1919.

The road runs in rolling areas for about 17 kilometers from the town of Bauang, then proceeds towards Baguio City through the steep mountainous terrain.

The Naguilian Road is a narrow two-lane road with carriageway width of 6.0 meters and road shoulders of 1.0 to 0.5 meters. The road surface is paved with asphalt concrete. The 30 km. Section near Baguio City has a poor road alignment, containing many sharp curves and steep gradients. Traffic volume on this road is about 1,240 veh./day.

3.4.2 Role

Although this road can be classified as a secondary trunk road due to predominant medium distance traffic which is mainly between Baguio and San Fernando, La Union, this road is quite important to the Baguio citizen's daily life. Oil shipped from San Fernando, La Union and seafoods are transported to Baguio via this road. Copper ores quarried in Benguet Province are transported to San Fernando, La Union through this road.

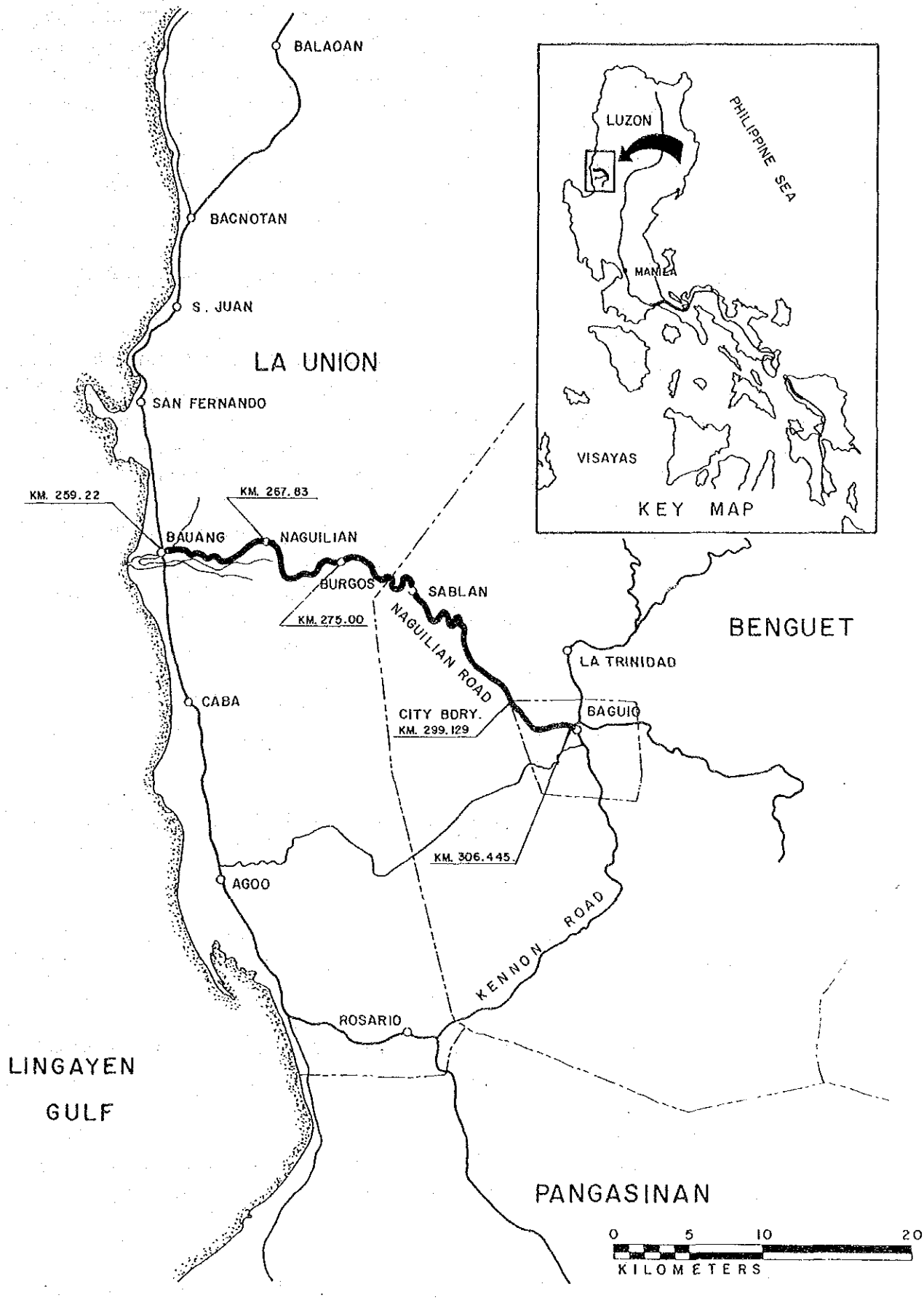


FIGURE 3.4-1 VICINITY MAP OF NAGUILIAN ROAD

In terms of road disasters, this road is the most stable route among three (3) roads leading to Baguio from Metro Manila. Therefore, when this road is closed to traffic due to road disasters caused by a typhoon or continuous heavy rains, Baguio will completely lose access and be isolated.

In view of above, this road is considered the life line of Baguio.

3.4.3 Topography / Geology

The Naguilian Road extends for about 47.2 kilometers from Bauang (Km 259 + 220) to Baguio (Km 306 + 445).

The Naguilian Road runs through a rolling terrain for about 16 kilometers from Bauang to point Km 275 + 500, then through a mountainous area for about 31 kilometers up to Baguio for a road elevation gap of about 1400 meters. Under the torrential rains peculiar to the Baguio area, slope failures have been experienced on this road,which was built on the steep mountain slope by cut opening.

The geology of this section is chiefly tuff, tuff breccia, conglomerate, limestone and sandstone.

The N 40° W orientation of tuffaceous sandstone revealed after collapse at point Km 281 + 500 suggests the possibility of collapse at other locations.

The whitish welded tuff rocks seen in the area from Km 288 + 300 to Km 291 + 000, are dense volcaniclastic rocks, but are highly weathered, have developed cracks and are falling in pieces.

The conglomerate seen at point Km 293 + 500, which is inclined 50° W and is perpendicular to the road. It is believed not to collapse, except for materials deposited on the conglomerate which will fall.

In the case of alternate strata of sandstone and mudstone seen from Km 294 + 100 to Km 294 + 400, the collapse of the sandstone due to the turning of the mudstones into soft clay by rainwater penetration will continue in the future.

Tuff and tuff breccia seen from Km 294 + 600 to 294 + 800 are not collapsing, but materials deposited on them are falling.

In the Naguilian Road section, conglomerate, tuff, and tuff breccia themselves are not collapsing in general, but mudstone in sandstone-mudstone alternating strata has turned into clay and is falling in large pieces. Materials deposited on these rocks are also falling.

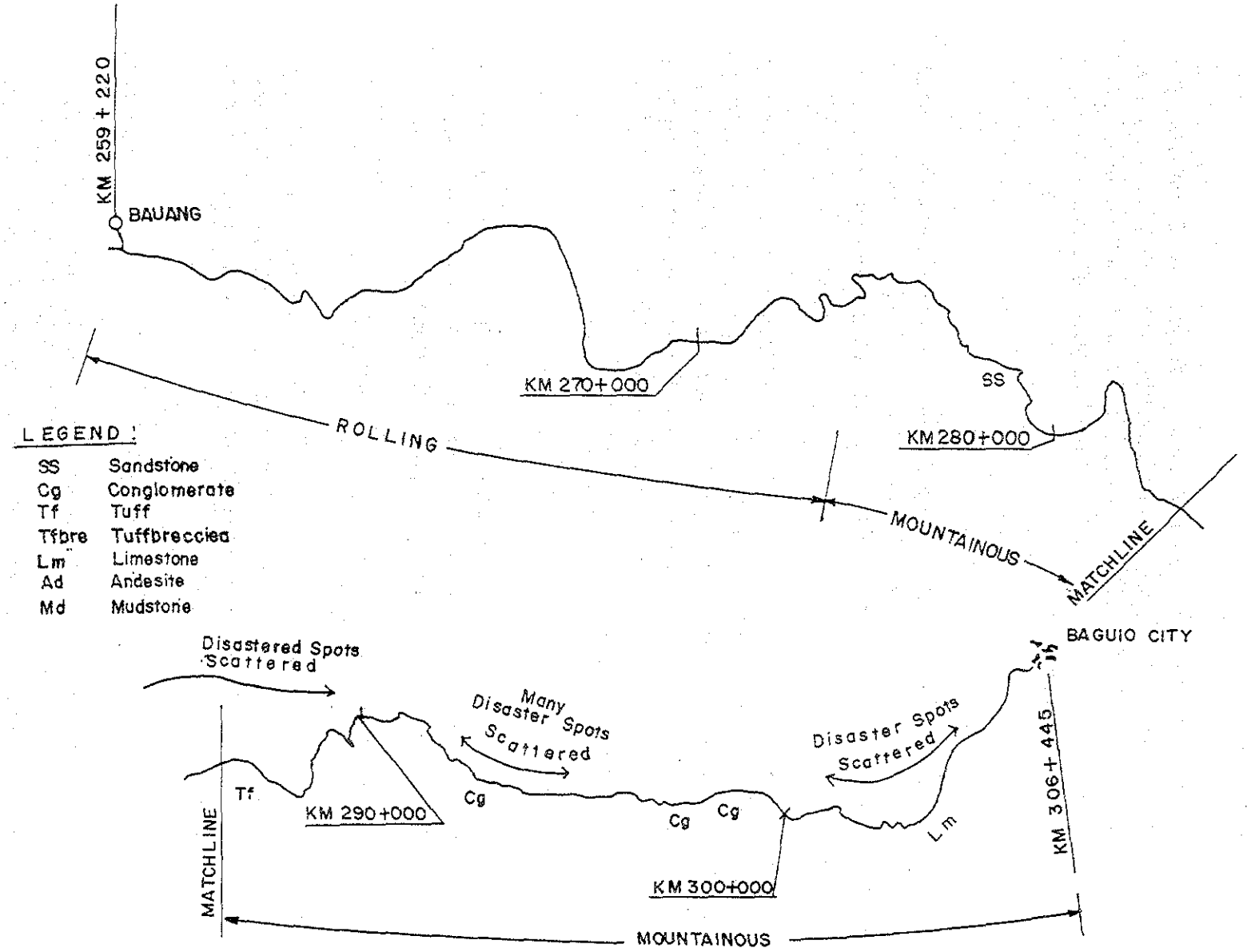


FIGURE 3.4-2 GEOLOGICAL LOCATION
NAGUILIAN ROAD L = 67.225 km

3.4.4 Traffic

1) Vehicle Traffic

Current traffic volume on the Naguilian Road is 1,239 veh./day. By vehicle type, cars, jeepneys, trucks and buses account for 38%, 33%, 22% and 7%, respectively (See Table 3.4-1). Jeepney is the predominant public transportation mode, while the share of buses is still very small. Vehicle O-D patterns were discussed in "3.1.2 Influence Area".

2) Passenger Traffic

A total of 10,071 passengers passes through this road daily. More than a half (53%) of the total passengers are transported by jeepneys. Buses are used by 3,335 passengers or 33% of the total. Table 3.4-2 shows the number of passengers by vehicle type.

Cars are used predominantly for "business" trips (38%), followed by "visiting relatives" trips (17%). Predominant trip purposes of jeepneys are "to/from school" trips (21%), "business" trips (19%) and "to/from work" trips (16%). Since Baguio City is the education center of Region I, many students use jeepneys for going to school. Trip purpose composition of bus passengers shows almost same pattern as jeepney passengers (see Figure 3.4-3).

3) Commodity Flow

A total of 1,368 tons of commodities is transported daily through this road. Of the total, 46% (or 629 tons) are transported from Baguio to La Union and Ilocos Provinces, while 54% (or 739 tons) are in the opposite direction.

Commodity Flow From Baguio to La Union/Ilocos: 629 tons

Commodity traffic generated in Baguio has one huge destination which is San Fernando, La Union. San Fernando, La Union alone attracts 96% (or 602 tons) of commodities. This is because 513 tons of copper ores are transported daily to San Fernando port.

Commodity Flow From La Union/Ilocos to Baguio: 739 tons

There are two predominant commodity traffic generating sources. The biggest is San Fernando, La Union which generates 51% (or 379 tons) of commodities. The second is Bauang, La Union which generates 39% (or 291 tons) of commodities.

TABLE 3.4-1 TRAFFIC VOLUME BY VEHICLE TYPE: 1984
NAGUILIAN ROAD

	Traffic Volume (Veh./day)	Share (%)
Car	465	38
Jeepney	415	33
PUV Bus	85	7
Sub-Total	500	40
Truck	274	22
Total	1,239	100

Source: The Study Team.

TABLE 3.4-2 NUMBER OF PASSENGER BY VEHICLE TYPE: 1984
NAGUILIAN ROAD

	Passenger (Pass./day)	Share (%)
Car	1,382	14
Jeepney	5,354	53
Bus	3,335	33
Total	10,071	100

Source: The Study Team.

Major commodities are building and construction materials (mainly cement, gravel and sand) which share 46% (or 338 tons), mineral oil products (mainly gasoline) which account for 31% (or 226 tons) and manufactured foodstuffs (soft drinks, beer, etc.) which share 17% (or 125 tons).

4) Type of Trucks

Of the 274 trucks passing through the Naguilian Road daily, 164 vehicles (60 percent) are two-axle trucks and 110 vehicles (40 percent) are three-axle trucks.

The average weight of cargoes per loaded truck is 8.4 tons/truck. However, trucks transporting copper ores or construction materials carry more than 10 tons of load per truck.

Of the total trucks, 41% are empty of cargo.

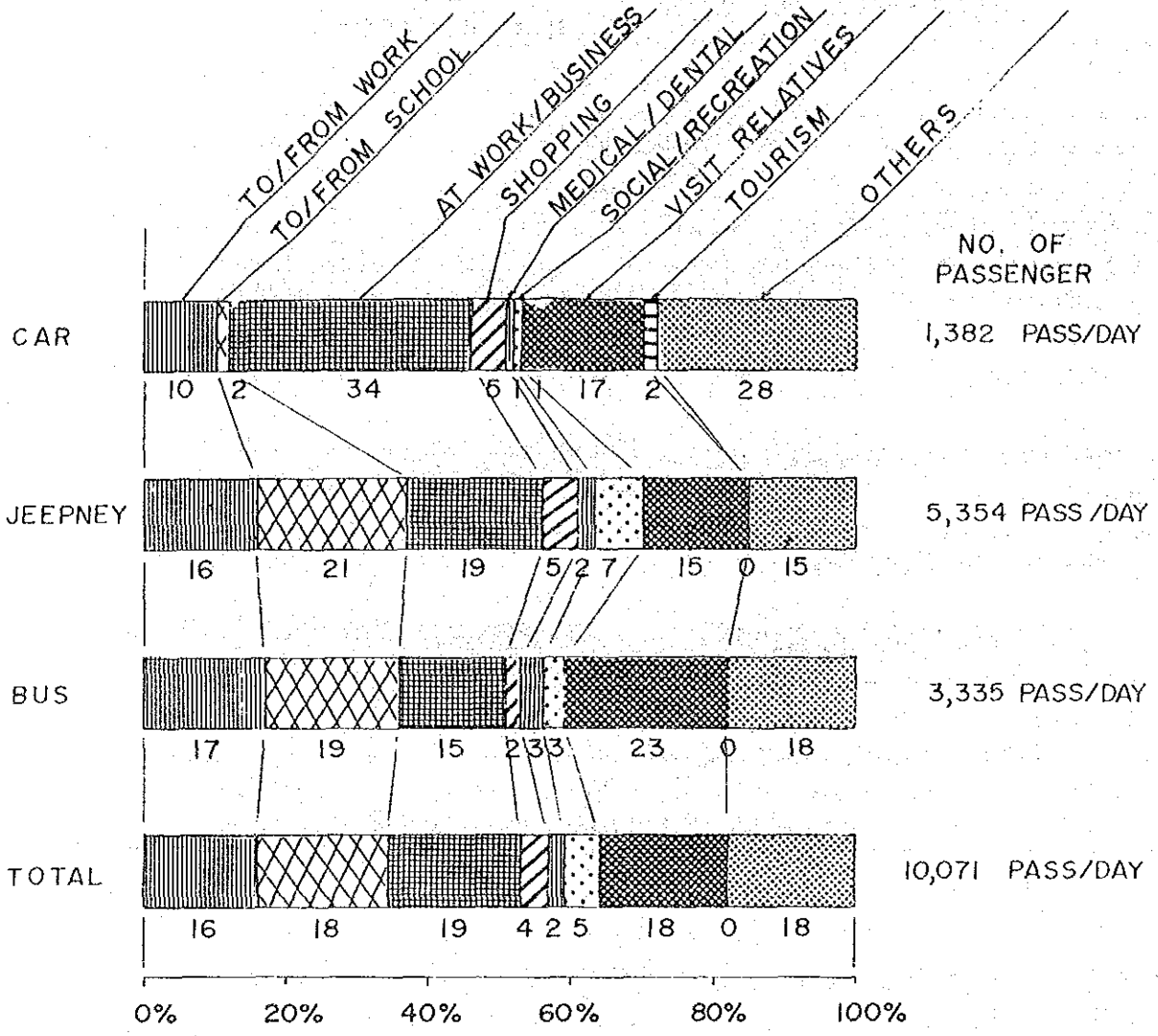


FIGURE 3.4-3 PURPOSE COMPOSITION OF PASSENGERS AT NAGUILIAN ROAD

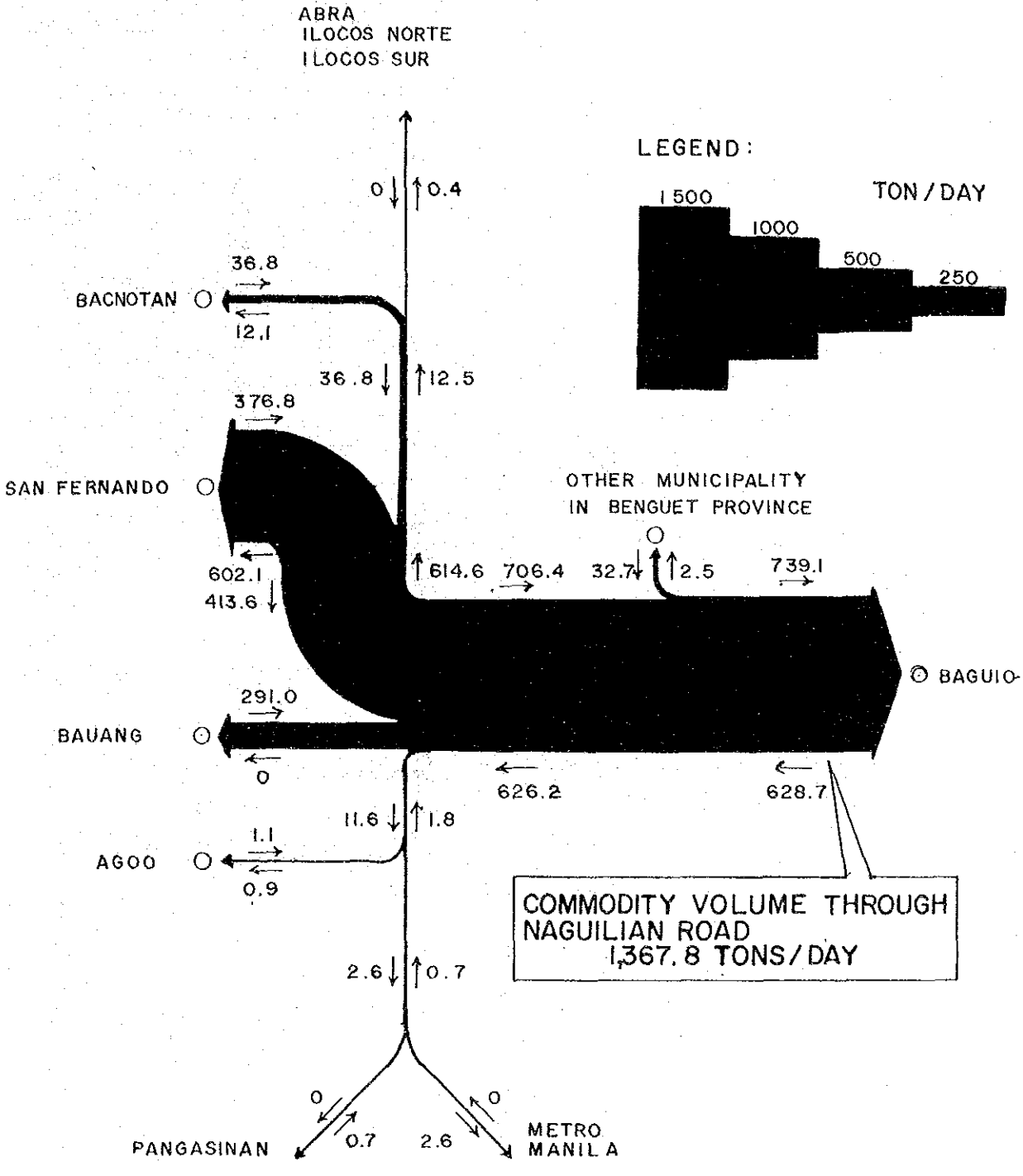


FIGURE 3.4-4 COMMODITY FLOW IN 1984 THROUGH NAGUILIAN ROAD (TOTAL COMMODITY)

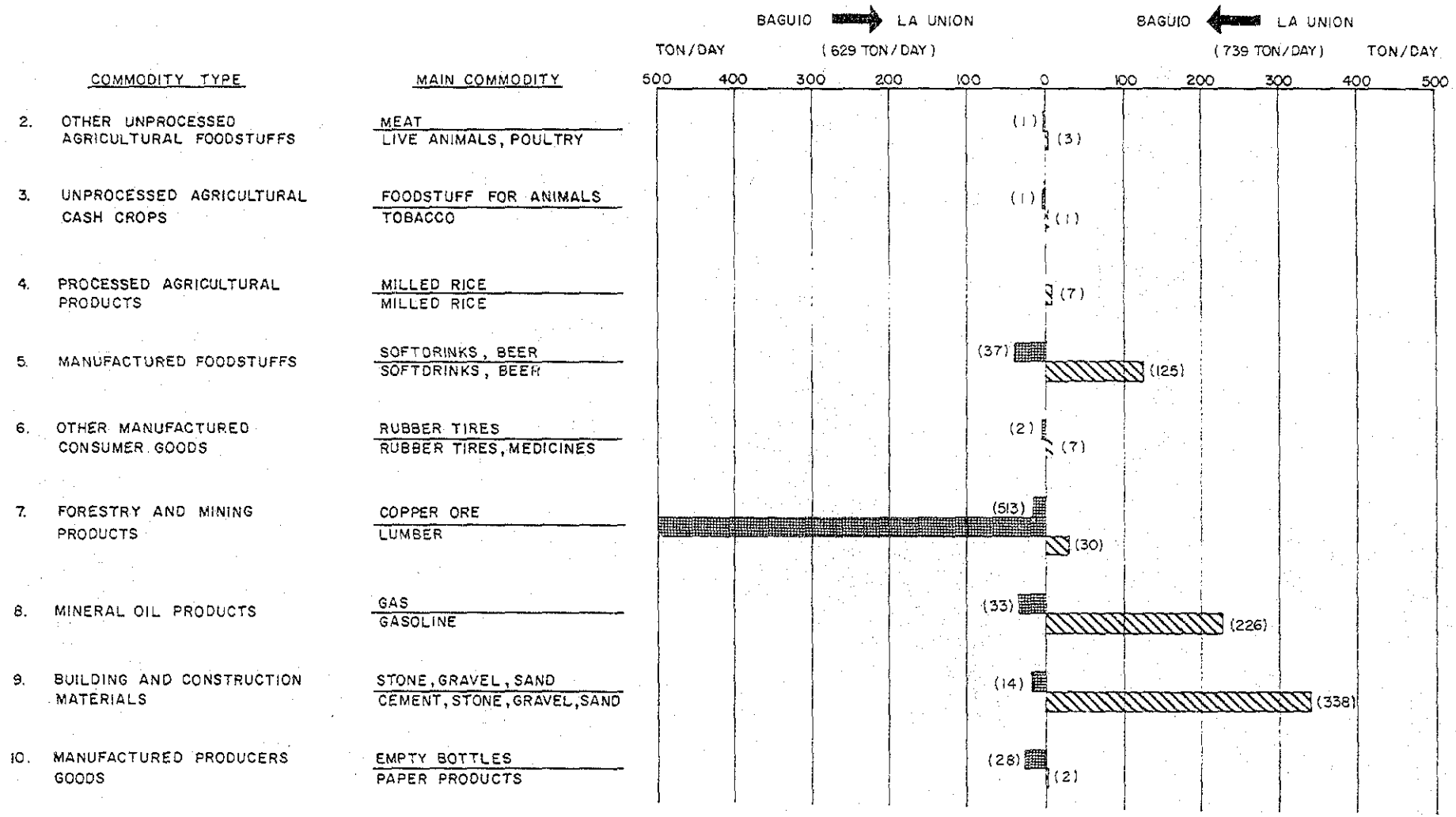


FIGURE 3.4-5 COMMODITY FLOW IN NAGUILIAN ROAD

3.4.5 Socio-economic Features

The Nagulilan road serves as an alternative route leading to Metro Manila in case the Kennon Road is closed. Aside from this, it also serves as the road linkage between Baguio City and the other provinces of Region I such as La Union and Ilocos provinces. It has a direct influence on Benguet Province and Region I as a whole.

1) Population

Based on the Census of Population and Housing, the population of Region I was 3,269,391 in 1975 and rose to 3,540,983 in 1980 for an increase of 271,502 in a span of five years. Of this regional total, Baguio City and La Union's population in 1975 was 97,449 and 414,635, which rose to 119,009 and 452,578 in 1980, respectively. Among the seven provinces, La Union ranked second in terms of total population with 452,570 behind Pangasinan with 1,636,057, while Benguet ranks fifth with 354,751 Baguio City accounts for more than one third of the population of Benguet Province.

Given the land area of Region I of about 21,568.4 sq. km. and the 1980 population of 3,540,893, the population density of the region was about 164.3 persons per sq. km. For La Union province, the land area is about 1,493.1 sq. km. distributed among 452,578 inhabitants in 1980 giving a provincial population density of 303.1 persons per. sq. km., much higher than the regional density. Baguio City, which is the most densely populated area in the province of Benguiet, has a present density of 2,433 persons per sq. km.

2) Economy

The economic performance of the region could be analyzed in terms of the gross regional domestic product (GRDP) which showed improvement during the period 1980-1983. From a level of ₱3.43 million in 1980, GRDP (at 1972 prices) rose to ₱3.79 million in 1983.

By industry, the service sector generally dominated the region's economy throughout the period 1980-1983. In 1983, the service sector had a share of 39% of the total GRDP whereas the agriculture sector had 38%.

3) Crop Production

Rice, corn, coconut, tobacco, root crops, fruit trees, sugarcane and vegetables are the crops planted in Region I.

The total area planted to all crops was registered at 468,065 hectares in 1983. Rice corn and vegetables occupied the largest area accounting for 91.06 percent of the total area planted. In La Union, rice and corn are the leading crops in terms of hectarage while vegetable is the leading crop in Baguio. The total vegetable crop area planted in Baguio City in 1982 was estimated at 159 hectares followed by rice, rootcrops and fruit trees involving an area coverage of 94 hectares.

In terms of production a total of 853,720 metric tons of palay was produced in 1983. Vegetables registered a yield of 108,697 metric tons. Corn ranks third with a yield of 60,265 metric tons.

CHAPTER 4 TRAFFIC DEMAND FORECAST

CHAPTER 4 TRAFFIC DEMAND FORECAST

4.1 PLANNING FRAMEWORK

4.1.1 Development Policies and Stragegies

1) National Development

The previous 5-Year Philippine Development Plan 1983-1987 was updated for 1984-1987 in order to speed up the country's recovery considering existing economic constraints due to some unexpected set-backs in the domestic economy. The objective of the said plan follows the development goals set forth in the previous plan which calls for sustainable economic growth through national productivity and a self-reliance program.

The recovery program will be pursued through productivity programs such as the Kilusang Sariling Sikap (Movement for Self-Reliance) and Kilusang Kabuhayan at Kaunlaran (Movement for Livelihood and Progress) to generate more livelihood activities, jobs, food supply, foreign exchange receipts, and to meet the other needs of the people and industries.

2) Regional Development

In view of the predominance of agriculture in the regions, the plan's principal objective is to pursue the development of all regions based on a balanced agro-industrial development strategy. Efforts will be directed toward modernizing agriculture in order to increase the sector's productivity while at the same time encouraging agro-based small and medium industries. This approach will strengthen the linkages between agriculture and industry and also integrate the socio-economic activities between rural and urban areas, thus reducing disparities in development. The plan's thrust also focuses on the enhancement of a balanced growth of sectors and regions as well as of urban and rural areas. This will in turn result in a balanced spatial distribution of people between rural and urban areas.

4.1.2 Population Forecast

1) National Level

From a total of 48.3 million persons in 1980, the total population is expected to grow to 75.2 million by year 2000 and 92.4 million by year 2015, the end of the planning period for the study. Likewise, national population density is also expected to increase, from 160.3 persons per km^2 in 1980 to reach 250.7 in the year 2000 and 308.1 in the year 2015. National population growth rate, on the other hand, is expected to continuously decline throughout the planning period. From an annual growth rate of 2.7% in the past ten-year period (1970-1980), it is ex-

TABLE 4.1-1 FUTURE POPULATIONS 1980-2015 (MEDIUM ASSUMPTION)

	Population[1] (In Thousand)						Annual Growth (%)				
	1980	1984[2]	1990	2000	2010	2015	1980-1990	1984-1990	1990-2000	2000-2015	1980-2015
N C R	5926	6672	7974	9895	11481	12152	3.0	3.0	2.2	1.4	2.1
Region I - Ilocos	3541	3824	4292	5073	5721	5995	1.9	1.9	1.7	1.1	1.5
Region II - Cagayan Valley	2215	2448	2845	3518	4116	4383	2.5	2.5	2.1	1.5	2.0
Region III - Central Luzon	4803	5300	6142	7529	8713	9215	2.5	2.5	2.1	1.4	1.9
Region IV - Southern Tagalog	6119	6847	8105	10188	12031	12831	2.9	2.9	2.3	1.5	2.1
Region V - Bicol	3477	3816	4388	5355	6212	6597	2.4	2.4	2.0	1.4	1.8
Region VI - Western Visayas	4526	4953	5672	6800	7728	8119	2.3	2.3	1.8	1.2	1.7
Region VII - Central Visayas	3787	4099	4616	5441	6131	6425	2.0	2.0	1.7	1.1	1.5
Region VIII - Eastern Visayas	2799	3008	3360	3973	4518	4766	1.8	1.8	1.7	1.2	1.5
Region IX - Western Mindanao	2528	2776	3195	3874	447	4735	2.4	2.4	1.9	1.3	1.8
Region X - Northern Mindanao	2759	3074	3616	4540	5405	5793	2.7	2.7	2.3	1.6	2.1
Region XI - Southern Mindanao	3347	3712	4334	5364	6304	6728	2.6	2.6	2.2	1.5	2.0
Region XII - Central Mindanao	2271	2519	2942	3675	4368	4690	2.6	2.6	2.2	1.6	2.1
P h i l i p p i n e s	48098	53048	61480	75224	87206	92430	2.5	2.5	2.0	1.4	1.9

Note: [1] Based on latest 1980 census.

[2] Values for 1984 are interpolated.

Source: National Census and Statistics Office (NCSO).

pected to decline to 1.4% in the period 2000-2015. This is as a consequence of the continuing efforts of the government to reduce population growth in order to maintain a population level conducive to national welfare especially during this time of economic difficulties.

2) Regional Level

Large disparities among population groups and regions resulted to wide welfare gaps and unequal distribution of the fruits of development among regions in the past years. In view of this, the government formulated programs aimed at balanced regional development and favorable population distribution through development measures such as harnessing agricultural resources particularly in undeveloped areas, regional dispersal of industries and lowering population growth. The NCSO regional population projection conforms with this development strategy as shown in Table 4.1-1. All the regions were projected to expand at slowly declining rates of growth.

4.1.3 Economic Framework

GNP and GRDP

The original Five-Year Philippine Development Plan 1983-1987 was updated to 1984-1987 in consideration of the existing economic constraints. The country's actual real Gross National Product dropped down to a -5.5% growth rate in 1984 as a result of economic difficulties faced by the country due to the tight financial bind of early 1980's. The debt service capacity of the country underwent stress and strains from both the high cost of borrowings as well as from the difficulty of earning foreign exchange.

Within the remaining three years of the Plan period, the economy is expected to move closer to the normal economic growth path, real gross national product is expected to post at an average growth of from 1.5% in 1985 to 4.0% in 1987 as reflected by the planned efforts to stabilize the external payments position and strengthen the financial system. By 1990 the normal economic growth of 6.0% is expected to be attained. The growth rate of 6.0% per annum was assumed by the study team to be constant up to the year 2015 based on the envisioned realization of the expected stabilization and economic recovery process sustained in the plan.

Likewise, the real Gross Domestic Product (GDP) is expected to follow the future national economic development performance. From ₱100.1 million in 1983, real GDP is expected to expand to ₱212.9 million in the year 2000 and to ₱496.0 million in the year 2015, accounting for an average growth of 4.0 percent for the period 1984-1990 and a constant 5.8 percent growth up to 2015.

By region, GRDP projections conform with regional development targets in the Plan. The undeveloped regions are projected to expand at higher growth rates reflecting the government's policy of higher concentration of development efforts to least developed regions. NCR, the most developed region had the lowest projected growth of 2.8% in 1984-1990 period. The next developed region, Region IV had the second lowest growth rate of 3.9%. The highest projected growth rate went to Regions Vand VIII, the two least developed regions, with a respective 6.2% growth rate in the same period. Region II, the other undeveloped region, had 5.9% growth rate. The other regions, which exhibited average growth performances in the past, are expected to expand at an average growth of 4.4%.

The annual breakdown of GNP and GDP growth projections are shown in Table 4.1-2. The GRDP projections are shown in Table 4.1-3.

TABLE 4.1–2 FUTURE ECONOMIC GROWTH RATE

	Annual Growth of GNP and GDP (%)	
	GNP	GDP
1984	-5.5	-4.5
1985	1.5	2.5
1986	3.0	2.9
1987	4.0	3.5
1988	5.0	4.5
1989	5.5	5.0
1990-2015	6.0	5.8

TABLE 4.1-3 GNP AND GRDP PROJECTIONS

	GNP and GRDP (Million Pesos at 1972 Price)						Annual Growth Rate (%)				
	1980	1984	1990	2000	2010	2015	1980/1990	1984/1990	1990/2000	2000/2010	2010/2015
G N P	92,629	94,545	120,705	216,164	387,116	518,049	2.68	4.16	6.00	6.00	6.00
G D P	92,637	95,613	121,168	212,933	374,197	496,053	2.72	4.03	5.80	5.80	5.80
N C R	29,224	30,883	36,350	59,087	95,396	121,104	2.21	2.75	4.98	4.91	4.89
Region I	3,433	3,633	4,726	8,625	15,740	21,263	3.25	4.48	6.20	6.20	6.20
II	2,615	2,486	3,514	6,601	12,349	16,966	3.00	5.94	6.51	6.46	6.56
III	7,783	8,318	10,663	18,738	32,929	43,653	3.20	4.23	5.80	5.80	5.80
IV	12,951	13,290	16,721	29,598	52,013	68,951	2.59	3.90	5.88	5.80	5.80
V	3,161	2,964	4,241	7,878	14,594	19,842	2.98	6.15	6.39	6.36	6.34
VIII	2,309	2,199	3,150	5,962	11,600	16,270	3.15	6.17	6.59	6.88	7.00
Other Region	31,161	31,840	41,803	76,444	139,576	188,004	2.98	4.64	6.22	6.21	6.14

4.2 TRAFFIC DEMAND FORECAST

4.2.1 Methodology

1) Target Year

The target year is established by taking into account the opening year of the project and the project life. With 1990, 2000, 2010 and 2015 as target years, future traffic volumes are forecasted based on current origin-destination data and future socio-economic frameworks.

2) Outline

Figure 4.2-1 shows the traffic forecast procedures. An analysis of current traffic behaviors in each section indicates the following points.

- Business purpose accounts for a high share of trip purpose for car passengers, while private purpose accounts for a high share of trip purpose for public transportation passengers. Cars tend to be used for higher value added trips than public transportation (jeepney and bus).

- Of the public transportation, jeepneys and buses show different traffic distribution patterns. The trip length of bus is longer than the trip length of jeepney.

- There are large differences in the volumes and items of commodity flow through each section.

- There are large differences in loading factors in each section, reflecting the differences in the physical conditions and the functions of roads.

From the above, making separate traffic forecasts for cars, for jeepneys and for buses are judged to be appropriate. As for truck traffic, it is judged appropriate to first forecast commodity flow by item and then convert these into truck trips using the loading factors.

a) Car Traffic

Car traffic is characterized by the high share of business purpose trips. In the Lucena-Calauag Section, the Allen-Calbayog Section and the Naguilian Road, business purpose trips represent 57 percent, 29 percent and 34 percent, respectively, of all car trips. Business purpose trips are assumed to increase in proportion to the region's economic growth as measured by GRDP.

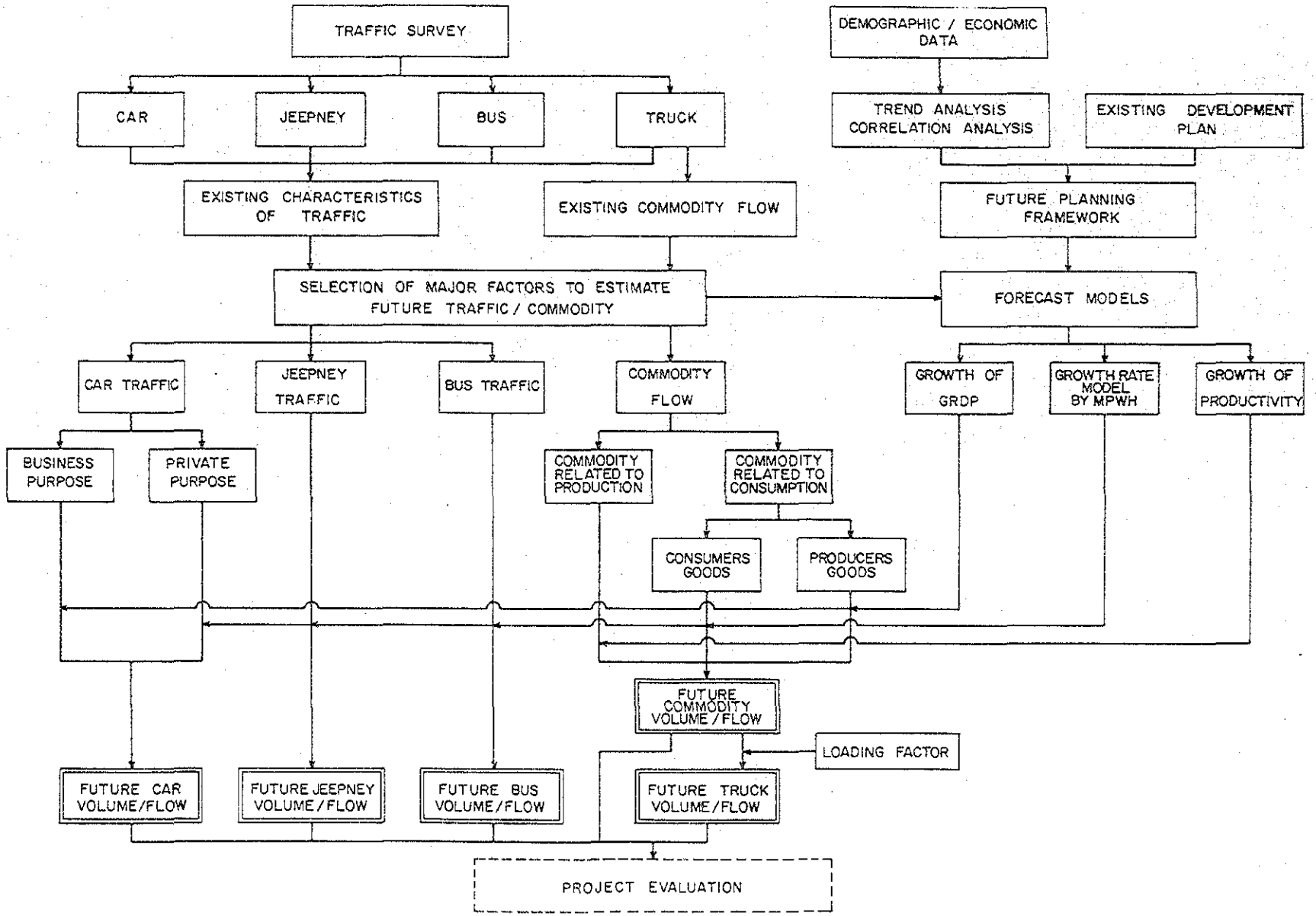


FIGURE 4.2-1 PROCEDURE OF FUTURE TRAFFIC FORECAST

Private purpose car trips, as represented by "visit relatives", reflects the trip-maker's intentions, and the frequency is in proportion to the trip-maker's ability to pay traffic costs. The forecast model recommended in MPWH's planning manual uses the trip-maker's ability to pay traffic costs as a factor, so the model is used for forecasting private purpose trips in the Study.

b) Public Transportation (Jeepney and Bus)

Most of public transportation trips are private purpose trips. In the Lucena-Calauag Section, the Allen-Calbayog Section and the Nagullian Road, private purpose trips represent 77 percent, 81 percent and 83 percent, respectively, of all public transportation trips. Hence, for the same reason as given for car traffic above, MPWH's forecast model is used to forecast future public transportation traffic.

c) Trucks

Commodities transported by trucks are divided into those produced in the area and those to be consumed in the area. Future volume of produced commodities is forecasted on the basis of the growth of productivity targeted in the Five-Year Development Plan and Regional Development Plan. (refer to Apendix 4.1-1).

Consumption commodities can be divided into consumer's goods, (mainly processed food), producer's goods (such as construction materials and gasoline). The former is assumed to correspond to personal income growth and the latter to GRDP which is the indicator of regional economic vitality.

Future volumes of commodity flow are converted into truck traffic volumes using the loading factors established on the basis of the traffic surveys.

3) Forecast Model

The Ministry of Public Works and Highways (MPWH), in the "Highway Planning Manual", recomends the growth rate model as a method of forecasting future traffic volumes. Use of the growth rate model in rural road planning rather than urban road network planning is indicated. The model is expressed by the following formula:

$$TGR = \left\{ \left(\frac{I \times E}{100} + 1 \right) CP - 1 \right\} \times 100$$

Where:

TGR is the traffic (or commodity) growth rate (in percent per annum,
E is the transport demand (or good consumption income elasttcity),
I is the growth rate (in percent) for per capita income in constant prices, and
CP is the compound population growth rate per annum.

Factors used in the model are population growth, per capita income growth and elasticity. Elasticity is defined as traffic demand-income elasticity when forecasting car, jeepney or bus and as goods consumption-income elasticity when forecasting commodity flow.

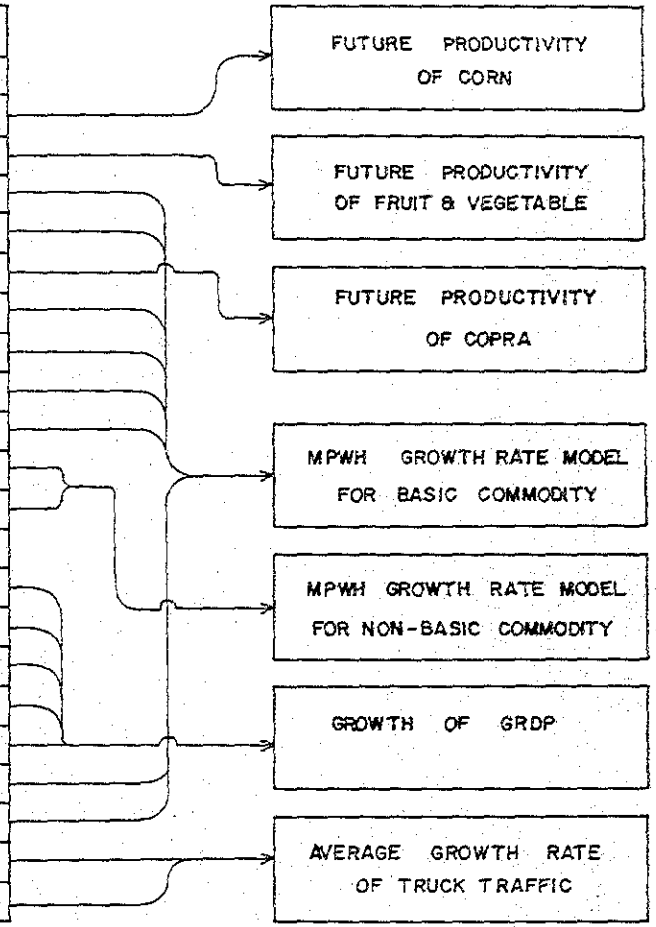
The planning manual indicated that 1.8 for cars and 1.1 for public transportation are appropriate traffic demand income elasticity values, and that these elasticity values should be adjusted to changes in fuel prices. In the Study, assuming that fuel prices will have strong impact on cars, elasticity value is reduced by 20 percent and established as 1.5.

The planning manual does not give any actual values for goods consumption-income elasticity. In the Stage-I Study, the relationship between per capita income growth and goods consumption growth has been analyzed from the results of the 1975 household income statistics, and the goods consumption-income elasticity factor has been established as 0.8 for basic commodities and 1.4 for non-basic commodities. This values are used for the goods consumption-income elasticity factor in the Study.

TABLE 4.2-1 TRANSPORT DEMAND (OR GOODS CONSUMPTION) INCOME ELASTICITY

Vehicle Type (or Commodity Type)		Elasticity
Car		1.5
PUV (Bus, Jeepney)		1.1
Truck	Basic Commodity	0.8
	Non-Basic Commodity	1.4

COMMODITY TYPE	DIRECTION OF FLOW	MAIN COMMODITY	COMMODITY VOLUME (TON/DAY)
UNPROCESSED CEREALS	1 1/	—	0
	2 2/	MAIZE (UNMILLED CORN)	68
OTHER UNPROCESSED AGRICULTURAL FOODSTUFFS	1	FRUIT AND VEGETABLES	10
	2	FISH, SEAFOODS, LIVE ANIMALS	385
UNPROCESSED AGRICULTURAL CASH CROPS	1	FOODSTUFF FOR ANIMALS	83
	2	COPRA	920
PROCESSED AGRICULTURAL PRODUCTS	1	MILLED RICE	133
	2	VEGETABLE OIL AND FATS	100
MANUFACTURED FOODSTUFFS	1	GROCERIES, SOFTDRINKS, BEER	763
	2	GROCERIES, SOFTDRINKS, BEER	127
OTHER MANUFACTURED CONSUMERS GOODS	1	APPLIANCES, HOUSEHOLD GOODS	111
	2	COTTAGE INDUSTRY PRODUCTS	113
FORESTRY AND MINING PRODUCTS	1	—	0
	2	LUMBER, CHARCOAL, FIREWOOD	50
MINERAL OIL PRODUCTS	1	GASOLINE	90
	2	INDUSTRIAL FUELS	37
BUILDING AND CONSTRUCTION MATERIALS	1	CEMENT, STONE, GRAVEL, SAND	251
	2	STONE, GRAVEL, SAND	269
MANUFACTURED PRODUCERS GOODS	1	EMPTY BOTTLES, MACHINERY	45
	2	EMPTY BOTTLES, PAPER	170
EMPTY TRUCK	1	—	149 3/
	2	—	50 3/



SOURCE: THE STUDY TEAM

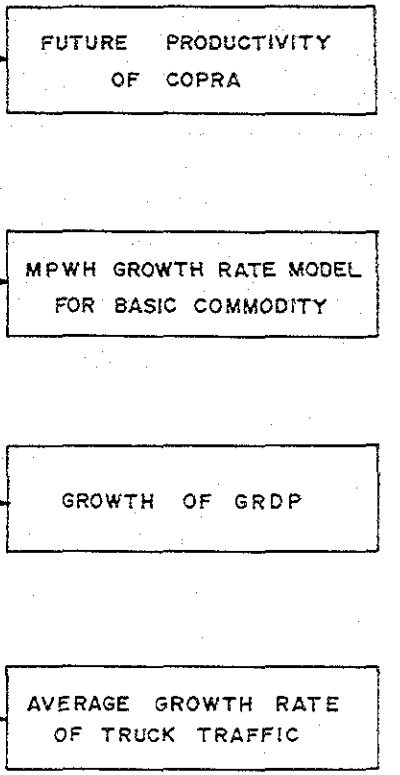
NOTE 1/: DIRECTION FROM METRO MANILA, LUCENA TO BICOL

2/: DIRECTION FROM BICOL TO LUCENA, METRO MANILA

3/: VEHICLE / DAY

FIGURE 4.2-2 FACTORS TO FORECAST FUTURE COMMODITY VOLUME IN LUCENA-CALAUAG SECTION

COMMODITY TYPE	DIRECTION OF FLOW	MAIN COMMODITY	COMMODITY VOLUME(TON/DAY)
UNPROCESSED CEREALS	1 1/	–	0
	2 2/	–	0
OTHER UNPROCESSED AGRICULTURAL FOODSTUFFS	1	–	0
	2	EGGS	1
UNPROCESSED AGRICULTURAL CASH CROPS	1	COPRA	37
	2	–	0
PROCESSED AGRICULTURAL PRODUCTS	1	MILLED RICE	22
	2	CEREAL MEALS AND FLOUR	16
MANUFACTURED FOODSTUFFS	1	SOFTDRINKS, BEER	10
	2	SOFTDRINKS , BEER	27
OTHER MANUFACTURED CONSUMERS GOODS	1	HOUSEHOLD GOODS	20
	2	TEXTILES	2
FORESTRY AND MINING PRODUCTS	1	–	0
	2	–	0
MINERAL OIL PRODUCTS	1	–	0
	2	GASOLINE	82
BUILDING AND CONSTRUCTION MATERIALS	1	–	0
	2	CEMENT,STEEL PRODUCT	12
MANUFACTURED PRODUCERS GOODS	1	PLASTIC MATERIALS	9
	2	–	0
EMPTY TRUCK	1	–	17 3/
	2	–	7 3/



SOURCE : THE STUDY TEAM

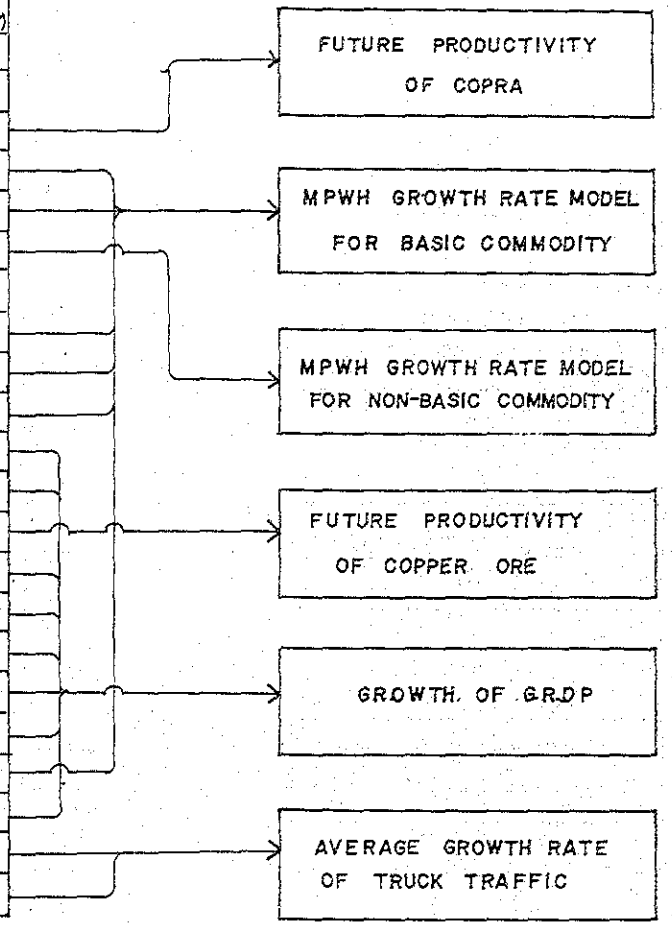
NOTE 1/ : DIRECTION FROM NORTHERN SAMAR TO CALBAYOG, LEYTE

2/ : DIRECTION FROM LEYTE, CALBAYOG TO NORTHERN SAMAR

3/ : VEHICLE / DAY

FIGURE 4.2-3 FACTORS TO FORECAST FUTURE COMMODITY VOLUME IN ALLEN-CALBAYOG SECTION

COMMODITY TYPE	DIRECTION OF FLOW	MAIN COMMODITY	COMMODITY VOLUME (TON/DAY)
UNPROCESSED CEREALS	1 1/	—	0
	2 2/	—	0
OTHER UNPROCESSED AGRICULTURAL FOODSTUFFS	1	MEAT	1
	2	LIVE ANIMALS, POULTRY	3
UNPROCESSED AGRICULTURAL CASH CROPS	1	FOODSTUFF FOR ANIMALS	1
	2	TOBACCO	1
PROCESSED AGRICULTURAL PRODUCTS	1	—	0
	2	MILLED RICE	7
MANUFACTURED FOODSTUFFS	1	SOFTDRINKS, BEER	37
	2	SOFTDRINKS, BEER	125
OTHER MANUFACTURED CONSUMERS GOODS	1	RUBBER TIRES	2
	2	RUBBER TIRES, MEDICINES	7
FORESTRY AND MINING PRODUCTS	1	COPPER ORE	513
	2	LUMBER	30
MINERAL OIL PRODUCTS	1	GAS	33
	2	GASOLINE	226
BUILDING AND CONSTRUCTION MATERIALS	1	STONE, GRAVEL, SAND	14
	2	CEMENT, STONE, GRAVEL, SAND	338
MANUFACTURED PRODUCERS GOODS	1	EMPTY BOTTLES	28
	2	PAPER PRODUCTS	2
EMPTY TRUCK	1	—	73 3/
	2	—	28 3/



SOURCE : THE STUDY TEAM

NOTE 1/ : DIRECTION FROM BAGUIO TO LA UNION

2/ : DIRECTION FROM LA UNION TO BAGUIO

3/ : VEHICLE / DAY

FIGURE 4.2-4 FACTORS TO FORECAST FUTURE COMMODITY VOLUME IN NAGUILIAN ROAD

4.2.2 Lucena-Calauag Section

1) Traffic Growth

The current traffic on the Lucena-Calauag Section is 1,822 vehicles/day. The average annual growth will be 4.8 percent during the period 1984-2015 wherein future traffic will reach 7,700 vehicles/day in the year 2015. Growth of traffic during the 1990s and thereafter is expected to be slightly higher than in the 1980s. This is based on the assumptions that the overall trend of the Philippine economy in the 1980s will be the decade for transition from economic instability to stability and that the economy will remain stable after 1990 (see Figure 4.2-5 and Table 4.2-2).

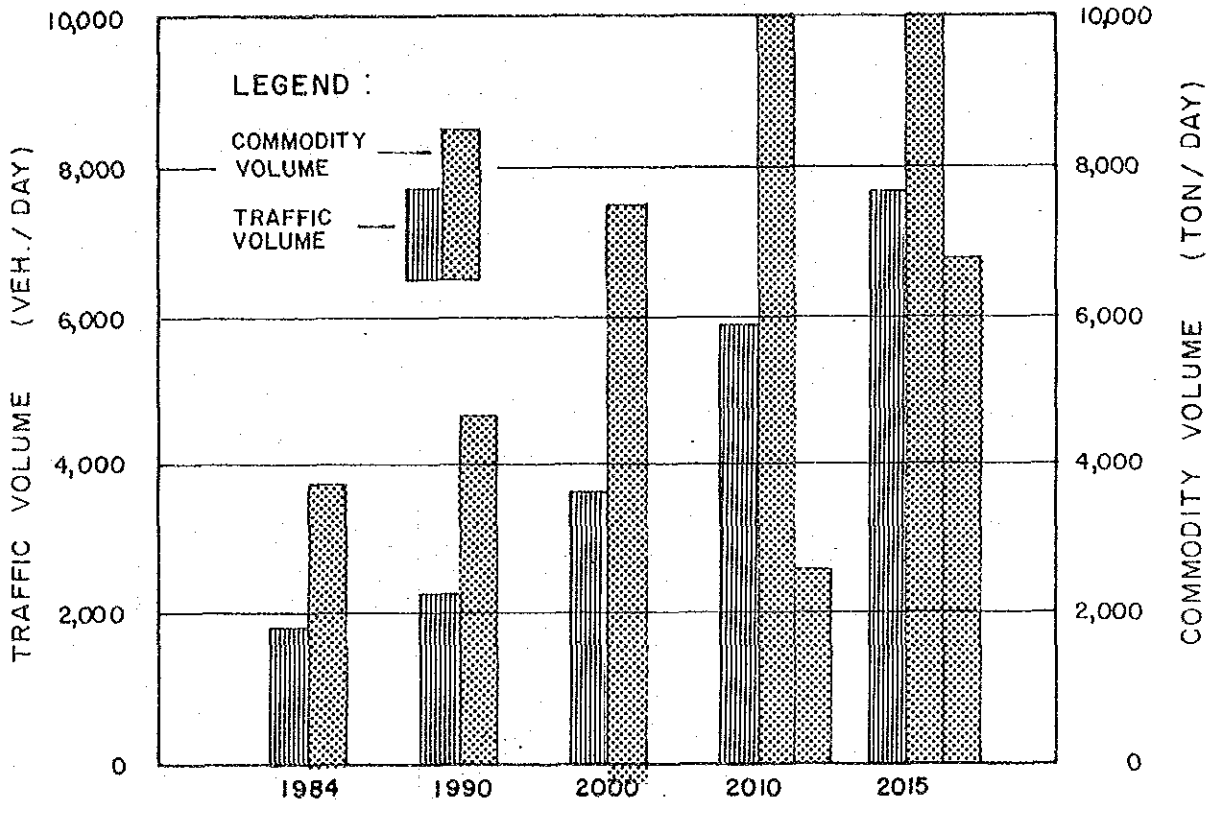


FIGURE 4.2-5 FUTURE TRAFFIC/COMMODITY VOLUME ON LUCENA-CALAUAG SECTION

TABLE 4.2-2 FUTURE TRAFFIC VOLUME ON LUCENA-CALAUAG SECTION

	Future Traffic Volume (Veh./Day)					Growth Rate (%)			
	1984	1990	2000	2010	2015	1984/1990	1990/2000	2000/2010	2010/1015
Car	498	633	1,101	1,930	2,544	4.1	5.7	5.8	5.7
Jeepney	115	132	203	295	362	2.3	4.4	3.8	4.2
Bus	512	617	929	1,375	1,666	3.2	4.2	4.0	3.9
Truck	697	872	1,391	2,333	3,130	3.9	4.8	5.3	6.0
Total	1,822	2,254	3,624	5,933	7,702	3.6	4.9	5.1	5.4

TABLE4.2-3 FUTURE COMMODITY VOLUME ON LUCENA-CALAUAG SECTION

	Future Commodity Volume (Ton/day)					Growth Rate (%)			
	1984	1990	2000	2010	2015	1984/1990	1990/2000	2000/2010	2010/2015
Type - 1	68	112	382	1,377	2,652	8.6	13.1	13.7	14.0
Type - 2	395	468	657	892	1,031	2.9	3.4	3.1	2.9
Type - 3	1,003	1,315	2,308	4,275	5,892	4.6	5.8	6.4	6.6
Type - 4	233	278	396	546	635	3.0	3.6	3.3	3.1
Type - 5	890	1,111	1,633	2,328	2,759	3.8	3.9	3.6	3.5
Type - 6	224	281	453	722	909	3.9	4.9	4.8	4.7
Type - 7	50	59	96	156	199	2.8	5.0	4.9	4.9
Type - 8	127	166	289	501	660	4.5	5.7	5.6	5.7
Type - 9	520	633	908	1,259	1,470	3.3	3.7	3.3	3.2
Type - 10	215	258	369	513	600	3.1	3.6	3.4	3.2
T o t a l	3,725	4,681	7,491	12,569	16,807	3.9	4.8	5.3	6.0

Note:

Type 1: Unprocessed Cereals
Type 2: Other Unprocessed Agricultural Foodstuffs
Type 3: Unprocessed Agricultural Cash Crops
Type 4: Processed Agricultural Products
Type 5: Manufactured Foodstuffs
Type 6: Other Manufactured Consumer's Goods
Type 7: Forestry and Mining Products
Type 8: Mineral Oil Products
Type 9: Building and Construction Materials
Type 10: Manufactured Product's Goods

Source: The Team

2) Commodity Flow

The current commodity flow of 3,725 tons/day will increase to 16,807 tons/day in the year 2015. The average annual growth will be 5.0 percent during the period of 1984-2015. For the commodity flow from Bicol side to Metro Manila side, the average annual growth of unprocessed cereals, such as maize, will be highest at 12.5 percent. This is followed by unprocessed agricultural cash crops, mainly copra, at 5.9 percent. In the other direction, growth of gasoline will be higher than other commodities, and it will be 5.5 percent.

The characteristic of the existing commodity flow through the Pagbilao-Atimonan Sub-section is that the primary products are transported from Bicol side to Metro Manila side and secondary products are transported in the opposite direction. This function of the section is expected to be strengthened over the years in stages (see Table 4.2-3).

4.2.3 Allen-Calbayog Section

1) Traffic Growth

Current traffic through the Allen-Calbayog Section is 328 vehicles/day. Average annual growth between 1984 and 2015 will be 5.3 percent and traffic in the year 2015 will be 1,600 vehicles/day (see Figure 4.2-6 and Table 4.2-4). Since the growth of car traffic is higher than that of other vehicle types, the share of car traffic in future will be greater. Public transportation traffic, on the other hand, will decrease its share in the future, both in vehicle traffic and in passenger traffic, however, over 80 percent of passenger transport on the Allen-Calbayog Section will still rely on the public transportation in the year 2015.

2) Commodity Flow

Commodity flow through the Allen-Calbayog Section is currently 238 tons/day. Average annual growth during the period of 1984-2015 will be 5.5 percent and 1,245 tons/day will be transported through the section in the year 2015.

The share of foodstuffs will decrease, while the share of mineral oil products such as gasoline and construction materials will increase. (see Table 4.2-5).

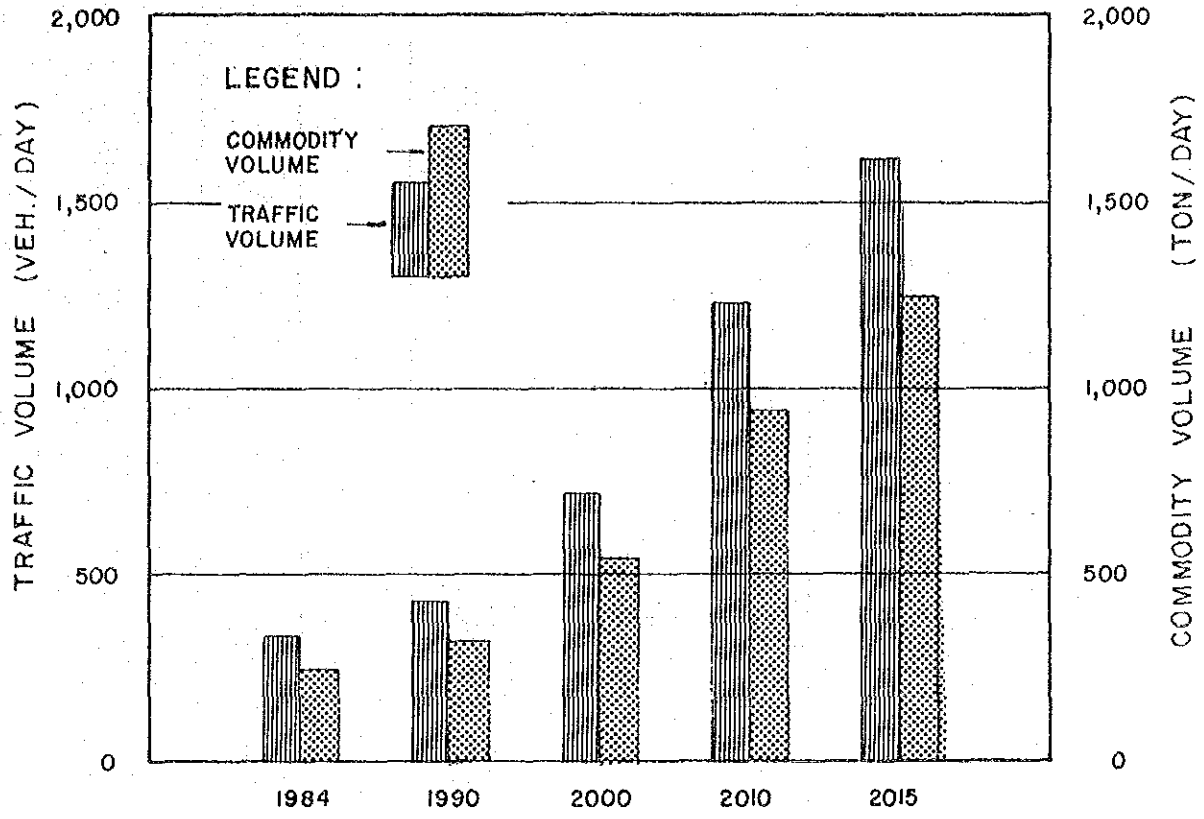


FIGURE 4.2-6 FUTURE TRAFFIC/COMMODITY VOLUME ON ALLEN-CALBAYOG SECTION

TABLE 4.2-4 FUTURE TRAFFIC VOLUME ON ALLEN-CALBAYOG SECTION

	Future Traffic Volume (Veh./Day)					Growth Rate (%)			
	1984	1990	2000	2010	2015	1984/1990	1990/2000	2000/2010	2010/2015
Car	120	156	285	529	723	4.5	6.2	6.4	6.4
Jeepney	85	104	164	254	318	3.4	4.7	4.5	4.6
Bus	50	70	110	168	205	5.8	4.6	4.3	4.1
Truck	73	95	159	276	365	4.9	5.4	5.7	5.9
Total	328	425	718	1,227	1,611	4.4	5.4	5.5	5.6

TABLE 4.2-5 FUTURE COMMODITY VOLUME ON ALLEN-CALBAYOG SECTION

	Future Commodity Volume (Ton/day)					Growth Rate (%)			
	1984	1990	2000	2010	2015	1984/1990	1990/2000	2000/2010	2010/2015
Type - 1	-	-	-	-	-	-	-	-	-
Type - 2	1	2	2	3	4	3.8	3.9	3.5	3.6
Type - 3	37	51	87	153	203	5.2	5.5	5.8	5.9
Type - 4	38	47	68	97	115	3.5	3.7	3.6	3.6
Type - 5	37	45	65	93	110	3.6	3.7	3.6	3.5
Type - 6	22	27	38	54	65	3.5	3.7	3.6	3.5
Type - 7	-	-	-	-	-	-	-	-	-
Type - 8	82	117	224	434	609	6.2	6.6	6.9	7.0
Type - 9	12	17	31	61	86	6.2	6.6	6.9	7.0
Type - 10	9	12	21	39	53	5.3	5.9	6.2	6.4
T o t a l	238	318	536	934	1,245	4.9	5.4	5.7	5.9

Note:

Type 1: Unprocessed Cereals
Type 2: Other Unprocessed Agricultural Foodstuffs
Type 3: Unprocessed Agricultural Cash Crops
Type 4: Processed Agricultural Products
Type 5: Manufactured Foodstuffs
Type 6: Other Manufactured Consumer's Goods
Type 7: Forestry and Mining Products
Type 8: Mineral Oil Products
Type 9: Building and Construction Materials
Type 10: Manufactured Product's Goods

Source: The Team

4.2.4 Naguilian Road

1) Traffic Growth

The current traffic on the Naguilian Road is 1,239 vehicles/day. Average annual growth during 1984 to 2015 will be 5.2 percent and traffic in the year 2015 will reach 6,000 vehicles/day. The traffic capacity of the Naguilian Road is rather small compared to ordinary two-lane roads due to its narrow roadway width and steep vertical gradient. Traffic volume of 6,000 vehicles/day in 2015 will be close to the maximum traffic the road can handle.

The growth of truck traffic is highest at 5.7 percent in the Naguilian Road. This is followed by car traffic at 5.6 percent, and public transportation traffic at 4.5 percent (see Figure 4.2-7 and Table 4.2-6).

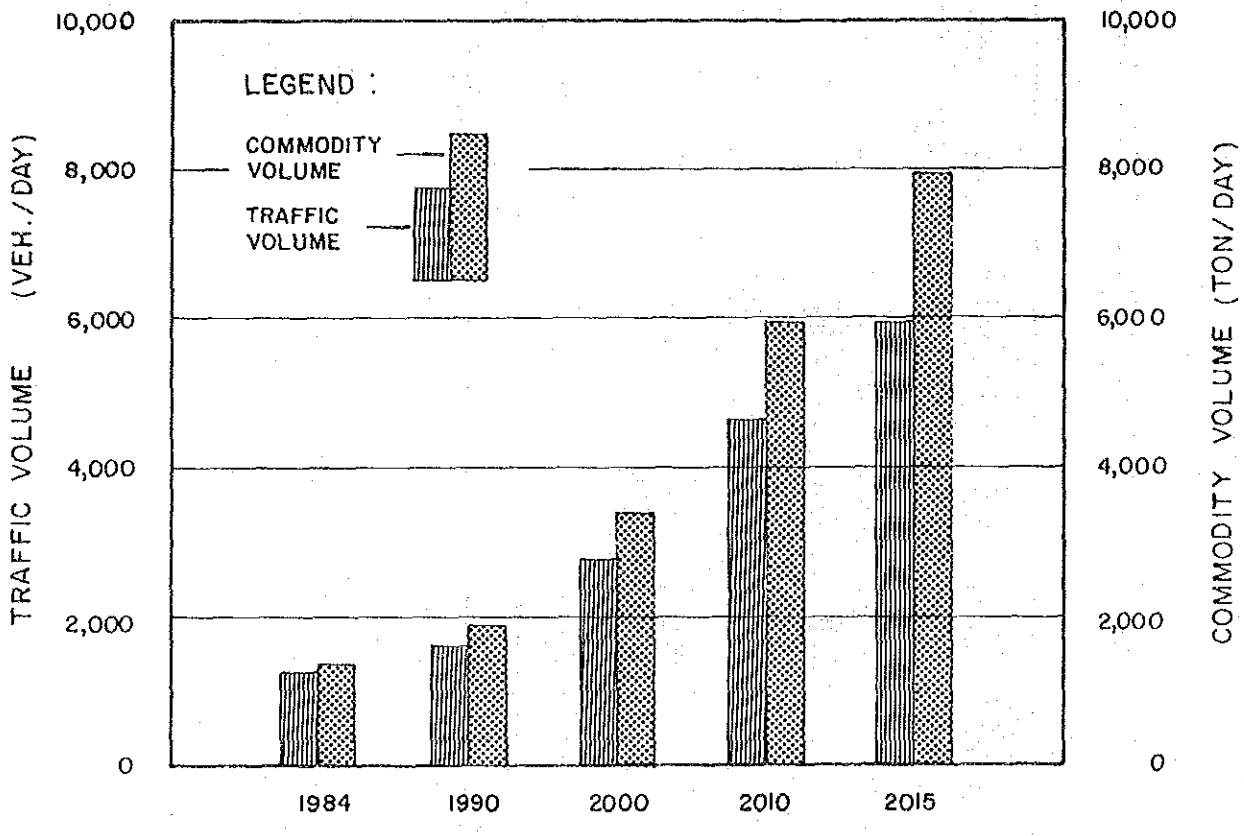


FIGURE 4.2-7 FUTURE TRAFFIC/COMMODITY VOLUME ON NAGUILIAN ROAD

2) Commodity Flow

The current commodity flow of 1,368 tons/day will increase to 7,935 tons/day in the year 2015. Average annual growth, at 5.8 percent, will be the highest of all Study Sections.

The share of copper, a valuable export item, to total commodity flow will increase from 40 percent in 1984 to 48 percent in the year 2015. On the other hand, the share of foodstuffs will decrease (see Table 4.2-7).

TABLE 4.2-6 FUTURE TRAFFIC VOLUME ON NAGUILIAN ROAD

	Future Traffic Volume (Veh./Day)					Growth Rate (%)			
	1984	1990	2000	2010	2015	1984/1990	1990/2000	2000/2010	2010/2015
Car	465	595	1,064	1,880	2,496	4.2	6.0	5.9	5.8
Jeepney	415	526	841	1,301	1,609	4.0	4.8	4.5	4.3
Bus	85	108	172	265	327	4.1	4.8	4.4	4.3
Truck	274	368	649	1,151	1,533	5.4	5.9	5.9	6.0
Total	1,239	1,597	2,726	4,597	5,965	4.3	5.5	5.4	5.3

TABLE 4.2-7 FUTURE COMMODITY VOLUME ON NAGUILIAN ROAD

	Future Commodity Volume (Ton/day)					Growth Rate (%)			
	1984	1990	2000	2010	2015	1984/1990	1990/2000	2000/2010	2010/2015
Type - 1	-	-	-	-	-	-	-	-	-
Type - 2	4	4	6	10	12	4.1	4.3	4.1	4.0
Type - 3	2	3	4	7	8	4.1	4.6	4.3	4.1
Type - 4	7	10	14	20	24	3.8	4.1	3.6	3.5
Type - 5	162	202	301	430	509	3.8	4.1	3.6	3.4
Type - 6	9	12	21	39	53	4.5	6.2	6.2	6.2
Type - 7	543	843	1,539	2,808	3,794	7.6	6.2	6.2	6.2
Type - 8	259	306	560	1,022	1,381	2.9	6.2	6.2	6.2
Type - 9	352	457	836	1,525	2,059	4.5	6.2	6.2	6.2
Type - 10	30	38	56	80	95	3.9	4.1	3.6	3.4
T o t a l	1,368	1,876	3,337	5,941	7,935	5.4	5.9	5.9	6.0

Note:

Type 1: Unprocessed Cereals
Type 2: Other Unprocessed Agricultural Foodstuffs
Type 3: Unprocessed Agricultural Cash Crops
Type 4: Processed Agricultural Products
Type 5: Manufactured Foodstuffs
Type 6: Other Manufactured Consumer's Goods
Type 7: Forestry and Mining Products
Type 8: Mineral Oil Products
Type 9: Building and Construction Materials
Type 10: Manufactured Product's Goods

Source: The Team

CHAPTER 5 ROAD DISASTERS

CHAPTER 5 ROAD DISASTERS

5.1 CLASSIFICATION OF ROAD DISASTERS

There are two known methods of classifying road disasters:

—Classification based on movement of failure
—Classification based on shape of failure

The Transportation Research Board of the National Academy of Science, for example, in "Landslide: Special Report 176", bases their classification on the movement, while the Japan Road Association, in "Slope Protection", bases theirs on the shape. Classification based on the movement requires a technical knowledge of movement mechanisms and is difficult to classify based on mere visual inspection. On the other hand, classification on the shape does not require such the knowledge and can be conducted easily through visual inspection. But *movement of failure, at any rate, must be analyzed when designing counter-measures.* Thus, both methods have their advantages and disadvantages. In the Study, classification based on the shape was chosen taking into account the easy categorization of road disaster types.

Road disasters in the Study were classified into six main types: namely i) cut slope failures, ii) embankment slope failures, iii) falls, iv) landslides, v) debris flows and vi) others. These are further classified into several sub-types depend-*ing on the cause or shape of disaster.*

5.1.1 Cut Slope Failures (including natural slopes) (See Table 5.1-1)

Cut slope failures are classified into surface failures and deep failures, which are further sub-classified by cause of failure.

a) Surface Failures

Surface failures are shallow failures created on slope surfaces and are sub-classified into three types: erosion, weathering and structural weakness failures. These failures are generally induced by surface water flow during intensive rain-falls.

b) Deep Failures

Deep failures are failures that originate or extend deep within a slope. They are sub-classified into three types: scouring, rotational failure and translational failure.

Scouring generally appears on slopes composed of soil, soft rock or highly weathered rock, and is induced by concentrated flow of surface water down the slope.

Rotational failure appears on slopes composed of thick soil or highly weathered soft rock, and it generally has a circular sliding plane. This type of failure is mainly induced by decrease of shear strength or increase of pore water pressure resulting from rising of groundwater level.

Translational failure appears on structurally weak planes such as fault, bedding planes, border planes between rock and soil, etc. It is mainly caused by rising of groundwater level.

5.1.2 Embankment Slope Failures including natural slopes (See Table 5.1-2)

Embankment slope failures are classified into surface failures and deep failures, which are further sub-classified by cause of failure.

a) Surface Failures

Surface failures are shallow failures which appear on slope surfaces and are caused by erosion resulting from surface water flow. Such failures appear often on embankments composed of sandy soil.

b) Deep Failures

Deep failures are failures which originate or extend in the deep within the slope. They are sub-classified into scouring and saturation failures depending on cause.

Scouring is often seen on slopes where there is concentrated flow of surface water, for example, slopes within the inside curves of roads in mountainous areas. Scourings are also caused by waves and river flow and they are often seen on seaside or riverside embankment slopes.

Saturation failures are caused by decrease of shear strength of fill due to ground water seepage into the embankment. These failures have circular sliding planes and often appear on embankment slopes located on inclined ground or semi-cut and fill sections.

5.1.3 Falls (See Table 5.1-3)

Falls are classified into two types: rock falls which are falls of rocks detached from slopes composed of highly cracked rocks and debris falls which are falls of supportless stones from slopes of debris or talus.

TABLE 5.1-1 CLASSIFICATION OF CUT SLOPE FAILURE

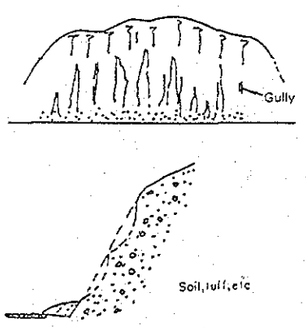
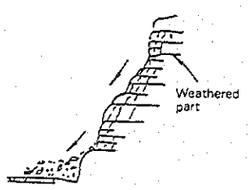
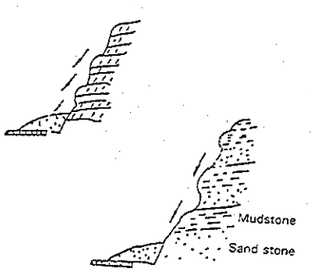
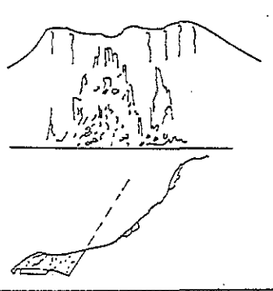
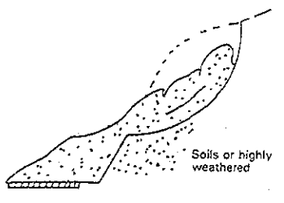
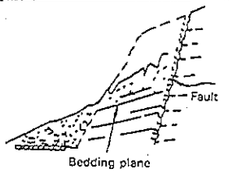
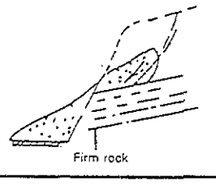
Classification	Description	Type		Illustration	Soil & Rock Susceptible To Failure	Remarks
Surface Failure (C - SF)	Shallow failure on surface of slope caused by erosion, weathering and structural weakness.	(1) Erosion (C-SF(E))	Erosion due to heavy rainfall which often forms gullies on slope surface.		Surface, Soil, Volcanic ash soil, masa, sand and gravel. Volcaniclastic material, Tuff, weathered shale and chert, Agglamerate, etc.	(1) Erosion occurs mainly on bare slope lacking in vegetation. (2) If left as is may develop into large scale slope failure.
		(2) Weathering Failure (C-SF(W))	Shallow failure of weathered parts on slope surface.		Soft rocks and easily weathered rocks, Mudstone, Tuff, weathered shale and schist, etc.	
		(3) Structural Weakness Failure (C-SF(S))	Shallow failure caused by structural weakness, such as developed cracks, joints, bedding faults and border planes in alternate strata of soft rock.		(1) Schist, diabase, serpentinites, granite Andesites, quartz, porphyries, sandstone, etc. (2) Alternate strata of sandstone and siltstone.	
Deep Failure (C - DF)	Deep failure caused by scouring.	(1) Scouring (C-DF(S))	Scouring due to concentration of surface water on slope.		Soil, all kind of soft rocks.	
		(2) Rotational Failure (C-DF(R))	Failure along circular slide plane which occurs mainly in slope of weak shear strength.		Sandy Soil, Clayey soil, Talus, Metamphic rocks.	
		(3) Translational Failure (C-DF(T))	Failure which occurs along the structural weakness of slope such as faults, bedding planes and border planes between firm bedrocks and overlaying detritus or soil.		(1) Sandstone, Mudstone, Slate, Alternate strata of above rocks, granites, porphyry, etc.	When joint or bedding planes incline towards slope surface, this type of failure occurs easily.
					(2) Talus, Sand & Gravel, Volcanic ash soil etc., on bedrock.	When ground water level is high, a large scale failure may occur.

TABLE 5.1-2 CLASSIFICATION OF EMBANKMENT SLOPE FAILURE

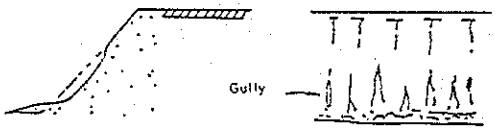
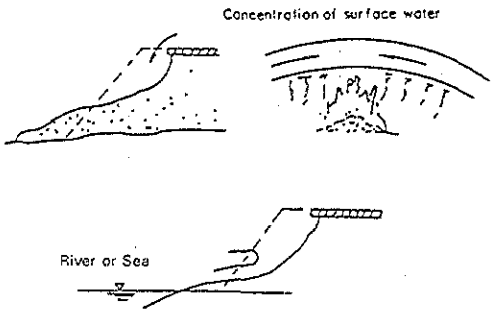
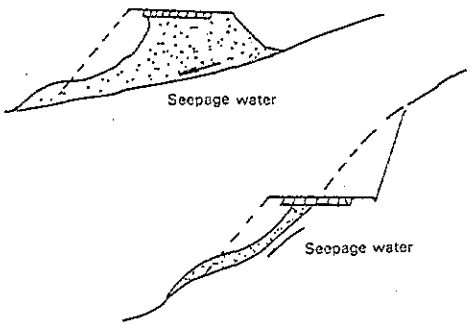
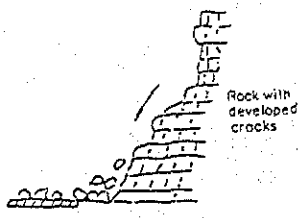
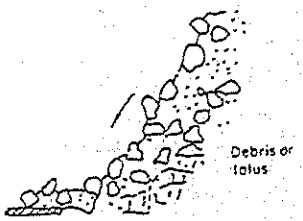
Classification	Description	Type		Illustration	Soil Susceptible To Failure	Remarks
		Type	Description			
Surface Failure (E - SF)	Shallow failure due to erosion.	Erosion (E-SF(E))	Erosion due to heavy rainfall which often forms gullies on slope surface.		Sandy soil, Masa etc.	
Deep Failure (E - DF)	Deep failure caused by scouring or saturations of embankment.	(1) Scouring (E-DF(S))	Scouring caused by concentration of surface water, or movement from river stream, waves, etc.			This type of failure is mainly seen in curve or sagging sections in road alignment and approaches of bridge.
		(2) Saturation Failure (E-DF(P))	Failure due to saturation caused by seepage of surface or ground water into embankment.			This type of failure mainly occur in embankments on inclined ground or semi-embankment-cut section.

TABLE 5.1-3 CLASSIFICATION OF FALL

Classification	Description	Type		Illustration	Soil & Rock Susceptible To Failure	Remarks
		Type	Description			
Falls (C - F)	Free fall of rocks, cobbles etc., detached from a surface of steep slope.	(1) Rock Fall (C-F(R))	Free fall of detached rocks from a surface of slope of bedrocks with developed cracks, joints and beddings.		All kinds of rocks with developed cracks joint and beddings.	
		(2) Debris Fall (C-F(D))	Free fall of unsupported pebbles, cobbles and boulders from a surface of slope of debris or talus.		Talus, Volcaniclastic materials, etc.	

5.1.4. Landslides (See Table 5.1-4)

Landslides are defined as a movement of materials forming the slope caused by loss of balance between shear strength and movement force along the specific slide plane. They are generally induced by rising of groundwater level.

It is difficult to distinguish between slope failures and landslide, but they are generally differentiated by the characteristics shown in Table 5.1-5.

TABLE 5.1-5 DIFFERENTIAL CHARACTERISTICS OF SLOPE FAILURE VERSUS LANDSLIDE

Factors	Type of Disaster	
	Slope Failure	Landslide
1. Geology	Minimal interrelation with geology.	Particularly connected to specific geology such as tertiary mudstone, tuff, etc.
2. Topography	Relatively steep slope	Relatively gradual slope 15 20%.
3. Causes	Heavy rains, concentration of surface water, etc.	Rising of ground water level.
4. Occurence	Sudden	Continous and recurring
5. Speed of Movement	Rapid	Slow (0.01 mm - 10 mm day)
6. Scale	Relatively small	Relatively large

Landslides are classified into rock and soil landslides, depending on slope composition.

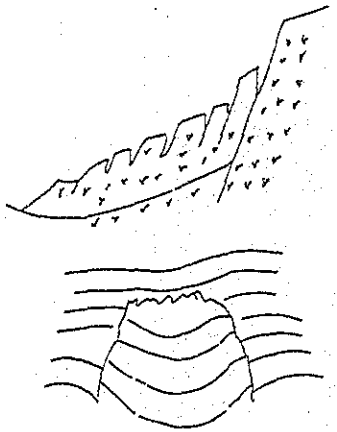
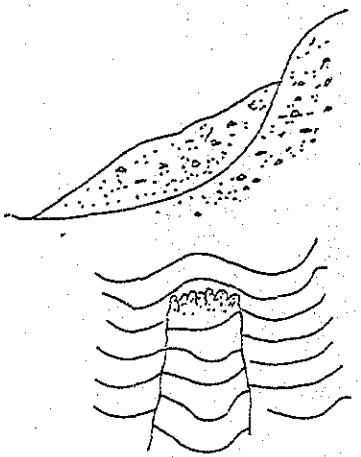
a) Rock Landslide

Rock landslides mainly occur along structurally weak planes such as planes of faults, bedding planes etc. inside a bedrock. The sliding speed is generally faster than that of soil landslides.

b) Soil Landslides

Soil landslides occur inside weak soil such as colluvial or clayey soil or along the border of rock and these soil. Sliding speed is low, and sliding is continuous and recurring.

TABLE 5.1-4 CLASSIFICATION OF LANDSLIDE

Classification	Description	Type		Illustration	Soil & Rock Susceptible To Landslide	Remarks
		Type	Description			
Landslide (L.S)	Movement of huge mass at moderate to slow speed.	Rock Landslide (L.S-R)	Movement which occurs along structural weakness in rock or in weathered rock of weak shear strength. (Moderate to rapid sometimes)		Neogene, crystalline schist, etc. Mainly in fault fracture zone.	(1) It is difficult to forseen the occurance of landslide due to structural weakness, since it happens suddenly. (2) Landslide in weathered rock shows intermittent movement.
		Soil Landslide (L.S-S)	Movement which occurs in colluvial soil and clayey soil or along border plane between firm rock and the said soils. (Slow)		Colluvial soil, clayey soil, the said soils with gravel.	This type of landslide shows continous movement.

5.1.5 Debris Flows (See Table 5.1-6)

Debris flows are defined as flows of riverbed deposits whose velocity distributions resemble the movement of viscous fluid. They are induced by the force of flow caused by floods when there is a large quantity of deposits on the riverbed. Debris flows are sub-classified into debris flows and mud flows, depending on the size of the flowed deposits.

a) Debris Flows

Debris flows contain large size stones and generally cause major damages.

b) Mud Flows

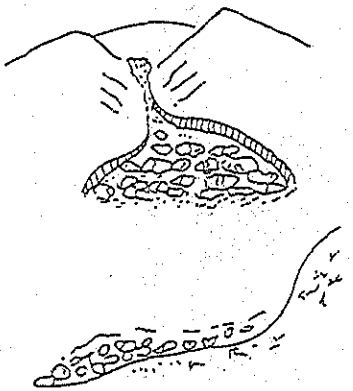
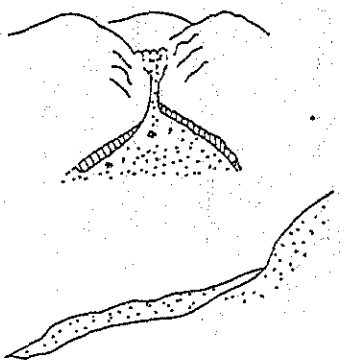
Mud flows mainly soil and sand and no large size stones. They occur easily but are less damaging than debris flows.

5.1.6 Others

Disasters not included in the above classifications, such as submersisons of road surface due to floods of rivers and settlement of embankment due to soft ground, are included in ''others''.

Road disasters are often caused by combinations of two or more causes and so are difficult to classify. In general practice, therefore, the classification is made focusing on the most predominant cause. This practice is adhered to in the Study.

TABLE 5.1-6 CLASSIFICATION OF DEBRIS FLOW

Classification	Description	Type		Illustration	Soil & Rock Susceptible To Debris Flow	Remarks
		Type	Description			
Debris Flow (D,F)	Flow movement of deposit on the stream bed resemble those of viscous fluids in distribution of velocities	(1) Debris Flow (DF-D)	Flow movement of deposit with large stones.		Fault fracture zone, Neogene, weathered granite, volcaniclastic etc.	
		(2) Mudflow (DF-M)	Flow movement of soil and mud without large stones.		Fault fracture zone, Neogene, weathered granite, volcaniclastic, etc.	

5.2 IDENTIFICATION OF DISASTERS SPOTS

5.2.1 Identification Procedure

The procedure for identifying spots with disaster potential are as follows:

—Collection and analysis of basic data, including topographic, geological, hydrological and meteorological information
—Collection and analysis of past disaster records
—Field reconnaissances

In order to identify spots with disaster potential with a high accuracy, it is desirable to conduct, in addition to the above, sounding, borings, seismic refractions, groundwater surveys, soil tests related to these surveys and so on. However, when there are many survey spots, time and funds constraints limit the conduct of these surveys. In the Study, therefore, the identification was done through visual inspection by experienced engineers without these surveys.

5.2.2 Identification of Disaster Spots

1) Analysis of Existing Data

A) Topographical Data

Main topographical data analyzed are as follows:
—1/50,000 scale topographical maps: BCGS

b) Geological Data

Main geological data analyzed are as follows:
—"Geology and Mineral Resources of the Philippines", by Bureau of Mines and Geo-Sciences, Ministry of Natural Resources, 1982.
—"Geological Map of the Philippines", Bureau of Mines and Geo-Sciences.

c) Hydrological Data
Main hydrological data analyzed are as follows:

—"Tropical Cyclone Summary", PAGASA, 1948-1982.
—"Climatological Data in Philippines", PAGASA.
—"Annual Tropical Cyclone Report", PAGASA.

All the above provided useful information. Areas where disasters occur frequently are mostly located in high-altitude mountainous sections, while weather stations are generally located in low altitude areas. It is practically impossible to estimate rainfall heights in high altitude areas on the basis of available data in low altitude areas. In addition to this fact, enough disaster records were not obtained. Due to these reasons, the relationship between rainfall intensity and disaster occurrence could not be analyzed.

d) Disaster-related Data

The only available formal records on road disasters were typoon damage reports (prepared by MPWH's Bureau of Maintennce, regional offices or district/city engineering offices). However, these reports have deficiencies as follows:

—Disaster spots are not precisely indicated. A typical description is: Gravel shoulders were washed out in at least 4 percent of the length between km. 15 + 000 and km. 30 + 000.

—Types of disaster are not clear because no classification of disaster are specified, and causes, topographical and geological conditions, etc. are not described, either.

—There are no data on rainfall on the day that the disaster occurred.

However, the damage reports were useful in obtaining rough information on sections which were affected greatly by certain typhoons.

For future damage reports, the formats and procedures printed in Chapter 15 of Volume V, An Approach on Road Disaster Prevention Project of the Stage I Study are recommended.

2) Field Reconnaissances

Field reconnaissances to identify spots with disaster potential were conducted by teams of experienced engineers on road disasters and geologists together with engineers in charge of maintenance in MPWH's regional or district/city engineering offices. Factors which would influence disaster occurrence were noted down in the check table by type of disaster. Examples of the check table for each type of disaster are shown in Appendix 4.2-1 . The factors checked are: slope height and gradient, type of soil or rock comprising the slope, geological conditions, surface water and groundwater conditions, evidences of past disasters, date of occurrence and rainfall intensity.

Sketches and photographs of the spots were attached to the check tables. During field reconnaissances, nearby residents were interviewed on any disasters which may have occurred in their areas.

5.2.3 Evaluation of Disaster Potential

After the spots with disaster potential are identified through the procedure given above, the disaster potential is evaluated by observation of experienced engineers according to the criteria given in Table 5.2-1 was undertaken.

The following points were taken into account in the evaluations:
—Slope gradient and height.
—Type of rock.
—Condition of weathering, crack, alterations, fractures and faults.
—Thickness and compactness of top soil.
—Possibility of concentration of surface water and quantity of groundwater.
—Deformation of the slope and evidence of past disaster.
—Influence of river flow or ocean waves.

TABLE 5.2-1 CATEGORY OF IMPACT TO ROAD

IMPACT	TYPE OF DISASTER		
	Cut Slope Failure, Landslide, Debris Flow and Others	Rock Fall	Embankment Slope Failure
Heavy (H) (Urgent counter-measure is required).	• Failure or moved material may cover full lanes of pavement. Expected to be unpassable to traffic.	• Fallen materials may cover full lanes or large size of rocks (more than about 50 cm) may fall on pavement.	• Pavement structure may collapse.
Medium (M) (Urgent counter-measure is required).	• Failure or moved materials may cover about one lane.	• Fallen materials of size of less than 50 cm may cover about one lane.	• Shoulder may fully collapse.
Slight (S) (No urgent counter-measure is required).	• Failure or moved materials may not extend to carriageway.	• Fallen materials may not extend to carriageway.	• Shoulder may partially collapse.