2.2 TRUNK ROAD NETWORK

2.2.1 Development Level

Total road extension as of 1982 is 154,470 kms., and road density, is 0.51 kms/square km. The total extension of national roads, which comprise the trunk road network, is 23,782 kms. There has been active development of national roads. During the seven years between 1975 and 1982, road extension grew 2,117 kms. (or 1.1 times), road density increased from 0.07 to 0.08, and pavement ratio rose from 39% to 44% (see Table 2.2.-1).

TABLE 2.2-1 ROAD DEVELOPMENT (1975–1982)

	Length				Ratio	Road Density	
	1975 (kms)	(%)	1982 (kms)	(%)	1982/1975	1975	1982
National Road							
Paved	8,413	(39)	10,465	(44)	1.24		
Un-paved	13,252	(61)	13,317	(56)	1.00		
Sub-Total	21,665	(100)	23,782	(100)	1.10	0.07	0.08
Local Road							
Paved	9,131	(11)	8,995	(7)	0.99		
Un-paved	73,634	(89)	121,693	(93)	1.65		
Sub-Total	82,765	(100)	130,688	(100)	1.58	0.28	0.43
T o t a l							
Paved	17,544	(17)	19,460	(13)	1.11		
Un-paved	86,886	(83)	135,010	(87)	1.55		
Total	104,430	(100)	154,470	(100)	1.48	0.35	0.51

Source: Planning Service, MPWH

2.2.2 Trunk Road Network

Defining roads actually functioning as trunk roads a "interprovince roads with pavement widths of 6.1 meters or more", trunk roads in the Study Area are as shown in Figure 2.2-1.

Two trunk roads running north and south, the Maharlika Highway and the Manila North Road, form the trunk road framework of North Luzon. The Maharlika Highway services the entire Cagayan Valley, which is bordered on three sides by the Sierra Madre Range along the eastern coast, the Luzon Central Cordillera located slightly to the west of center and the Caraballo Mountains to the south. The Manila North Road runs through the narrow flat land along the western coast. The Luzon Central

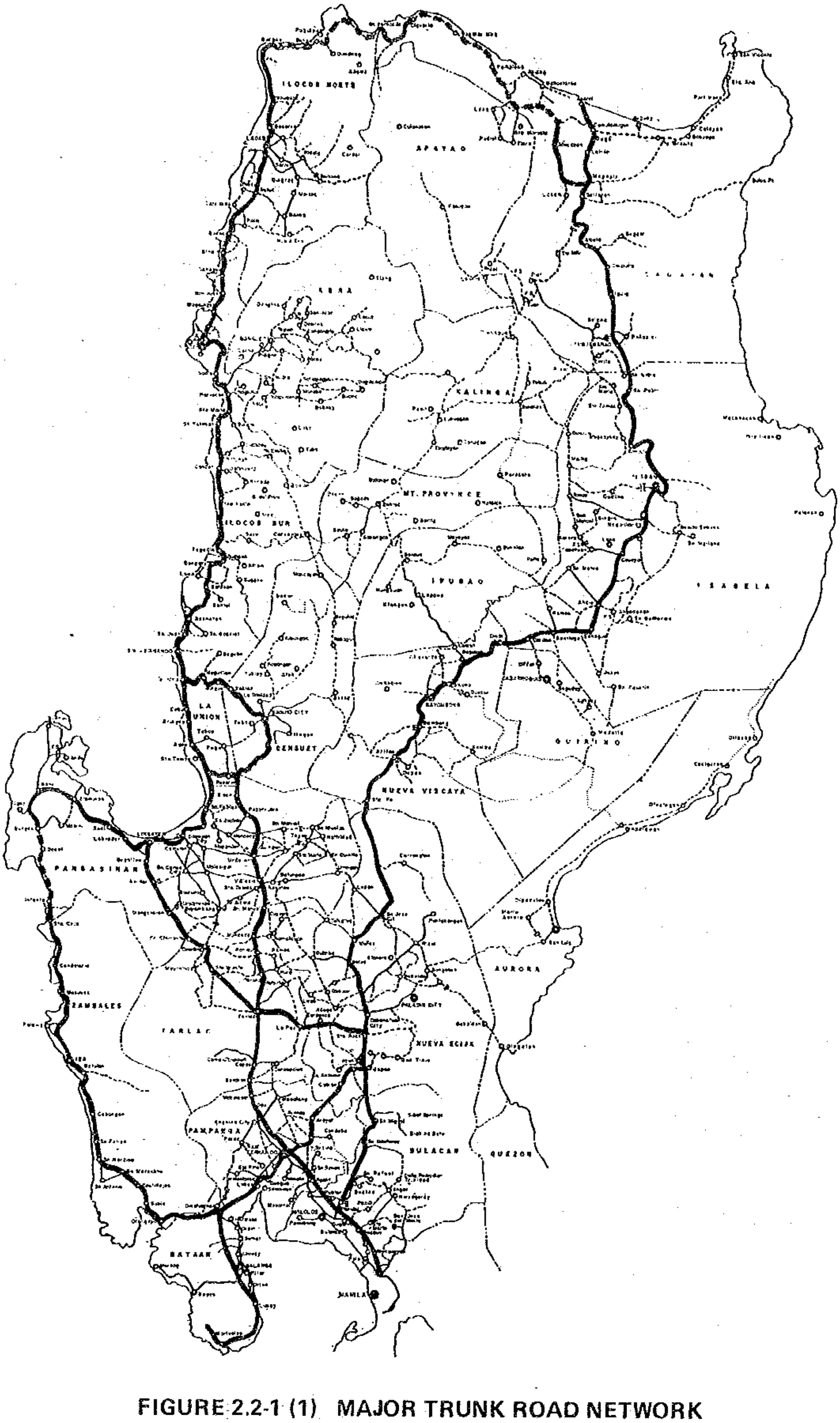


FIGURE 2.2-1 (1) MAJOR TRUNK ROAD NETWORK
(CENTRAL AND NORTHERN LUZON)

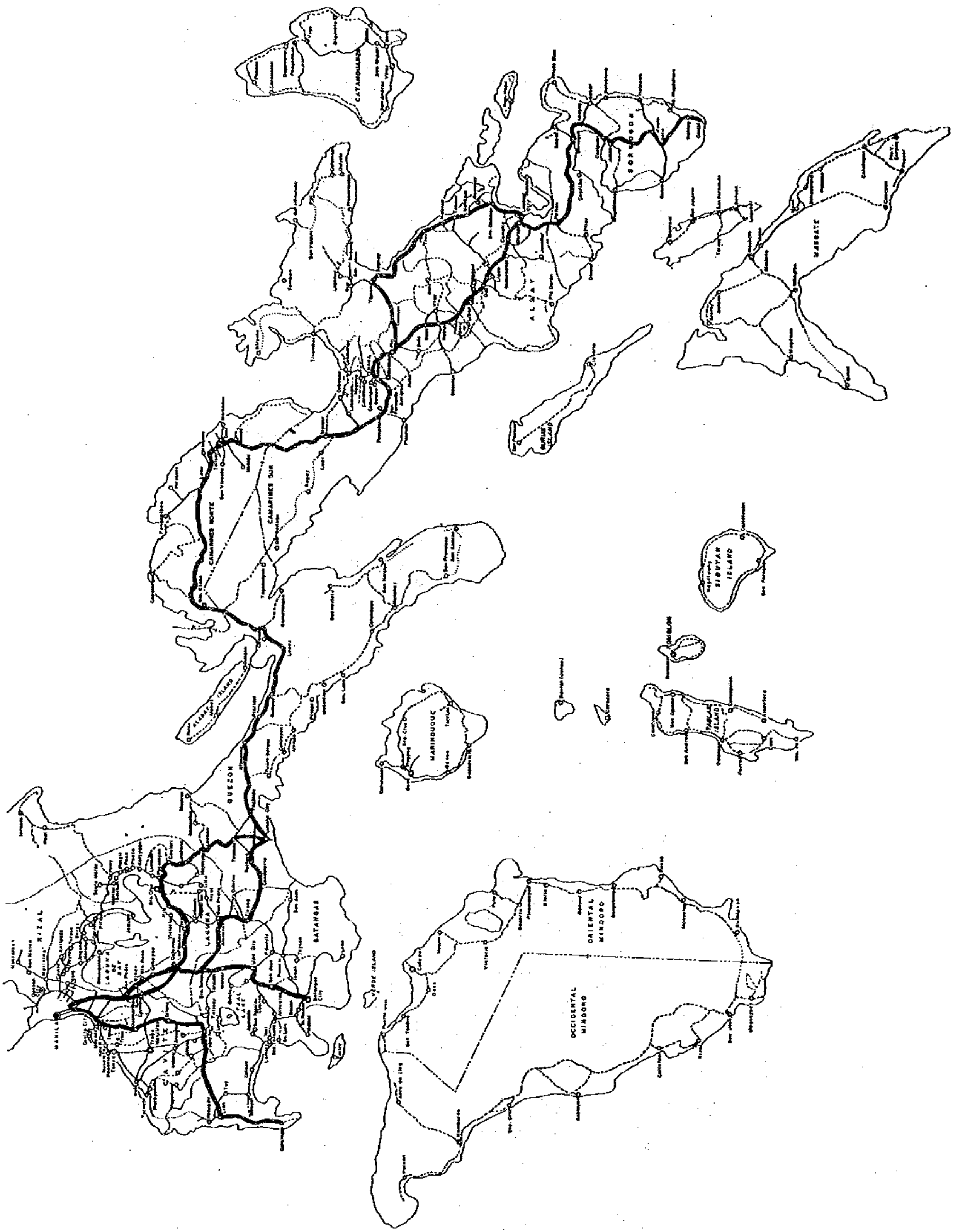


FIGURE 2.2-1 (2) MAJOR TRUNK ROAD NETWORK
(SOUTHEN LUZON)

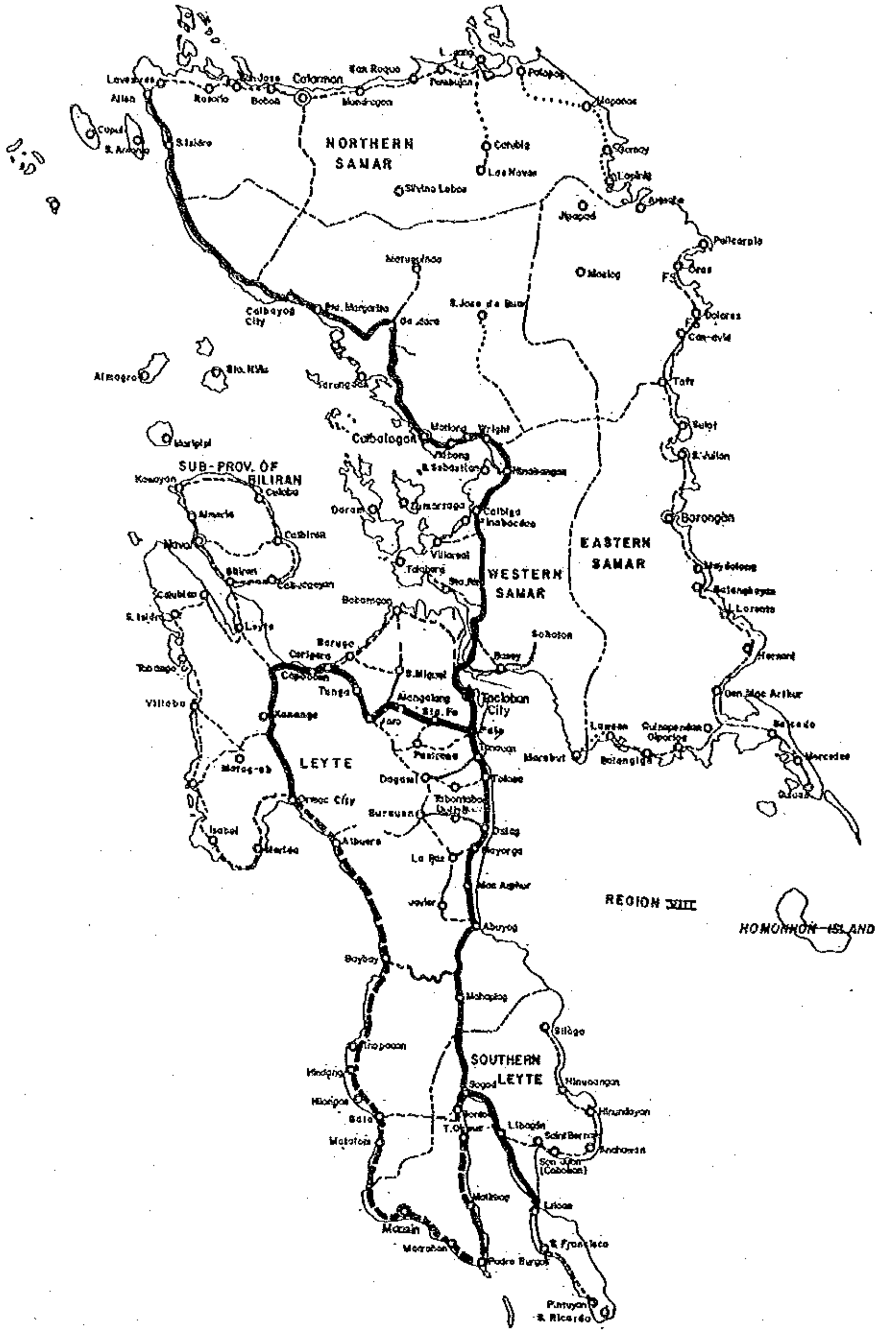


FIGURE 2.2-1 (3) MAJOR TRUNK ROAD NETWORK (SAMAR AND LEYTE)

Cordillera range located in between prevents the two trunk roads from being linked by roads. For this reason, trunk roads in North Luzon are not yet functioning as a network.

Trunk roads in Central Luzon are rather well developed owing to favorable topographical conditions in this region.

South Luzon, from Quezon Province southward, is a long and narrow land with only about 20 to 50 kilometers wide, and the sole trunk road of this region is the Maharlika Highway, which runs through almost the center of the region.

The Maharlika Highway is also the only trunk road in Samar, where it runs along the western coast of the island. There are as yet sub-standard roads on the eastern coast.

There are two trunk roads in Leyte; the Maharlika Highway on the eastern coast and the West Leyte Road on the western coast. The latter, however, contains many gravel sections and temporary bridges such as wooden bridges and therefore is not up to the standards of a trunk road yet.

Although the development of trunk roads has been promoted intensively during the past ten years or so, a full-scale road network allowing flexible handling of emergency situations such as traffic interruptions caused by road disasters is yet to be seen. It might be said that only the backbone of such a network has been completed.

2.3 MAHARLIKA HIGHWAY

2.3.1 General Description

The Maharlika Highway, which traverses the four main islands of the Philippines; Luzon, Samar, Leyte and Mindanao, is the most important trunk road in this country. The Highway extends from Allacapan at the northern tip of Luzon to Davao on the eastern coast of Mindanao, for a total extension of about 2,100 kilometers. Upgrading of existing sections and construction of missing sections were started in 1969 under financial assistance from Japan and completed in 1979.

The Maharlika Highway is a two-lane road with pavement width of 6.7 meters and road shoulders of 2.0 to 2.5 meters. Portland cement concrete pavement comprises 95 percent of the Highway, and the rest is paved with asphalt concrete. Designed speed is 80 to 100 kms/hour in flat terrain, 60 to 80 kms/hour in rolling terrain and 40 to 60 kms/hour in mountainous terrain.

In addition to the private ferry services now operating between Luzon and Samar, a public ferry service is also expected to start operating sometime in 1984, due to large demand for transport between the two islands. Connection between Samar and Leyte is provided by a bridge. Leyte and Mindanao will soon be connected by ferry; terminals are now being constructed and operation is expected to start sometime in 1984. When this is realized, the four islands will be finally linked by car traffic.

2.3.2 Significance

The Maharlika Highway, which traverses the Philippines and links Metro Manila with major regional towns and cities, plays an extremely important role in this country. In addition to providing a fast, reliable, safe and comfortable means of transport, the Highway contributes to the following:

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

As an index illustrating the fact that the Maharlika Highway supports regional socio-economic activities, the modal splits of Manila-related passenger movements in the Cagayan Valley corridor and the Bicol-Samar corridor are shown in Table 2.3-1. The Maharlika Highway is the sole road linking the two corridors to Manila, and hence reliance on the highway is 99 percent in the Cagayan Valley corridor and 93 percent in the Bicol-Samar corridor.

TABLE 2.3-1 ANNUAL PASSENGER MOVEMENT IN MAIN CORRIDORS, BY MODE 1981 (x 1,000)

	Road							
	Economy Bus	A/C Bus	Car and Vans	Sub-Total	Rail	Sea	Air	Total
Manila-Cagayan								
(Cagayan	3,905	51	1,758	5,714	-	-	37	5,758
Corridor)	(68)	(1)	(30)	(99)	(0)	(0)	(0.6)	(100)
Manila-Bicol - Samar	11,725	198	260	12,183	594	191	115	13,083
(Bicol-Samar Corridor)	(90)	(1)	(2)	(93)	(5)	(1)	(1)	(100)

Source: NTPP

The following regional development projects are being implemented along the Maharlika Highway, and the Highway provides vital support to these projects.

Cagayan Valley Region

- Chico River Irrigation
- Magat River Multi-Purpose Project
- Cagayan Integrated Rural Development Project

Central Luzon

- Central Luzon Groundwater Irrigation Project

South Luzon

- Bicol River Basin Irrigation Development Project
- Libmanan – Cabusao Integrated Area Development Project

Samar

- Samar Integrated Rural Development Project
- National Irrigation Systems Improvement Project

Leyte

- National Irrigation Systems Improvement Project

In these ways, the Maharlika Highway, as the most important trunk road of the country, supports the nation's economic development and promotes national unity and public peace and order.

2.4 PROJECT ROADS LEADING TO BAGUIO

2.4.1 General Description of Baguio City

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, only four hours are required to drive from Manila to the City. 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 facilities, 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 characteristics is that the city and its surrounding areas are production centers of various vegetables. The vegetables are transported to Metro Manila for consumption.

2.4.2 General Description of the Project Roads leading to Baguio

The three roads leading to Baguio City, namely Kennon Road, Agoo-Baguio Road and Naguilian Road, are subject to this Study.

1) Kennon Road

Kennon Road which branches off from Manila North Road at Rosario and leads to Baguio City, extends 34.2 kms. and provides the shortest route to Manila from Baguio of the three roads. It is the second oldest of the three roads; its construction took 12 years, from 1926 to 1937. Due to topographical conditions, its road alignment is very poor and there are many sharp curves and steep gradients. The road is also narrow, its pavement width being only 6.0 meters and its road shoulder width, 0.5 to 1.0 meters. The Kennon Road is a toll road, most of the income of which goes to maintenance.

2) Agoo-Baguio Road

Agoo-Baguio Road which branches off from Manila North Road at Agoo and leads to Baguio City, extends 48.9 kms. It is the newest of the three roads; construction began in 1974 and ended in 1981. Its pavement width is 6.7 meters, and its road shoulders are 2.0 to 2.5 meters wide. Road alignment of the 36 km. section near Baguio City is poor due to topographical conditions and has many sharp curves and steep gradients.

3) Naguilian Road

Naguilian Road which branches off from Manila north Road at Bauang and leads into Baguio City, extends 47.2 kms. and is the oldest of the three roads. It was opened to traffic in 1919. The 30 km. section near Baguio City, containing many sharp curves and steep gradients, has poor road alignment. The road is narrow; pavement width is 6.0 meters and shoulder width is 0.5 to 1.0 meters.

2.4.3 Functions of the Three Roads

The origin and destinations of traffic on the three roads are shown in Table 2.4-1. Over 95 percent of the traffic linking Baguio City and areas to the south of Baguio, such as the Baguio-Manila and Baguio-Pangasinan traffic, use Kennon Road. Most of the traffic linking Baguio City and the northern part of Region I, such as the Baguio-San Fernando, La Union traffic, are serviced by Naguilian Road. Agoo-Baguio Road services mainly local traffic. Figure 2.4-1 shows the service area (influence zone) of each road, and Table 2.4-2 shows traffic volume on each road by type of vehicle.

1) Kennon Road

Kennon Road is described as a road that supports the tourist industry of Baguio City. Nearly all tourists and vacationers visiting the City from Metro Manila come by bus or car on Kennon Road. Therefore, traffic on it is mostly long-distance traffic and is categorized as an inter-regional trunk road.

2) Agoo-Baguio Road

Agoo-Baguio Road has light, mostly short-distance traffic and is functioning only as a local road at present. There is little possibility in the future that the road will service long-distance traffic coming in Metro Manila or Pangasinan. However, there are several view decks along the Road, a golf course is under construction, and a sports center is planned to be constructed, when these are completed, the Road will provide support to the leisure industry along the Road.

3) Naguilian Road

Naguilian Road has heavy truck traffic. Oil shipped to San Fernando, La Union by sea and seafoods are transported to Baguio City via this road. Medium-distance traffic is dominant on this road, which can be described as a secondary trunk road.

TABLE 2.4-1 TRAFFIC MOVEMENT RELATED TO BAGUIO CITY

Unit : Veh/12-hour

O-D	Kennon Road	Agoo-Baguio Road	Naguilian Road	T o t a l
Baguio-M. Manila	1,222(95%)	21 (2%)	33 (3%)	1,176
Baguio-San Fernando La Union	29(4%)	10 (1%)	744 (95%)	783
Baguio-West Pangasinan	385(1.0%)	-	-	385
Baguio-Region II	84(100%)	-	-	84
Local Movement	195	227	419	841
T o t a l	1,815	258	1,196	3,269

Source: Traffic Survey by the Study Team conducted in June, 1983

TABLE 2.4-2 TRAFFIC VOLUME BY VEHICLE TYPE

Unit : Veh/day

	Car Jeep Pick-up Van	Jeepney	Bus	Truck	Total
Kennon Road	847 (48%)	169 (9%)	464 (26%)	308 (17%)	1,815 (100%)
Agoo-Baguio Road	135 (52%)	91 (35%)	6 (2%)	26 (10%)	258 (100%)
Naguilian Road	455 (38%)	403 (34%)	73 (6%)	265 (22%)	1,196 (100%)

Source: Traffic Survey by the Study Team conducted in June, 1983

2.5 IMPORTANCE OF DISASTER CONTROL

Metro Manila is the great center of this country from any standpoint. The Maharlika Highway, which traverses the country and links Metro Manila with regional towns and cities, supports the nation's socio-economic activities and at the same time contributes greatly to promoting national unity. Under the current trunk road network, there are no roads that can substitute for the Maharlika Highway and access to most regions are provided by the Highway alone. Nevertheless, the Highway has been affected by typhoons and heavy rains, which caused largescale road disasters and long-term traffic interruptions lasting one to three months. However, because only temporary measures and no fundamental measures have been effected against such road disasters, such disasters are recurring every year.

Road disasters and accompanying traffic interruptions not only inconvenience road users, but also create substantial loss to the nation's economy. It is, therefore, essential to effect disaster control and secure traffic on trunk road at all times.

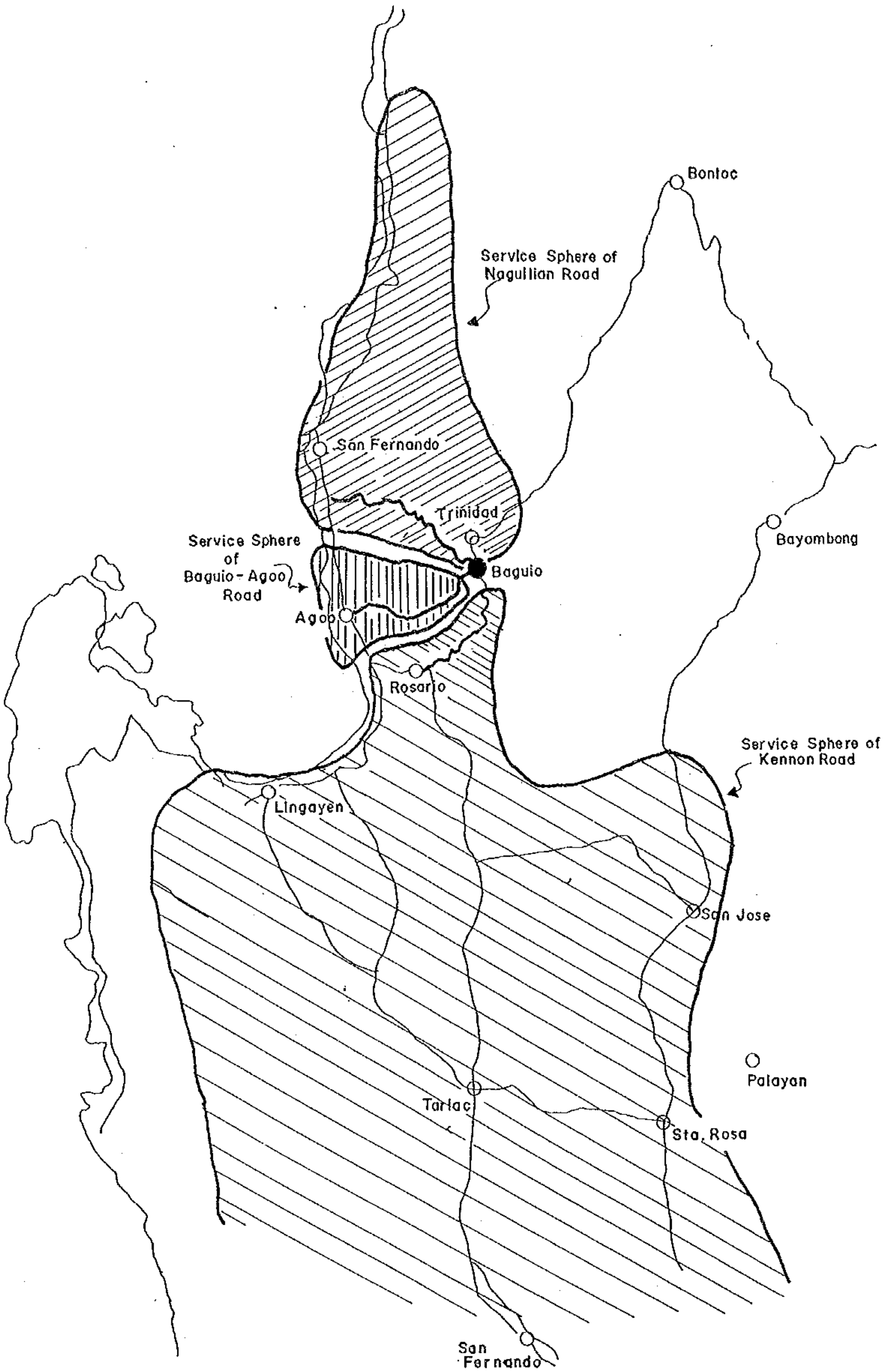


FIGURE 2.4-1
SERVICE SPHERE OF PROJECT ROADS LEADING TO BAGUIO

CHAPTER 3

PROFILE OF STUDY AREA

3.1 NATURE

3.1.1 Topography and Geology (See Figure 3.1-1)

1) General

The Philippines consist of 7,100 islands that were formed by repeated orogenic movements and volcanic activities. The islands are divided into the three main groups of Luzon, Visayas and Mindanao. Luzon is the largest island and is located furthest north. Visayas, composed of Samar, Leyte and other islands, is situated between the other two, and Mindanao, the second largest island, is located furthest south.

The Sierra Madre and Cordillera Central Mountain ranges located in North Luzon were formed by upheavals of the land, and the Cagayan Valley, which is surrounded by the two ranges, was formed by a submergence of the land. The Caraballo Mountain, located at the southern tip of the two ranges, is the northern boundary of the wide Luzon Central Plain. On the eastern side of the plain is the Sierra Madre range, which extends to near Lucena. There are small mountain ranges near the Camarines Norte, and terraces and narrow alluvial land along the coastline.

South Luzon has volcanoes such as Isarog, Mayon and Bulusan, and the coastal areas are alluvial land.

A fairly low (about 900 meters maximum) but steep mountain range runs nearly north to south through the central area of Samar, and there are terraces along the coast.

A rift formed by the Philippine Fault divides Leyte into east and west. Other than the narrow alluvial lands along the coasts, the island is more or less entirely mountainous. The highest peak on the island has an altitude of about 1,200 meters.

The skeletal structure of the Philippine islands was formed at a relatively late geological period (late Cretaceous and Paleocene periods). Therefore, it is mainly composed of relatively soft, unconsolidated sedimentary rock such as sandstone, tuff, mudstone and conglomerates. There are also a considerable quantity of igneous rock such as diorite, andesite and basalt formed by repeated volcanic activities. The borders where igneous and sedimentary rocks meet usually show strong alternation.

The Philippine Fault runs north and south through the Philippine islands, and secondary faults and holds resulting from the major fault can be seen in all regions. Faults and developed fracture zones are found in the following sections:

- the Dalton Pass section, between San Jose and Aritao;
- the South Sierra Madre section in southern Lucena;
- the Mahaplag- Sogod section in southern Leyte; and
- Cordillera Central Mountain, through which the three access roads to Baguio city runs.

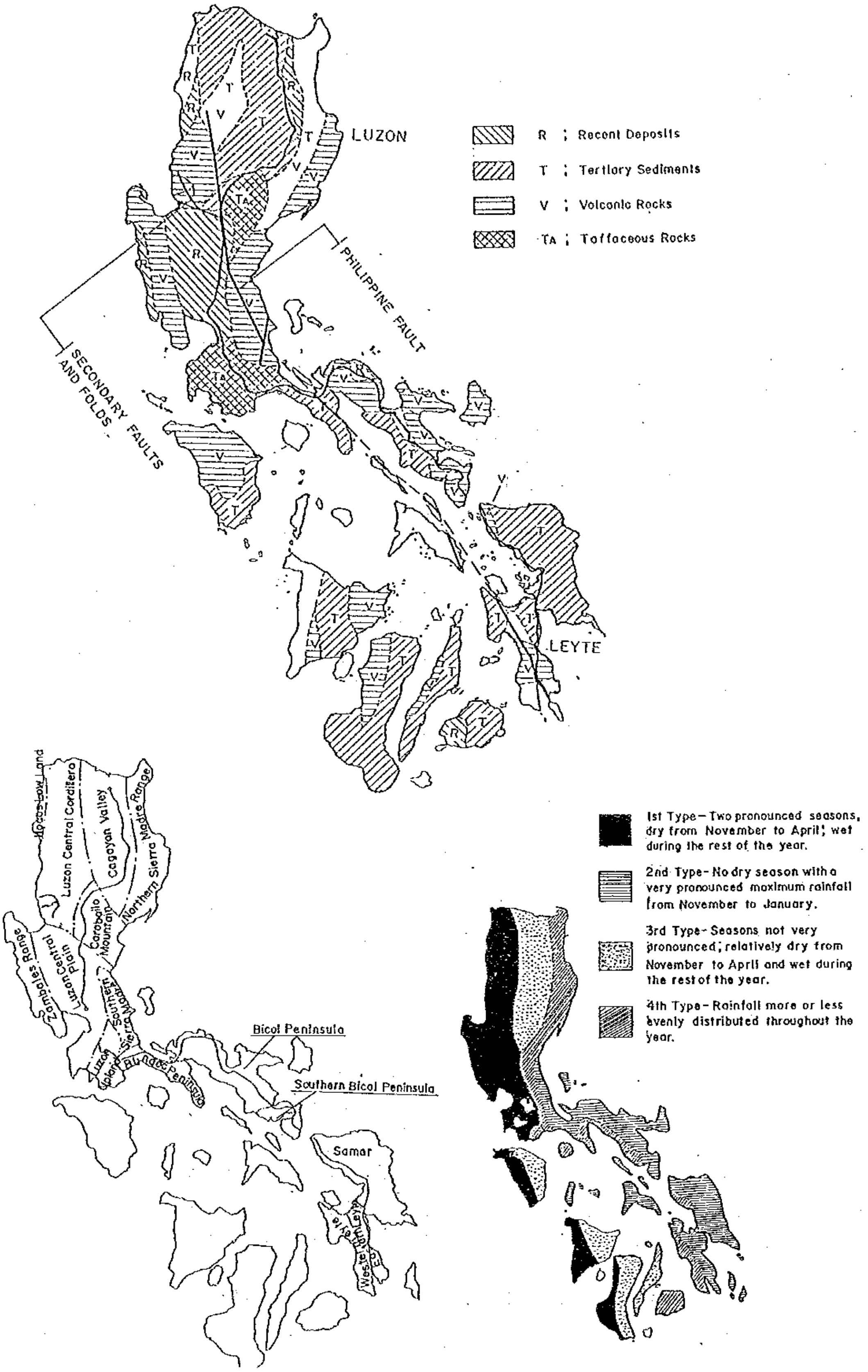


FIGURE 3.1-1 TOPOGRAPHY, GEOLOGY AND CLIMATE OF STUDY AREA

In addition, the country's severe climatic conditions, namely high temperature and heavy rains, accelerate weathering of rocks.

The combined effect of such geologically adverse factors – in other words, the high composition of soft and unconsolidated rock, the many areas of alteration and fracturing, and accelerated weathering – is one of the major causes of road disasters, especially cut slope failures, rock falls and landslides.

2) Along the Maharlika Highway

The section of the Maharlika Highway subject to the Study extends about 1,530 kilometers, from Allacapan at the northern tip of Luzon to Liloan at the southern tip of Leyte. Rough descriptions of the topography and geology of land along this section are as follows:

- Allacapan, the terminating point of the PJHL Phase II Project to Santiago (kms 576 + 930 – kms 327 + 700): Mostly flat alluvial land formed by the Cagayan River. Main disasters are flooding and embankment slope scouring due to overflowing rivers. A short hilly segment near kms 530 + 000 contains cut slopes composed of tuff and sandstone, but none of these slopes show major failures.
- Santiago to Aritao (kms 327 + 700 – kms 236 + 600): Mostly flat alluvial land, with a fairly steep mountainous terrain lasting about 30 kms. in the middle of this Section Geological composition of the mountainous section is mainly tuff, tuff breccia and sandstone, and there are a considerable number of cut slope failures and one typical landslide. Main disasters in the alluvial area are embankment slope scouring due to overflowing rivers.
- Aritao to San Jose (kms. 236 + 600 – kms. 159 + 000): The steep and mountainous segment at Dalton Pass is included in this section. Segments on both sides of Dalton Pass are alluvial flat lands surrounding the Sta. Fe and Digdig Rivers, respectively Geological composition in this section is mainly limestone, granite, diorite, diabase and andesite. Since these rocks are fractured because of secondary faults created by the Philippine Fault and are also highly weathered, cut slope failures and rock falls occur frequently. In addition, segments along the Sta. Fe and Digdig Rivers are scoured by the rivers at many places.
- San Jose to Sta. Rita (kms. 159 + 000 – kms. 36 + 000) and Calamba to Lucena (kms. 51 + 200 – kms. 136 + 407): Two (2) sections pass through mostly flat terrain consisting of the Luzon Central Plain and alluvial plains developed along the coastline. Main disasters are flooding and scouring due to flooding of rivers.
- Lucena to Naga (kms. 136 + 407 – kms. 433 + 750): The segment that goes over the southern tip of South Sierra Madre, located north of Lucena, is included in this section. This segment is not very steep, but there are major failures of cut slopes composed of limestone fractured by faults. This section also includes the mountainous segment of Camarines Norte Rocks in this segment are mainly schist, quartz, diorite, tuff and andesite, many of which are fractured by faults, so that, there are cut slope failures, embankment slope failures and rock falls in many spots. Other than these two mountainous segments, the section contains only coastal alluvial plains.

– Naga to Daraga (kms. 433 + 750 – kms. 524 + 523): Alluvial flat land. Main disasters are floodings and scourings caused by overflowing of the Bicol River and others rivers. Segments near the mayon volcano are affected by debris flow from the Mayon.

– Daraga to Matong (kms. 524 + 523 – kms. 644 + 400): Flat alluvial plains along the coastline passes through alternately and moderately hilly terrains. Rocks in hilly terrains are mainly tuff, and main disasters are cut slope failures, none of which are large-scale. Coastal segments show some scouring by waves.

– Allen to southern tip of Samar (kms. 663 + 814 – kms. 902 + 150): Can be divided into the moderately hilly segment that passes through the foot of Samar's central ranges and flat coastal terraces segment passes along the coast. Rocks in the hilly segment are mainly sandstone, with some limestone, andesite, tuff, tuff breccia and mudstone. Because these rocks are cracked, weathered or fractured there are many cut slope failures and falls. Main disasters in the coastal segment are scouring by waves.

– Northern tip of Leyte to Mahaplag (kms. 902 + 150 – kms. 988 + 800): Mainly flat alluvial land along the coast. Segment near Mahaplag is hilly, but there are only two or three small scale cut slope failures in this segment.

– Mahaplag to Sogod (kms. 988 + 800 – kms. 1,025 + 450): Southern Leyte's steep mountainous area. Rocks are mainly sandstone, mudstone and tuff. Since the Highway here runs along the fracture zone of the Philippine Fault, there are many large-scale cut slop failures. Moreover, embankment slopes along this section are built high because of the steep topography, and many of them are scoured by surface water concentrations.

– Sogod to Liloan (kms. 1025 + 450 – kms. 1059 + 877): This section runs along the coastline, near the base of a mountain. The land is moderately undulating and the geological composition is mainly snadstone, mudstone and tuff. There are many cut slope failures and falls, but none of them are large-scale.

3) Roads leading to Baguio

Baguio city is situated at the southern tip of the Cordillera Central Mountain, about 1,500 meters above sea level. The three roads subject to the Study all link Baguio city with the Manila North Road.

– Kennon Road

The Kennon Road runs through steep land along the Bued River. Rocks are mainly conglomerates, andesite, diorite and granite, most of which have developed cracks or fractures. Disasters involving cut slopes are mainly failures and rock falls, and those involving embankment slopes are mainly scrouring caused either by the Bued River or surface and seepage water concentrations.

– Agoo-Baguio Road

About half of the Agoo-Baguio road, coming in from the Manila North Road, runs through either flat alluvial land or moderately hilly land and has no large-scale road disasters. The rest of the road runs through steep mountainous areas, whose slopes are composed of weathered or fractured sandstone, mudstone, conglomerates, tuff, diorite and limestone, The weakened conditions of the rocks are causing cut slope failures and largescale falls. In addition, embankment slopes on the valley side are scoured due to concentrated run-off of surface water.

— Naguilian Road

The Naguilian Road generally runs through mountainous land, except for some short rolling section. Rocks seen on slopes are mainly sandstone, shale, tuff, conglomerates, limestone and diorite. Main disasters are falls, but there are fewer disasters on this road than on the other two access roads.

3.1.2 Climate (See Figure 3.1-1)

1) General

The Philippines is located in the tropics. The climate in the Philippines is due to its geographical location and the different wind system that prevails over the locality. The condition of the climate has been described in terms of the characteristics of the distribution of rainfall received in a locality during the different month of the year. There are four cilmate types in the Philippines.

Over 50% of the rainfall is associated with tropical cyclones. The frequency of tropical cyclones in the Philippine. Area of Responsibility (PAR) has an average of 20 times a year, while the frequency crossing in the Philippines has an average of 8.8 times a year.

An average annual rainfall in the Philippines is 2416.3mm. The largest average annual rainfall are 4316mm. and 4360mm. at Borongan in Samar and Hinatuan in Surigao del Sur, respectively, both of which face to Pacific Ocean and belong to the 2nd type of climate. The highest daily rainfall was 979.4mm recorded in Baguio City on October 17,1967. In Samar and Leyte Islands, the highest daily rainfall of 387.9mm. was recorded in Catbalogan City, whereas in Mindanao Island, 564.7mm in Surigao City.

2) Maharlika Highway

The route in Cagayan Valley Region (Region II) runs mostly along the Cagayan Valley River. This area is in the 3rd type of climate. Aparri which is located at the northern end and Santa Fe, the southern end of the Region have high annual rainfall over 2,000mm., annual rainfalls of the rest of the Region range from 1,500mm. to 1,900mm. The monthly rainfall for the period of May to December is relatively high over 100mm., and under 100mm. for the rest of the months of the year. The maximum daily rainfall recorded at Aparri was 453.1mm., and 349.9mm. in Tuguegarao. Santa Fe has the maximum daily rainfall record of 732.0mm. during typhoon Aring in November, 1980.

The route in Central Luzon Region (Region III) passes thru the Provinces of Nueva Ecija and Bulacan. The boundary of 1st type and 3rd type of climate is in this region, however, most of the region is governed by the 1st type of climate, which usually records the highest monthly rainfall in August or September and has rather clear dry and rainy seasons. The maximum monthly rainfall recorded is 520.4mm. at San Jose City and 394.2mm., at Cabanatuan City in August. The maximum daily rainfall recorded at San Jose City is 424.9mm. and 311.5mm., at Cabanatuan City, both of which were caused by tropical cyclone.

Southem Tagalog Region (Region IV-A) has all types of climate. The route, from Manila to San Pablo City which is located about 85km from Manila, passes thru 1st type of cilmate. The section which faces to Tayabas Bay thru Lucena is located in in the area of both 3rd and 4th types of climate. The section between Atimonan and Lopez is located in the 2nd type of climate which usually have a high amount of monthly rainfall during October to December. The maximum monthly rainfall of 336.2mm. was recorded at Lucena City in October and 446.8mm. at Atimonan in November. The maximum daily rainfall recorded was 258.6mm. in Lucena City and 673.0mm. at Alabat weather station.

There are 2nd type and 4th type of climate in the Bicol Region (Region V). Maharlika Highway in Camarines Norte runs along the east side of peninsula and belongs to 2nd type of climate. In Camarines Sur and Albay Provinces, the route runs almost center of peninsula and just located on the boundary of 2nd and 4th type of climate. Sorsogon Province belongs to 2nd type of climate. The maximum monthly rainfall recorded was 614.1mm. in Daet and 478.4mm. in Legaspi. For the daily rainfall the greatest record obtained were 554.3mm. and 484.6mm. for Daet and Legaspi, respectively.

Samar and Leyte belong to 2nd and 4th type of climate. Catarman which faces to Pacific Ocean has the maximum monthly rainfall of 548.3mm. From October to December it has relatively a big amount of monthly rainfall. Along the east coast of Samar where Maharlika Highway runs, it does not show pronounced fluctuation of monthly rainfall throughout the year. At Catbalogan City, maximum value of monthly rainfall is 335.7mm. in November. In Leyte, there is also no pronounced monthly rainfall fluctuation. The maximum value of monthly rainfall at Tacloban City and Maasin are 288.0mm. and 251.2mm., respectively. At Tacloban City, it was recorde 127.5mm. maximum daily rainfall, while it was 210.3mm. at Maasin.

3) Roads leading to Baguio

Baguio and its vicinity belongs to the 1st type of climate. There are a rainy season from May to October and dry season from December to April. Annual rainfall in Baguio City is 3,422mm., while Dagupan, Naguilan and San Fernando in the west coast have annual rainfall of 2,248mm., 2,765mm. and 2,447mm. respectively. The difference of annual rainfall between Baguio City and its vicinities is caused by elevations. Baguio City has an elevation of 1,500m. above the mean sea level while Dagupan has only 1.0m. above the mean sea level.

Maximum monthly rainfall is usually recorded in August and its amount varies from 671mm. to 817mm. Baguio City has a maximum daily rainfall record in the Philippines and its value is 979.4mm. Dagupan City has maximum daily rainfall of 623.0mm.

3.2 POPULATION

3.2.1 National and Regional Demographic Trend

For the last 20 years, the national population had increased at an annual rate of 2.9% per annum from about 27 million in 1960 to about 48 million in 1980 as shown in Table 3.2-1. The same table also shows that the annual rate of growth is decreasing for each censal period from 3.1% in the period 1960–1970 to 2.7% in the period 1975–1980. These indicate that the national population figure continously increases at a declining rate of growth for each censal period, probably due to government efforts to control continuous population increases in order to cope up with the gradual uptrend of the country's economic and social development.

In terms of regional differences, within the 20-year period (1960–1980) seven regions among the thirteen regions achieved a higher population growth than the national level of 2.7 percent while six others had growth rates below it. The most rapidly growing regions turned out to be NCR and the regions in Mindanao while the least rapidly growing regions is Region VIII in the Visayas, with only 1.6 percent.

3.2.2 Population Distribution

In 1980 the total population of the Philippines was more than 48 million with a density of 160.3 persons per square kilometer. A major concentration of the country's population is observed in the two regions, the Southern Tagalog Region (R-IV) with more than six million population and the National Capital Region (NCR) with more than five million. Together, these two regions hold about a quarter (12 million) of the total national population (See Table 3.2-1). However, the least populated regions are Region II, VIII, IX and XII each having only a population of more than 2 million. Densitywise, NCR is of course the most densely populated region with a population density of 9,317.4 very much higher than the national level and the rest of the regions, while the least densely populated is Region II with only 60.9. (See Figure 3.2-1).

The above informations denote that the country is presently exhibiting an unequal distribution of its population among the regions. Such unbalanced population distribution is undoubtedly one of the most important problems requiring serious and immediate consideration in order to attain a proportional share of the country's population in fixed area units.

This problem is partly attributable to internal migration. These are summarized in the following matrix table on the number of inter-regional migrants by region of origin and destination in 1970–1975 obtained from NCSO.[1/] This table also indicates that NCR is the most migration-gaining region having an aggregate of 263.058 migrants during the 5-year period followed by Region III, IV and XI.

1/ This was the latest NCSO information on migration based on the changes in the place of birth and place of residence of the population during the 1970 – 75 period obtained from vital registration and census data.

TABLE 3.2-1 PAST POPULATION TREND (1960 – 1980)

	Population				Density				Annual Growth Rate (%)			
	1960	1970	1975	1980	1960	1970	1975	1980	1960-70	1970-75	1975-80	1960-80
N C R	2,462	3,967	4,970	5,926	3,871.8	6,236.9	7,814.5	9,317.4	4.9	4.6	3.6	4.5
Region I	2,428	2,991	3,269	3,541	112.6	138.7	151.6	164.2	2.1	1.8	1.6	1.9
Region II	1,202	1,691	1,933	2,215	33.0	46.5	53.1	60.9	3.5	2.7	2.8	3.1
Region III	2,525	3,615	4,210	4.803	138.5	198.3	230.9	263.4	3.6	3.1	2.7	3.3
Region IV	3,081	4,457	5,214	6,119	65.7	95.0	111.1	130.4	3.8	3.2	3.2	3.5
Region V	2,363	2,967	3,194	3,477	134.0	168.3	181.1	197.2	2.3	1.5	1.7	1.9
Region VI	3,078	3,618	4,146	4,526	152.2	178.9	205.0	223.8	1.6	2.8	1.8	1.9
Region VII	2,523	3,033	3,387	3,787	168.7	202.9	226.5	253.3	1.8	2.2	2.3	2.0
Region VIII	2,041	2,381	2,600	2,799	95.2	111.1	121.3	130.6	1.5	1.8	1.5	1.6
Region IX	1,351	1,869	2,048	2,528	72.3	100.0	109.6	135.3	3.3	1.8	4.3	3.2
Region X	1,297	1,953	2,314	2,759	45.8	68.9	81.7	97.4	4.2	3.4	3.5	3.8
Region XI	1,353	2,201	2,715	3,347	42.7	69.4	85.6	105.6	5.0	4.3	4.3	4.6
Region XII	1,383	1,941	2,070	2,271	59.4	83.3	88.9	97.5	3.4	1.3	1.9	2.5
Philippines	27,088	36,684	42,071	48,098	90.3	122.3	140.2	160.3	3.1	2.8	2.7	2.9

NOTE : POPULATION IS IN THOUSAND.

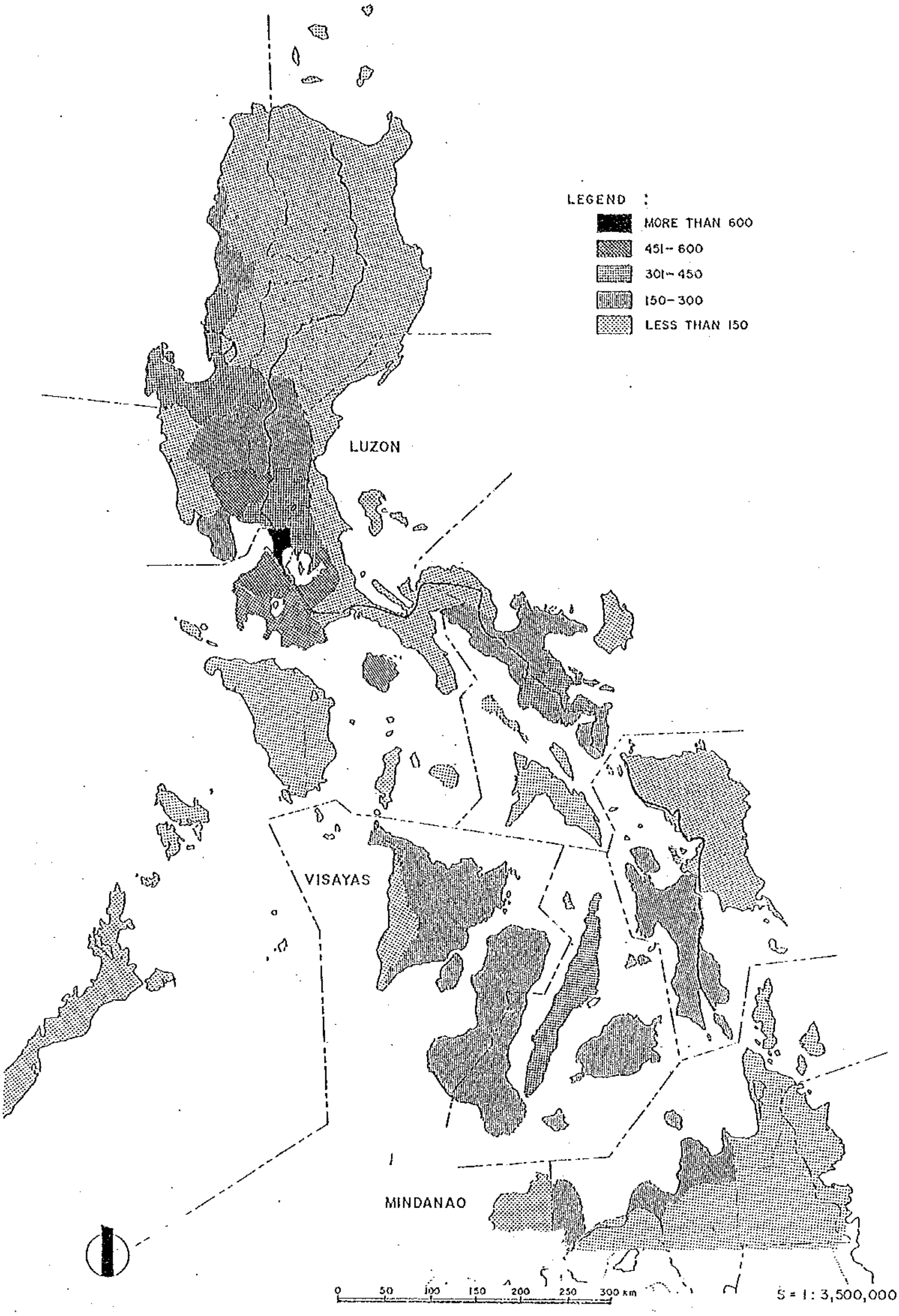


FIGURE : 3.2-1 1980 POPULATION DENSITY BY PROVINCE

TABLE 3.2-2 NUMBER OF INTER-REGIONAL MIGRANTS BY REGION AND DESTINATION, 1970 – 1975

Regions of Origin \ Regions of Destination	NCR	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	TOTAL
NCR	-	12,874	3,859	57,414	47,941	19,419	15,467	7,650	19,897	1,269	3,922	5,066	1,082	195,860
I	34,793	-	10,526	11,480	4,853	1,323	763	1,411	998	286	1,543	2,053	710	70,739
II	14,145	4,930	-	3,221	1,055	658	663	835	402	101	1,164	466	578	28,218
III	46,021	4,619	5,805	-	7,906	2,429	1,037	600	2,017	204	399	1,002	240	72,279
IV	48,071	2,130	1,658	8,228	-	5,939	1,762	1,000	2,149	77	1,472	1,026	220	73,730
V	36,685	806	553	5,120	16,459	-	905	1,266	2,944	99	1,086	981	198	67,102
VI	24,823	279	177	2,786	5,067	1,125	-	5,770	580	1,701	3,577	5,907	3,996	55,786
VII	19,157	1,039	601	3,643	2,405	1,930	7,780	-	7,022	4,179	20,273	18,056	3,702	89,787
VIII	23,583	502	157	3,693	2,576	978	596	4,284	-	962	6,562	5,274	540	49,706
IX	4,512	384	39	555	2,455	81	2,081	7,124	1,094	-	13,227	5,295	4,013	40,860
X	4,317	876	400	1,640	1,537	857	2,100	9,301	2,967	4,064	-	12,585	5,306	45,950
XI	4,343	588	99	1,075	1,128	423	4,914	8,101	4,089	1,487	14,882	-	8,721	49,850
XII	2,609	642	196	355	731	357	1,841	3,739	505	3,564	13,828	19,674	-	48,041
TOTAL	263,058	29,669	24,070	99,210	94,113	35,517	39,909	51,081	44,664	17,993	81,935	77,385	29,306	887,910

SOURCE : NATIONAL CENSUS AND STATISTICS OFFICE (NCSO)

The government's objective given in the 5-Year National Development Plan provides two alternative solutions to this problem: 1) the population control measures to regulate continuous population increases and 2) the concentration of more development projects to low-income areas in order to have a balanced economic growth among regions so as to prevent the overflow of migrants.

3.3 ECONOMY

3.3.1 National Economy

From 1970 to 1975 real Gross National Product (GNP) registered a compound annual growth rate of 6.5%. It varies from 4.9% to 9.6% by year. According to NEDA, the relatively high growth rate in 1973 was due to the boom in world commodity prices as well as the quick and responsive effort of the government to restore the economy. Throughout the years 1975 to 1981 the real GNP was posted at a compound annual growth rate of 6.0%, slightly below the componded growth from 1970–1975. From 5.8% growth in 1975 it slowly increased to 7.0% in 1977 and 1978, then gradually decelerating up to 4.7% in 1981. This again, according to the NEDA, was due to external influences brought about by unstable world economy and some internal difficulties such as natural calamities. On the whole, the economy exhibited creditable performance despite the experienced difficulties which stemmed partly from the major reforms instituted by the government since 1972. (See Table 3.3-1 below).

By industrial sector, services dominates the country's economy throughout the years from 1970 to 1981. Next are industry and agriculture. The percentage contribution of Agriculture to the national economy slowly decreases during the twelve-year period from 29% to 25%. Service sector's contribution also gradually decreases from 42% to 38% whereas industry increases from 29% to 37%. This means that the country's sources of economy slowly shifts from agriculture to industry.

TABLE 3.3-1 NATIONAL AND REGIONAL ECONOMIC PERFORMANCE 1970–1981

(In Million Pesos at Constant 1972 Prices)

		1970 1/	1971	1972	1973	1974	1975	1976 1/	1977 1/	1978	1979	1980	1981
	G N P	50035	52921	55526	60881	64739	68530	72718	77789	83070	88128	92609	97446
	N C R		16182	16474	18989	21393	20976			26040	27971	29959	30504
	Region I		2691	2734	3036	3011	3144			3022	3181	3315	3634
	Region II		1421	1685	1688	1726	1809			2325	2441	2437	2691
	Region III		4664	4528	4660	5012	5556			6724	7056	7500	8508
	Region IV		6434	6351	6798	7092	9617			11795	12331	12935	13237
	Region V		2032	2499	2486	2494	2554			2819	3018	3277	3243
GRDP	Region VI		5988	5986	6468	6472	5837			6699	7090	7331	7985
	Region VII		3137	3619	3942	4036	4754			6158	6511	6794	6992
	Region VIII		1766	1798	2018	2002	2094			3209	2208	2272	2393
	Region IX		1589	1794	1768	1937	1834			2865	3037	3248	3249
	Region X		2304	2571	2758	2556	2731			3645	4068	4267	4387
	Region XI		3552	3950	4454	4363	4587			5637	5933	6292	6335
	Region XII		1768	1987	1866	1813	1962			2803	2904	3079	3027
	Philippines		53528	56076	60931	63907	67455			82797	87744	92706	96185

Note:

1/ Regional breakdown of GRDP is not available.

3.3.2 Regional Economy

The review of past regional economic performance revealed that the different regions of the country showed wide variations in growth and development. Overall, more than half of the country's domestic output was contributed by only 3 regions: Metro Manila (NCR) Southern Tagalog (R-IV) and Western Visayas (R-VI). The least economically developed regions are Regions II, VIII, IX and XII.

In terms of growth performance, Table 3.3-1 also showed that the growth in real terms of the different regions of the country exhibited a fluctuating trend. A very dramatic change is exhibited in some regions especially in the 1970–1975 period showing an abrupt change from a very low growth to a very high growth while others showed the opposite. Figure 3.3-1 shows the trend of national and regional economic growth in the study area.

The allocation of these industrial sector by region as of 1981 (as presented in Figure 3.3-2) shows that NCR is characterized as an industrialized region with high share of industry and services contribution. Regions III, IV and VIII have contributions coming mostly from services, moderately low in industry and very low in agriculture. The rest are agricultural regions with contributions coming mostly from agriculture.

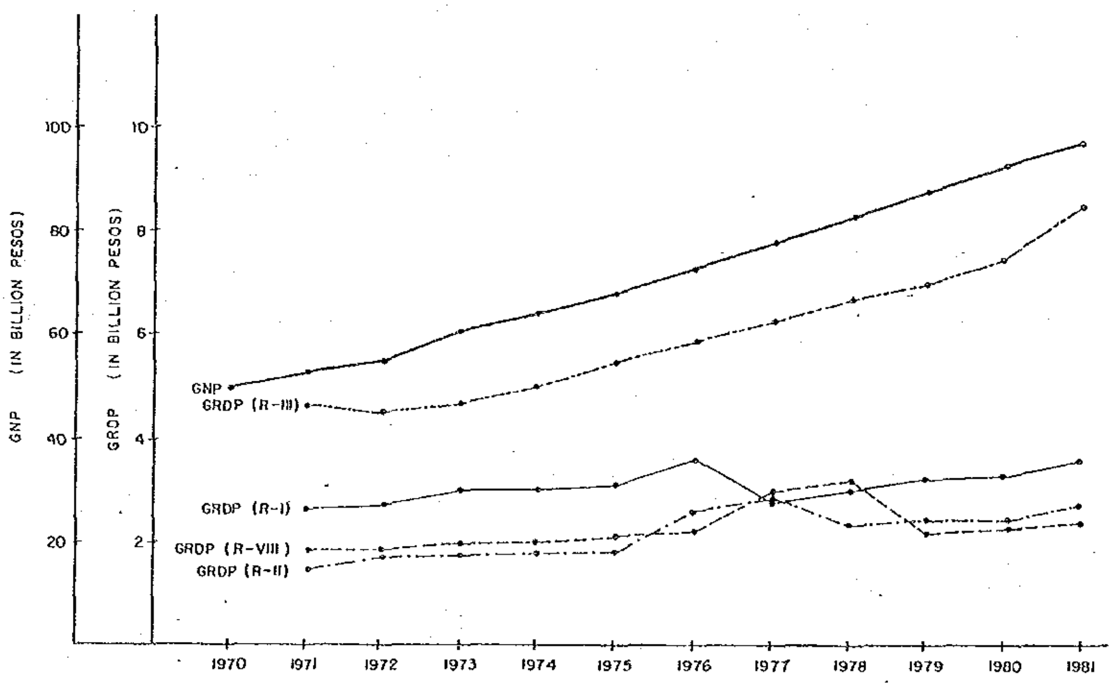
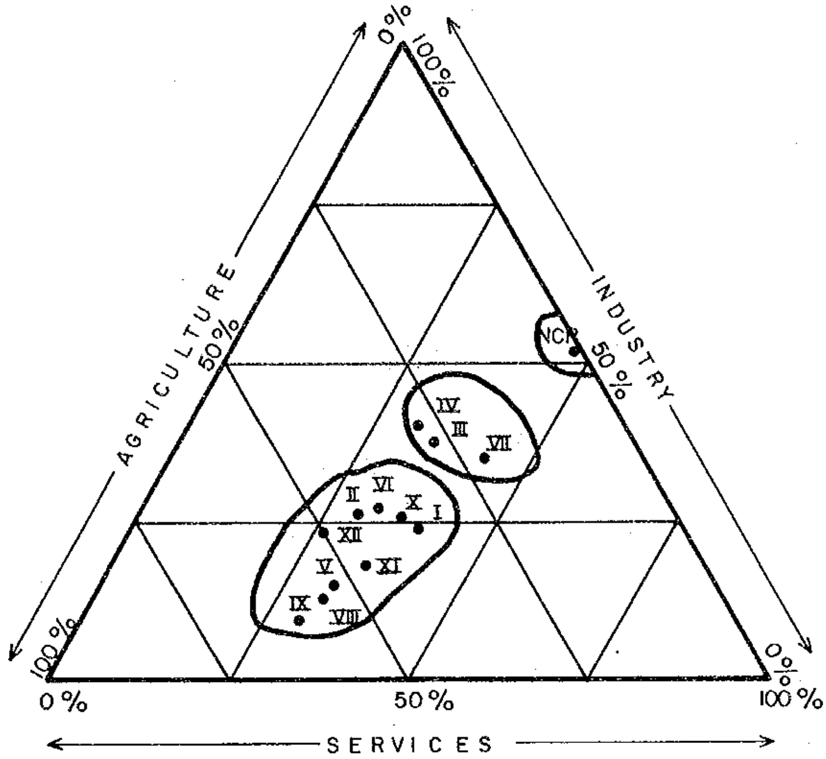


FIGURE 3.3-1 TREND OF GNP AND GRDP AT CURRENT 1972 PRICES



SOURCE OF BASIC DATA : NEDA estimates on GRPD, 1981

FIGURE 3.3-2 REGIONAL DISTRIBUTION BY INDUSTRIAL SECTOR, 1981

CHAPTER 4

ROAD FACILITIES AND TRAFFIC CHARACTERISTICS

4.1 TRAFFIC FACILITIES

4.1.1 Road Traffic Facilities

Table 4.1-1 shows national road extensions in each of the Regions included in the Study Area.

Both road densities and pavement ratios in Regions I, III and IV-A are higher than the national average. On the other hand, both road density and pavement ration in Region II are lower than the national average, and the Region has the lowest level of national road development within the Study Area. The Maharlika Highway accounts for 62 percent of the paved national road extension in this Region and thus contributes greatly to raising the Region's pavement raito.

Road density in Region V is the same as the national average, while pavement ratio is higher than the national average. The Maharlika Highway contributes greatly to raising the level of national road development in this Region, the Highway accounts for 24 percent of national road extension and 45 percent of paved road extension in this Region.

Road density in Region VIII is the same as the national average and pavement ratio is lower than the national average. As in Region V, the Maharlika Highway contributes greatly to raising the national road development level in this Region.

TABLE 4.1-1 NATIONAL ROAD LENGTH BY REGION: 1982

	Philippine	Region I	Region II	Region III	Region IV-A	Region V	Region VII
National Road							
Paved (km)	10,465	1,224	591	1,682	1,407	851	672
Unpaved (km)	13,317	935	1,682	402	724	793	1,212
Total (km)	23,782	2,159	2,273	1,608	2,131	1,644	1,884
Road Density (km/km^2)	0.08	0.10	0.06	0.09	0.11	0.09	0.09
Pavement Ratio (%)	44	57	26	75	66	52	36
Project Roads							
Total (km)	-	130	368	173	206	387	396
Project Road/National Road (%)	-	6	16	11	10	24	21
Project Road/Paved National Road (%)	-	11	62	14	15	45	59

Soure: Planning Service, MPWH

4.1.2 Other Traffic Facilities

1) Rail

Two lines of the Philippine National Railways (PNR) operate within the Study Area.

- Main Line North (Manila – San Fernando, La Union) .... 226 kms.
- Main Line South (Manila – Camalig) .... 460 kms.

There is also a branch line of the Main Line North:

- Branch Line (Tarlac – San Jose) .... 55 kms.

The Maharlika Highway and Main Line South run more or less parallel to each other and compete with each other in South Luzon. However, rail transport is gradually losing ground to road transport due to the deteriorated equipment and low service standard of the former caused by poor management and inadequate maintenance.

2) Sea

Figure 4.1-1 shows the locations of public ports which handle over 15,000 tons of commodities annually. There are three (3) such ports in North Luzon, eight (8) in South Luzon, five (5) in Samar and five (5) in Leyte.

Most sea transport is inter-island, and intra-island (coastal) transport is quite small, as indicated by the fact that only 6 percent of domestic sea freight are intra-island cargo. Moreover, among intra-island cargo, oil accounts for 98 percent of coastal transport.

NTPP estimates that road transport can compete effectively with sea transport within the following trip distances:

- For passenger transports, up to 1,000 kilometers (corresponds to Manila – Sogod, Southern Leyte)
- For general mixed freight, up to 600 kilometers (correspond to Manila – Sorsogon)
- Less than the above distances for large volume-bulk and semi-bulk cargoes

If the mode of transport is selected along the above guidelines, road transport will be selected for all Manila-based passenger trips within the Study Area and sea transport will be selected mainly for cargo trips between Manila and Samar or Leyte.

3) Air

Figure 4.1-1 shows the location of international, trunkline, and secondary airports within the Study Area. There are eight (8) airport in North Luzon, four (4) in South Luzon, two (2) in Samar and two (2) in Leyte.

Reliance on air transport for either passenger or cargo transport is extremely slight.

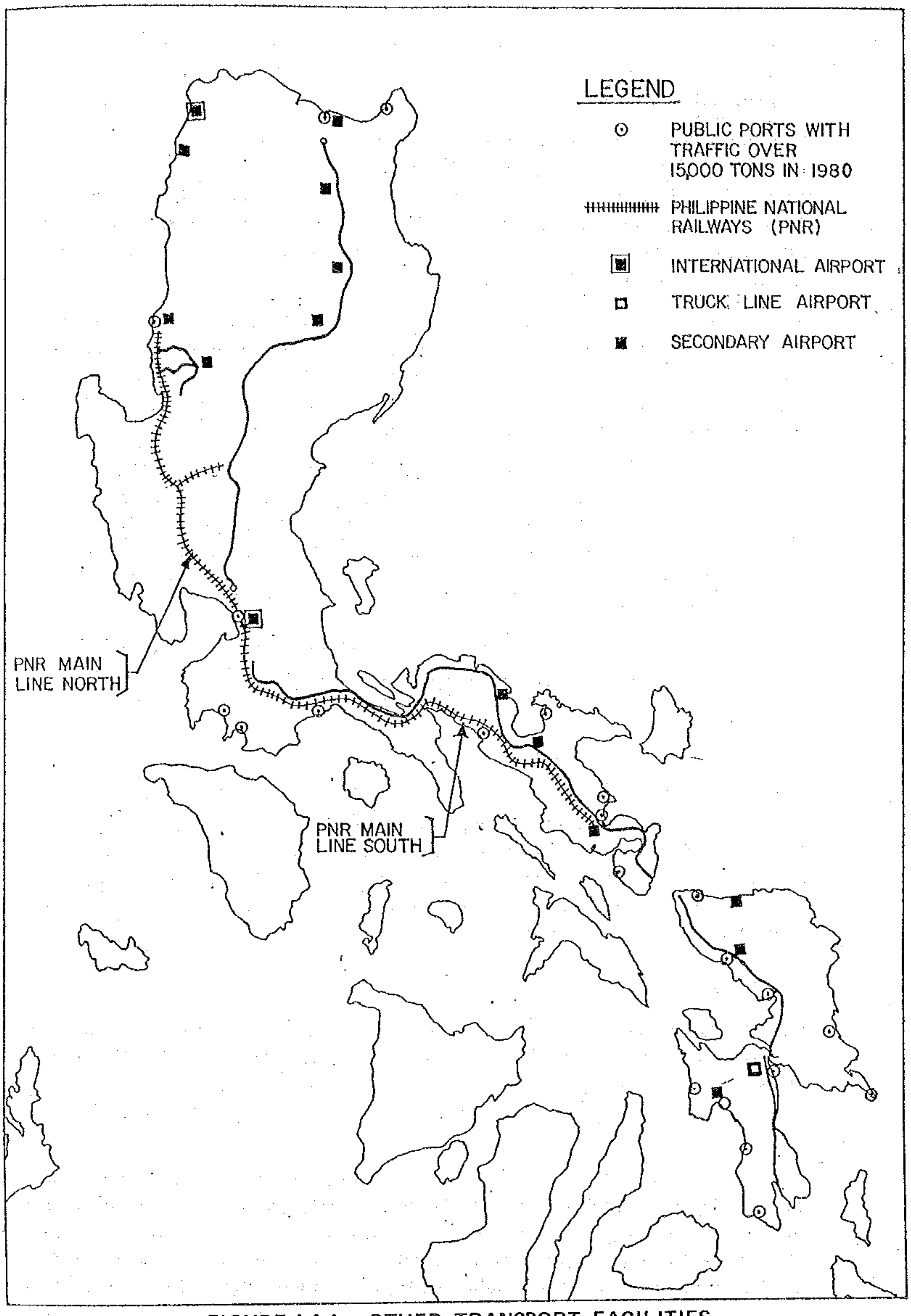


FIGURE 4.1-1 OTHER TRANSPORT FACILITIES

4.2 TRAFFIC CHARACTERISTICS

4.2.1 Traffic Data

1) Execution of Traffic Surveys

The study covers the entire Maharlika Highway, excluding the Mindanao section, namely the 1,637 kilometers from Allacapan at the northern tip of Luzon to Liloan at the southern tip of Leyte, and the three roads leading to Baguio City (i.e. Maguilian Road, Agoo-Baguio Road and Kennon Road, as listed from north to south, with respective road lengths of 47km, 49km and 34km). The total road length covered by the Study is about 1,770 kilometers.

The Maharlika Highway is a major trunk road that traverses the Philippine Islands from north to south. Because of its extreme length, the various sections that comprise the Maharlika Highway differ greatly in traffic characteristics. The three roads leading to Baguio City, each of which fulfill differing functions depending on their respective positions, also show characteristics on traffic behavior.

In order to obtain an accurate grasp of the traffic characteristics of each Study Section, to conduct traffic analyses and estimate future traffic volumes based on such characteristics, and to assess the feasibility of the Plan, the traffic surveys listed in Table 4.2-1 were conducted under the Study. The survey stations/routes are given in Figure 4.2-1.

2) Use of Existing Data

Data collected under the National Transportation Planning Project (NTPP) and roadside traffic count statistics conducted by the Ministry of Public Works and Highways (MPWH) during 1978 through 1982 are used as data supplementary to those obtained through the various traffic surveys conducted under the Study.

a) NTPP Data

Under NTPP, which started in 1980, data on various types of traffic are being collected on a nationwide basis and comprehensive traffic study covering land, sea and air transport is being conducted. Some of the main traffic surveys that have been executed are roadside origin-destination surveys, roadside traffic counts, bus passenger survey and commodity surveys at ports.

b) MPWH Data

MPWH takes annual roadside traffic counts at 1,386 survey station nationwide and also gathers data on traffic volumes, daily and monthly fluctuations of traffic volumes, etc. with regard to trunk roads.

3) Zoning

The NTPP zoning and coding system were used in the traffic surveys conducted under the Study. However, since NTPP uses a uniform coding system nationwide, the number of zones – 76 medium zones and 1,548 small zones – is considerably numerous, making it extremely inconvenient to tabulate and analyze the data collected under the Study. Hence, the basic zones established by NTPP were integrated into several larger

TABLE 4.2-1 TRAFFIC SURVEYS CONDUCTED

	Items Surveyed	Station/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	Station 1 ~ 8	12-hour survey. Converted to 24-hour traffic volumes using roadside traffic count results.
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	Station 2 ~ 5 Station 7 ~ 8	Same as above. NTPP data used for stations 1 and 6.
Roadside Traffic Count	Survey of number of vehicles passing through by type of vehicle, traffic direction and time period.	Station 1 ~ 8	24-hour traffic count
Travel Time Survey	Survey of average vehicle running speed on trunk roads near Baguio City.	Kennon Road Naguilian Road Manila North Road	
Cause of Delay Survey	Survey of vehicle delay time caused by road disasters (especially rockfalls and eroded sections).	Kennon Road	
Traffic Accident Survey	Survey of traffic accidents caused by road disasters: - Cause and location of accident - Type of accident - Cost of damages.	Kennon Road	Based on traffic accidents records.
Bus/ Jeepney Operation Survey	Survey of detours made due to road disasters: - Detour route - Number of detours made in a year - Loss caused by detour	Baguio City	

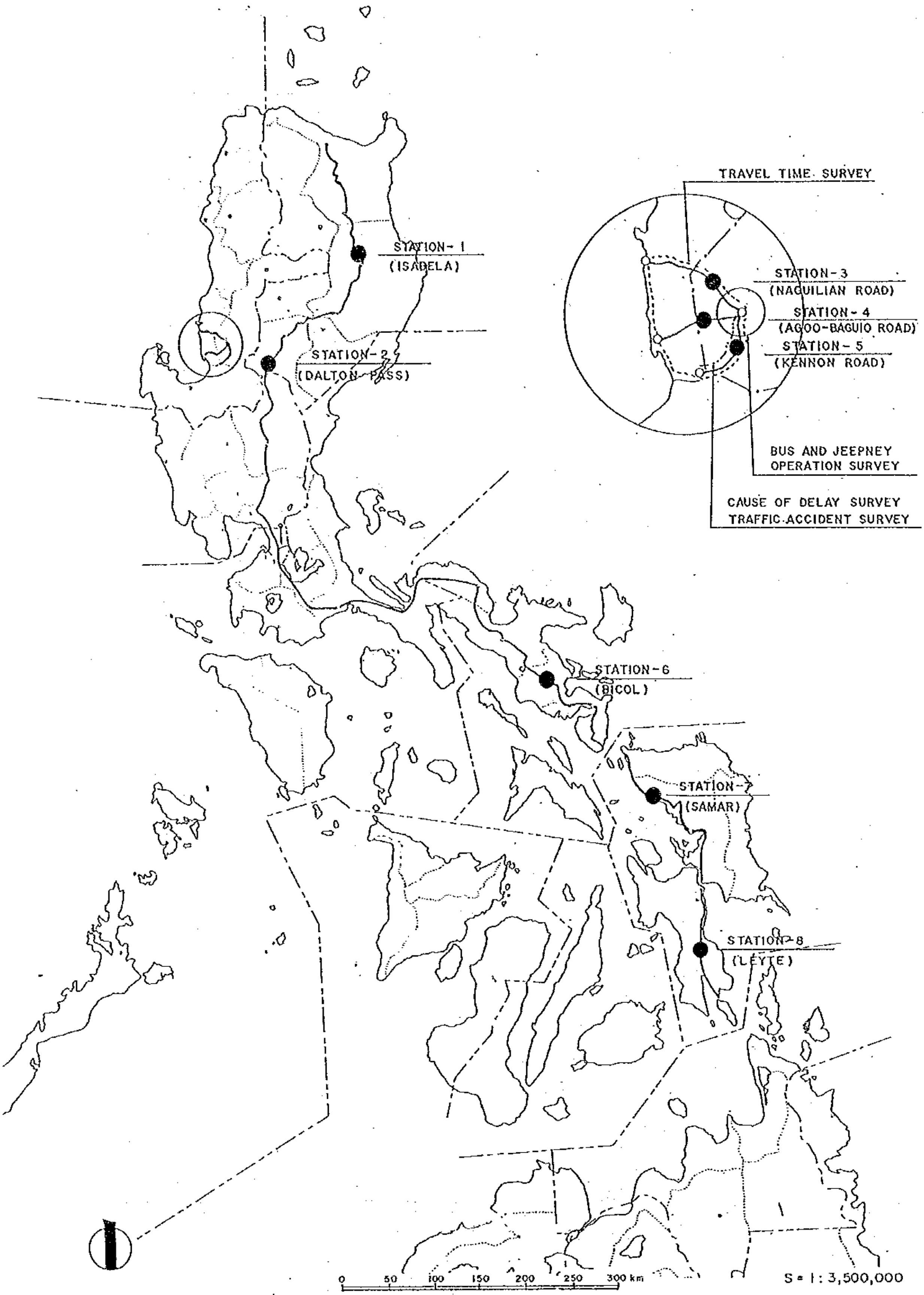


FIGURE : 4.2-1 TRAFFIC SURVEY STATIONS / ROUTES zones (about 30 zones) as appropriate for each survey station when tabulating and analyzing the results in order to facilitate the work.

As shown in Appendix 4-2, which gives the zoning used for this purpose.

4) Annual Average Daily Traffic

In order to obtain as accurate an annual average daily traffic (AADT) as possible, the reliability of the 24-hour traffic counts under the Study was checked by comparing the results with those of the time-series traffic counts taken by NTPP and MPWH, and daily and monthly traffic volume fluctuations at each survey station were analyzed based on MPWH's traffic counts taken at its seasonal stations[1/]. AADTs for each survey station were determined, as shown in Table 4.2-2, based on the following considerations:

- At survey stations 1 through 7, traffic counts obtained under the Study correspond closely with MPWH's data and, hence, are used without adjustment as AADT's for these stations.
- At survey station 8, the traffic count obtained under the Study is considerably smaller than MPWH's time-series data. (Although a detailed analysis is impossible since there are no MPWH seasonal stations nearby, the discrepancy is assumed to be due mainly to daily and monthly fluctuations and to the fact that, since traffic volume is small to begin with, variations inevitably become relatively large). Hence, the traffic count obtained under the Study adjusted to correspond to the average value of MPWH's time-series data is used as AADT for this station.
- For Kennon Road (survey station 5), detailed toll gate traffic counts are available. According to the data, there are about 1.68 times more passenger car traffic on weekends than on weekdays, while the volume of public transportation (bus, jeepney) remains about the same. The average weekday traffic count is used as AADT for this section (station) and in estimating future traffic volumes, and the weekend increase in passenger car traffic is taken into consideration only in the project benefit estimation.

TABLE 4.2-2 AADT AT EACH SURVEY STATION

(UNIT: VEH./DAY)

NUMBER OF SURVEY STATION	LOCATION	TRAFFIC SURVEYED	AADT
1	ISABELA	2,114	2,114
2	DALTON PASS	2,128	2,128
3	NAGUILAN ROAD	1,196	1,196
4	AGOO-BAGUIO ROAD	258	258
5	KENNON ROAD	1,815	1,815[1/]
6	BICOL	2,314	2,314
7	SAMAR	594	594
8	LEYTE	56	134

NOTE 1/ : DAILY FLUCTUATION IS CONSIDERED ON PROJECT BENEFIT ESTIMATION.

1/ *There are 56 seasonal stations nationwide, and one-week traffic counts are taken at each seasonal station once every month.

5) Basic Orign-Destination Tables

The origin-destination (O-D) tables are the most important source of information in analyzing current traffic conditions and estimating future traffic volumes. The basic O-D tables listed below were prepared in line with the objectives of the Study, first and foremost, and also as valuable data for MPWH to retain for future reference. The tables are coded and stored on magnetic tapes to allow computer analyses at a later data.

Basic O-D Tables	Unit
Origin-destination by type of vehicle	vehicles/day
Cargo origin-destination	tons/day
Bus/jeepney passenger origin-destination	passengers/day
Car origin-destination by trip purpose	vehicles/day

4.2.2 Traffic Characteristics

1) Nationwide Traffic Volume and Commodity Flow

a) Traffic Volume on Trunk Roads

- Northern Luzon

Traffic volumes on trunk roads in Luzon, Samar and Leyte, which comprise the Study Area, are given in Figure 4.2-2. The figures given are average daily traffic in 1980 based on NTPP statistics.

There are two major trunk roads – the Maharlika Highway and the Manila North Road – in Northern Luzon. They function as socio-economic arteries linking Metro Manila with the Cagayan Valley and with La Union/Ilocos Province, respectively. Traffic on both trunk roads varies within a range of 1,000 to 6,000 vehicles/day and increases as distance to Metro Manila decreases.

The Maharlika Highway traverses the near center of the Cagayan Valley in a vertical direction, running through Tuguegarao, Ilagan and Bayombong, the major cities of the region as listed from north to south, and extending to the Dalton Pass. Traffic in the northern part of Cagayan valley is 1,000 vehicles/day and in the southern part, 2000 vehicles/day. Past the Dalton Pass, the highway runs through Nueva Ecija and Bulacan and reaches Metro Manila. Traffic in Nueva Ecija is 4,000 vehicles/day and in Bulacan, the northern gateway to Metro Manila, is 6,000 vehicles/day.

The Manila North Road traverses western Luzon along its coastline, also in a vertical direction. It connects the municipalities and cities located along the coastline to Metro Manila. Major cities along the roads are Laoag, Vigan, San Fernando and Tarlac. Traffic in the northern area is 1,500 vehicles/day and in San Fernando, located at about mid-way between the northern tip of Luzon and Metro Manila, 4,000 vehicles/day despite the short length of this roads section. Traffic increases gradually as one goes south and

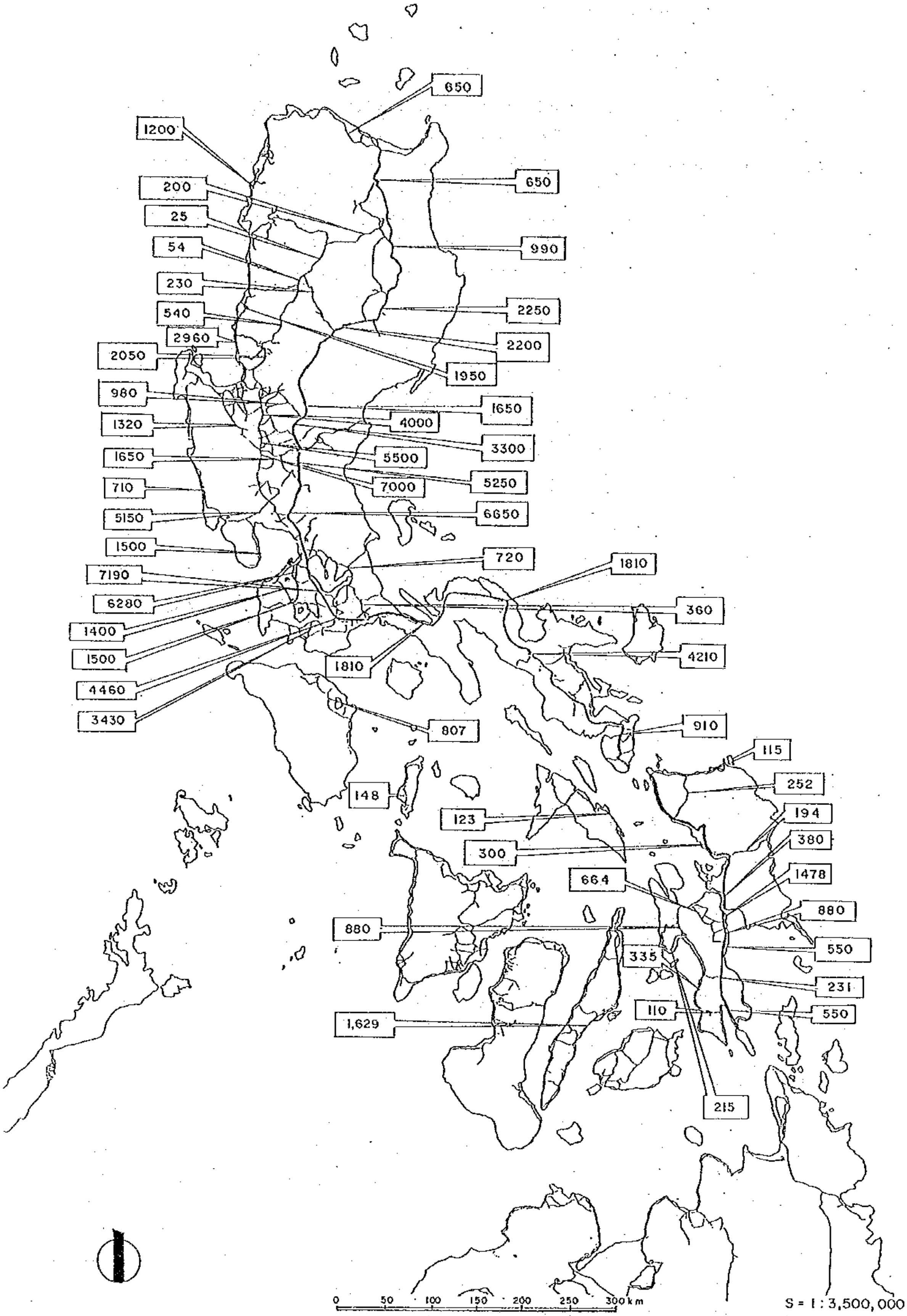


FIGURE : 4.2-2 ROAD NETWORK AND TRAFFIC VOLUME IN 1980 reaches 7,000 vehicles/day in Tarlac.

- Southern Luzon

The sole artery linking Southern Luzon with Metro Manila is the Maharlika Highway. The highway runs south – southeast from Metro Manila and extends to Matnog at the southern tip of Luzon. Traffic is less than 1,000 vehicles/day in Matnog but increases steadily to 2,000 vehicles/day at a point midway to Metro Manila, to 4,000 vehicles in Lucena and to 8,000 vehicles/day in Laguna. Moreover, traffic counts of 4,000 vehicles/day were recorded at certain points in and around Naga and Legaspi, the two major cities in Southern Luzon.

- Samar

In Samar, the Maharlika Highway runs along the western coastline of the island, connecting the municipalities scattered along the coastline to each other, and traffic ranges from 300 to 600 vehicles/day. There are two access roads leading from the Maharlika Highway to the eastern coast of Samar. Traffic on these roads is about 200 vehicles/day.

- Leyte

There are two trunk roads in Leyte, the Maharlika Highway along the eastern coastline of the island and the West Leyte Road along the western coastline. Each trunk road passes through a major city, namely Tacloban and Ormoc. Traffic on the Maharlika Highway exceeds 2,000 vehicles/day at certain points in and around Tacloban, located in northern Leyte, and decreases as one goes south – about 700 vehicles/day in the central area and 200 to 400 vehicles/day in the southern area. Traffic on the West Leyte Road is 2,000 vehicles/day at certain points in and around Ormoc but is about 400 vehicles/day on average.

- Baguio City and its Vicinity

Trunk roads extending from Baguio City are the three roads that link the city with the Manila North Road running along the western coastline – the Naguilian Road, Agoo-Baguio Road and Kennon Road, as listed from north to south. Traffic volumes on these roads are 1,200 vehicles/day, 300 vehicles/day and 1,800 vehicles/day, respectively. The Baguio-Bontoc Road leading out from Baguio City in a northeasterly direction is an important part of the road network in this area, but traffic on this road is only 500 vehicles/day.

b) Commodity Flow

A surplus-deficit analysis was made under the Study in order to grasp the general flow of commodities on a national level. Regional production volumes of selected basic commodities obtained from various government agencies and regional consumption volumes of such commodities estimated on the basis of census records and other data were compared in order to analyze their supply/demand situation in each region. Commodities with heavy flow and that are basic to the needs of the nation's socio-economic activities were selected for analysis. They are: rice, perishable food, sugar, timber and cement (see Appendix 4-4 and 7-1).

• Rice

Metro Manila requires the largest volume of rice, at an estimated 525,000 tons/year, followed by Southern Luzon, at 144,000 tons/year. The largest supplier of rice is the Cagayan Valley, at 255,000 tons/year, followed by Central Mindanao, at 224,000 tons/year, and Central Luzon, at 165,000 tons/year. The Cagayan Valley accounts for an estimated 40 percent of the total volume of rice supplied to Metro Manila. Rice shipped out from Central Mindanao goes to Metro Manila and Southern Luzon.

• Perishable Food (Vegetables)

The largest consumption of perishable food occurs, as in rice, in Metro Manila and Southern Luzon, while Central Mindanao and Bicol are the major suppliers. Shipments to Metro Manila are made by boat from Central Mindanao and by truck from Bicol. Vegetables produced in Eastern Visayas are shipped by boat to Western and Central Visayas.

• Sugar

Western Visayas accounts for a major portion of sugar supply in this country. Sugar produced in Western Visayas is shipped by boat to Metro Manila, Eastern Visayas and Mindanao. Part of the sugar that reaches Manila is, in turn, transported to Ilocos and the Cagayan Valley by truck. Central Luzon is also an important supplier of sugar to Metro Manila and the Cagayan Valley.

• Timber

Nearly all regions are supplied with timber, but consumption is by far the greatest in Metro Manila. Important timber-producing areas are the Cagayan Valley and Northern and Eastern Mindanao. Truck shipments from the Cagayan Valley account for about 40 percent of the timber supplied to Metro Manila and boat shipments from Mindanao, about 60 percent.

• Cement

Because of the fact that regions supplying cement and regions requiring cement are located relatively close to each other and are connected by land, it is assumed that most cement shipments are made by truck. Metro Manila receives its supply of cement from Ilocos and Central and Southern Luzon, and the Cagayan Valley and Bicol receive theirs from Central and Southern Luzon, respectively.

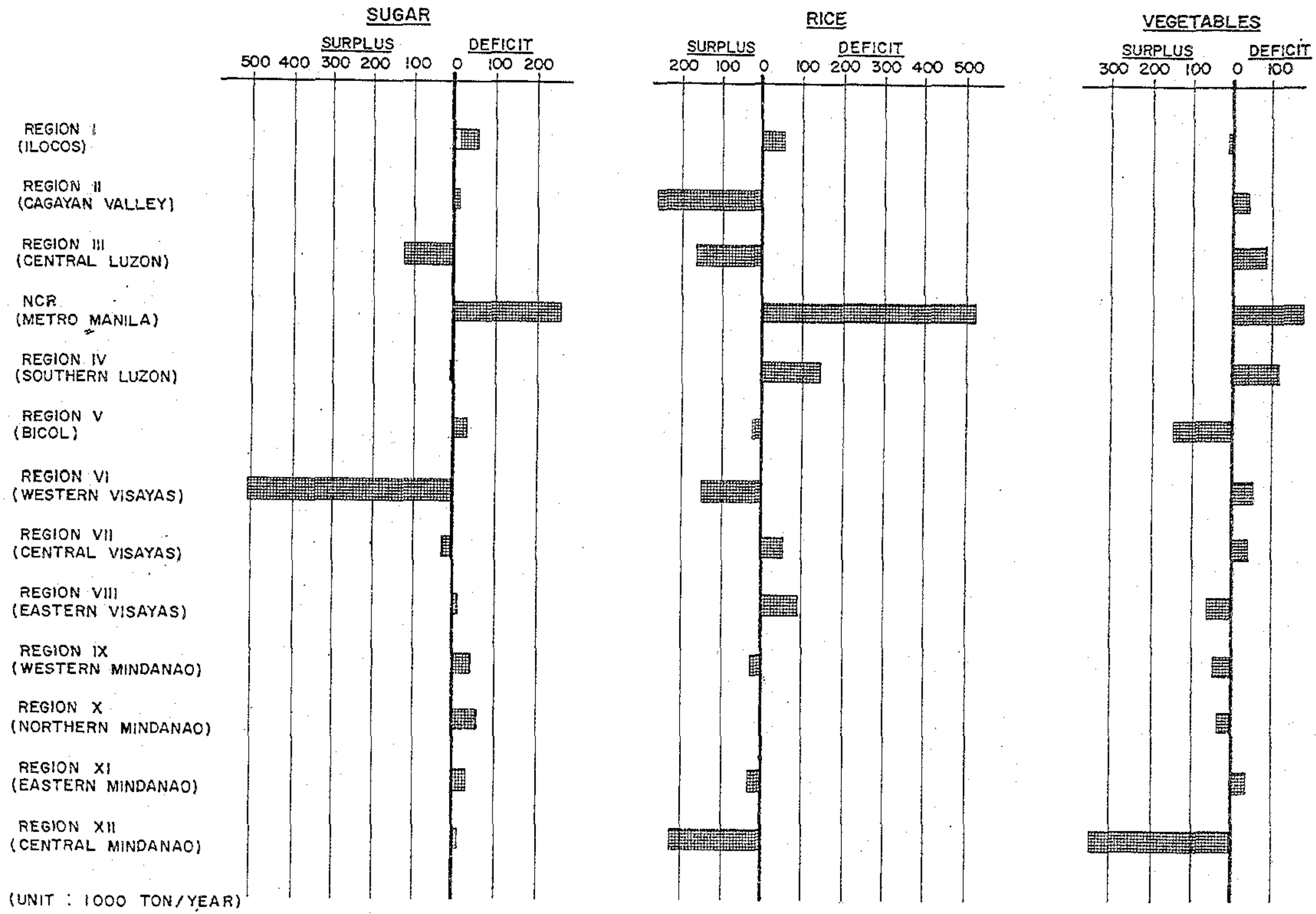


FIGURE 4.2-3(1) SURPLUS/DEFICIT BY COMMODITY TYPE IN 1980

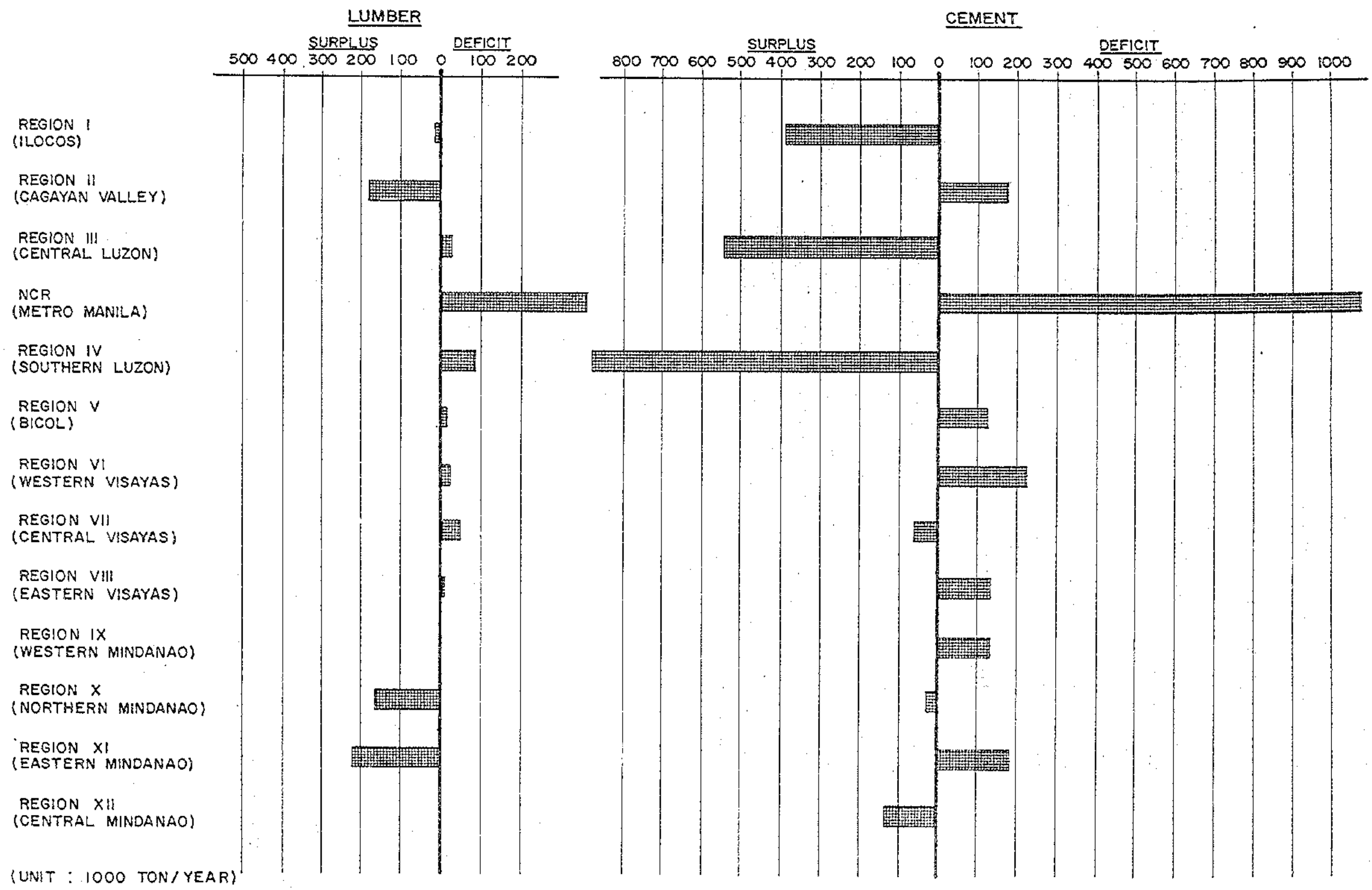


FIGURE 4.2-3(2) SURPLUS/DEFICIT BY COMMODITY TYPE IN 1980

2) Traffic Characteristics of Each Survey Station

a) Traffic Volume and Commodity Flow

• Traffic Volume

Sections with heavy traffic are Bicol, Dalton Pass and Isabela, where high traffic counts of 2,314 vehicles/day, 2128 vehicles/day and 2,114 vehicles/day, respectively, were recorded (see Table 4.2-3). All these three sections are part of the Maharlika Highway in Luzon. Sections with light traffic are Mahaplag – Sogod, which is part of the Maharlika Highway in Leyte, and the Agoo-Baguio Road. Low traffic counts of 134 vehicles/day and 258 vehicles/day, respectively, were recorded in these sections.

• Passenger Transport

The number of passengers transported by public transportation (bus, jeepney) is given in Table 4.2-3. Passenger transport exceeds 10,000 persons/day in the Bicol and Isabela sections of the Maharlika Highway and on Kennon Road. Owing to inadequate long-distance railroad facilities and the limited number of people that can afford cars in the Philippines, public transportation represented by buses and jeepneys accounts for a major share of passenger transport. Hence, these sections constitute important corridors supporting the nation's socio-economic activities which go hand in hand with the movement of people from place to place.

TABLE 4.2-3 EXISTING PUBLIC UTILITY VEHICLE PASSENGER AND COMMODITY FLOW

Survey Station	Traffic Volume (Vehicle/Day)					P U V Passengers (Pass./Day)	Commodity (Ton/Day)
	Car	Jeepney	Bus	Truck	Total		
1. Isabela Section	776	543	224	571	2,114	14,049	2,527
2. Dalton Pass Section	588	212	261	1,067	2,128	8,386	8,220
3. Naguilian Road	455	403	73	265	1,196	8,123	1,404
4. Agoo-Baguio Road	135	91	6	26	258	989	63
5. Kennon Road	874	169	464	308	1,815	13,776	1,160
6. Bicol Section	934	532	492	356	2,314	16,326	1,492
7. Samar Section	217	182	46	149	594	4,293	438
8. Leyte Section	60	2	29	43	134	329	144

Source: The Team

• <u>Commodity Flow</u>

Commodity flow is by far the heaviest — 8,200 tons/day — in the Dalton Pass section. Rice and timber are the main items transported from Cagayan Valley to Metro Manila, while in other direction, processed food, gasoline, construction materials and machinery are transported. Another major characteristic of the Dalton Pass section is its large traffic of heavy-duty trucks. Whereas the average weight of cargo per truck in other sections is three to four tons. In Dalton Pass, it is 7.7 tons, or about twice that of other sections. Next to Dalton Pass, commodity flow is heaviest in the Isabela section (2,500 tons/day), which is also located in the Cagayan Valley followed by the Bicol section (1,500 tons/day), the Naguilian Road (1,400 tons/day) and the Kennon Road (1,200 tons/day). The above sections have distinct characteristics in terms of commodity transport: In Isabela section, majority are timber and rice, in Bicol section-processed food, in Naguilian Road-copper ore and gasoline and in Kennon Road-perishable food and construction materials.

b) Influence Zone

Based on data obtained under the Study on the origins and destinations of vehicles passing through survey stations, each section was extended to encompass its zone of influence, as shown in Figure 4.2-4.

TABLE 4.2-4 SUMMARY OF TRAFFIC ON DALTON PASS, LEYTE AND KENNON ROAD

		Dalton Pass Section Direction			Mahaplag-Sogod Section Direction			Kennon Road Direction		
		North	South	Total	North	South	Total	North	South	Total
CARGO (in tons)	1. Unprocessed Cereals	0	587	587	0	0	0	0	0	0
	2. Other Unprocessed Agricultural Foodstuffs	36	122	158	0	0	0	12	202	214
	3. Unprocessed Agricultural Cash Crops	0	57	57	24	0	24	113	0	113
	4. Processed Agricultural Products	185	1,039	1,224	0	0	0	83	0	83
	5. Manufactured Foodstuff	406	191	597	0	87	87	126	2	128
	6. Other Manufactured Consumer Goods	71	11	82	0	0	0	14	9	23
	7. Forestry and Mining Products	0	3,867	3,867	0	2	2	30	35	65
	8. Mineral Oil Products	252	2	254	0	0	0	20	6	26
	9. Building and Construction Materials	743	173	926	0	0	0	231	13	244
	10. Manufactured Producers Goods	174	294	468	31	0	31	141	62	205
	11. Empty Trucks	-	-	-	-	-	-	0	0	0
	12. Unknown	-	-	-	-	-	-	-	-	59
	Total	1,867	6,343	8,220	55	89	144	771	329	1,160

- Isabela Section

Of the 2,114 vehicles daily traffic passing through the Isabela section, about 70 percent, or 1,480 vehicles, originate in the Isabela Province. This is followed by the Cagayan Province and Metro Manila, so that this section is seen to service traffic linking Cagayan, Isabela and Metro Manila. The length of the influence zone is about 560 kilometers.

- Dalton Pass Section

The Dalton Pass section has a very large influence zone encompassing regions along the Maharlika Highway from the Cagayan Province to Metro Manila as well as the Benguet and Pangasinan Provinces. Its length of about 730 kilometers is slightly shorter than the influence zone of the Bicol section, but its spread is the largest.

- Naguilian Road

The influence zone of the Naguilian Road covers about 190 kilometers from Benguet Province to Ilocos Norte Province. Most of the vehicles passing through this section originate in Baguio, San Fernando, La Union and Ilocos. Each of the Agoo-Baguio, Kennon and Naguilian Roads have separate influence zones and fulfill separate functions. In other words, the Naguilian Road services traffic between Baguio and the provinces north of Baguio, the Agoo-Baguio Road services traffic within the provinces along the road, and the Kennon Road services traffic between Baguio and the provinces/regions south of Baguio, especially Pangasinan and Metro Manila.

- Agoo-Baguio Road

The influence zone of the Agoo-Baguio Road is limited to those provinces which lie along the road. The length of its influence zone is about 40 kilometers.

- Kennon Road

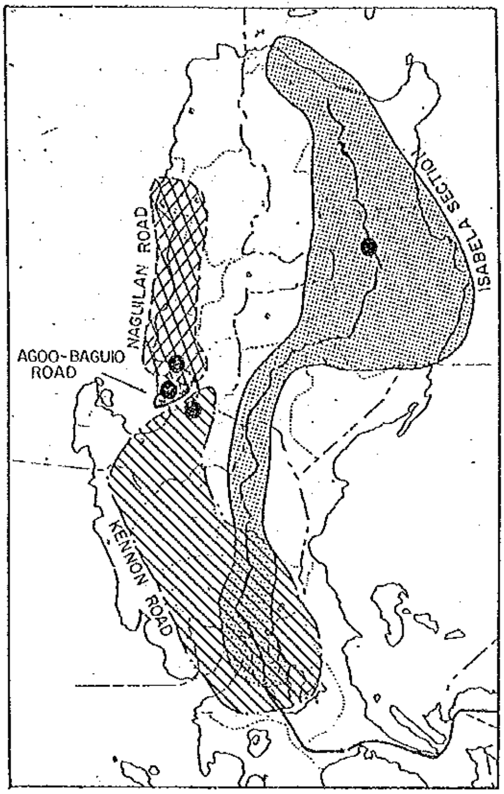
The influence zone of the Kennon Road extends from Benguet to Pangasinan and Metro Manila, resulting in a length of about 310 kilometers.

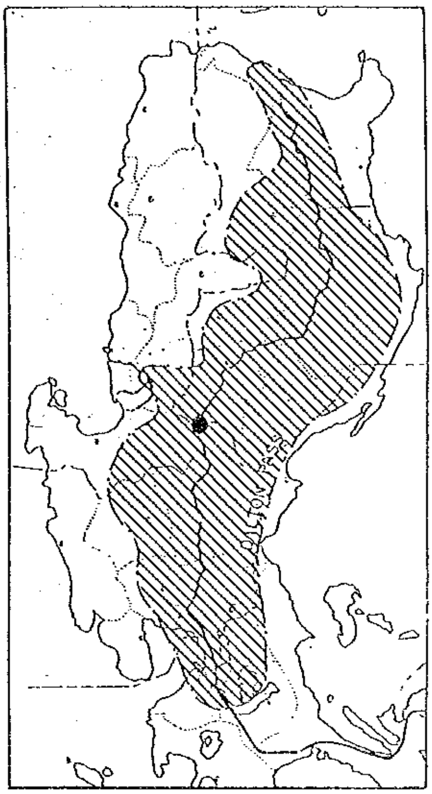
- Bicol Section

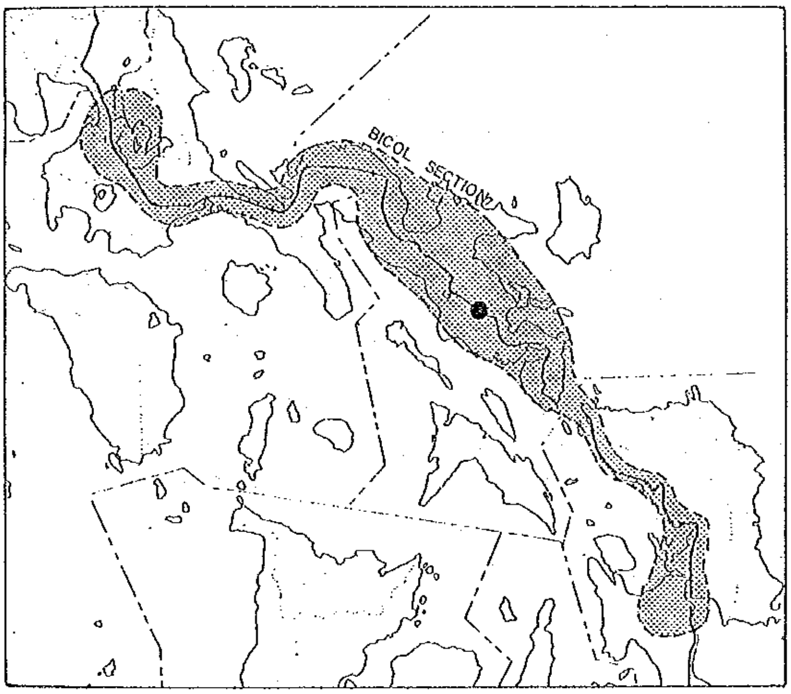
Of the 2,314 vehicles daily traffic passing through the Bicol section, about 90 percent, or 2,130 vehicles, originate in Bicol, which is comprised of Camarines, Albay and Sorsogon. Of the three provinces, Albay generates the most traffic accounting for 1,610 vehicles/day. Traffic generated in Metro Manila and Leyte – about 85 and 60 vehicles/day, respectively – also pass through this section. As a result, the influence zone of this section is the longest, covering 920 kilomaters from Metro Manila to Leyte.

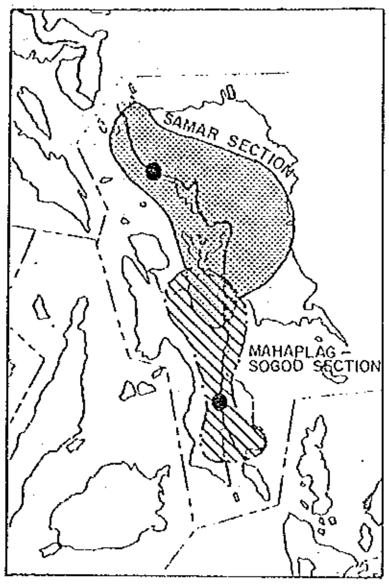
- Samar Section

The major zone of influence is limited to the whole of Samar which covers about 240 kilometers.









(UNIT : KM)

EXPANSION OF AFFECTED AREA	
ISABELA SECTION	560
DALTON PASS SECTION	730
NAGUILAN ROAD	190
AGOO - BAGUIO ROAD	40
KENNON ROAD	310
BICOL SECTION	920
SAMAR SECTION	240
MAHAPLAG-SOGOD SECTION	150

FIGURE : 4.2-4 EXPANSION OF AFFECTED AREA OF EACH SURVEY STATION

- Mahaplag - Sogod Section (Leyte)

The Mahaplag - Sogod section in Leyte has the lightest traffic, at 134 vehicles/day, of all sections surveyed. Its influence zone, being limited to Leyte, is also small and covers only about 150 kilometers. Tacloban and Southern Leyte generate most of the traffic in this section, and the section services traffic linking the two regions. The influence zone of this section is expected to expand to include Mindanao as well, when the planned ferry service between Mindanao and Leyte is in operation in the near future.

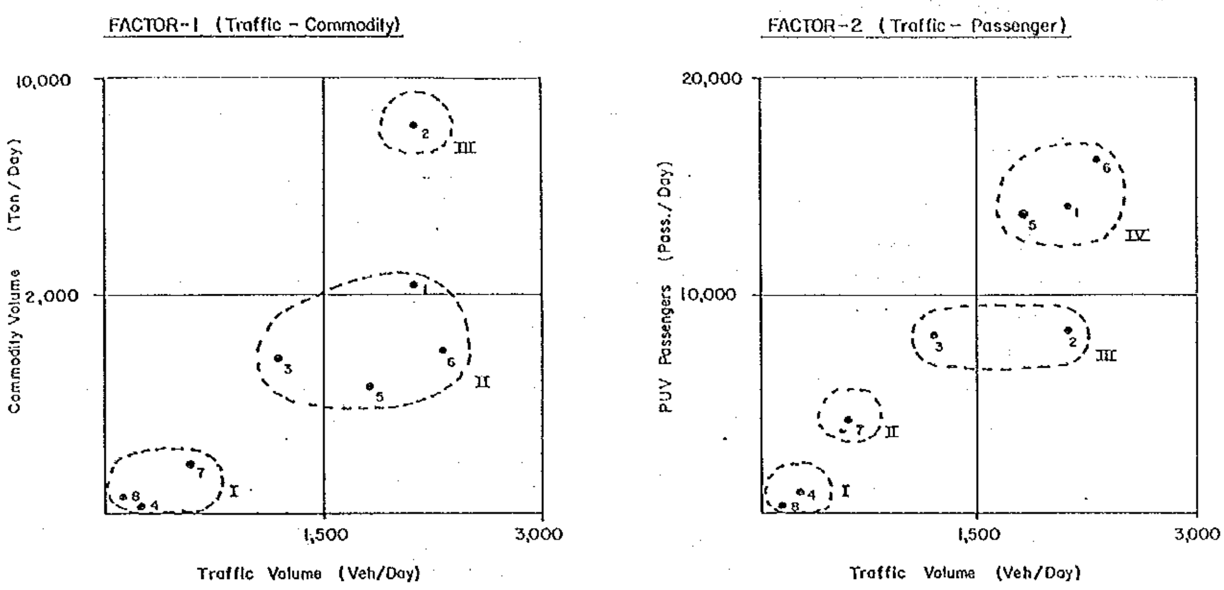
c) Functional Characteristics of Each Section

An attempt was made to express the functional characteristics of the sections by factors composed of traffic volume, commodity flow and number of public transportation passenger combinations. A traffic volume/commodity flow combination is used as factor 1, and the sections are grouped together according to this factor. A traffic volume/number of public transportation passenger combination is used as factor 2, and the sections are likewise grouped together according to this factor, Finally, the functional characteristics of the sections are expressed on diagram by factors 1 and 2. Figure 4.2-5 shows this process and its results.

The sections can be classified into the following five groups acoording to their functional characteristics:

- Group 1 : Dalton Pass section
- Group 2 : Isabela section, Kennon Road and Bicol section
- Group 3 : Naguilian Road
- Group 4 : Samar section
- Group 5 : Agoo-Baguio Road and Leyte section

Group 1 consists of trunk roads with heavy commodity flow and these roads are especially important from an economic standpoint. Group 2 consists of major trunk roads with heavy passenger flow and these roads are especially important in relation to social activities. The sections and roads included in Groups 1 and 2 are extremely important on a national as well as regional level. Roads in Group 3 have medium commodity and passenger flow and are next in importance to Group 1 and 2. Groups 4 and 5 consists of roads with light commodity and passenger flow. These roads are currently functioning as roads servicing interregional traffic, and they support the socioeconomic activities of surrounding provinces.



Note: Figures beside dots show each station number

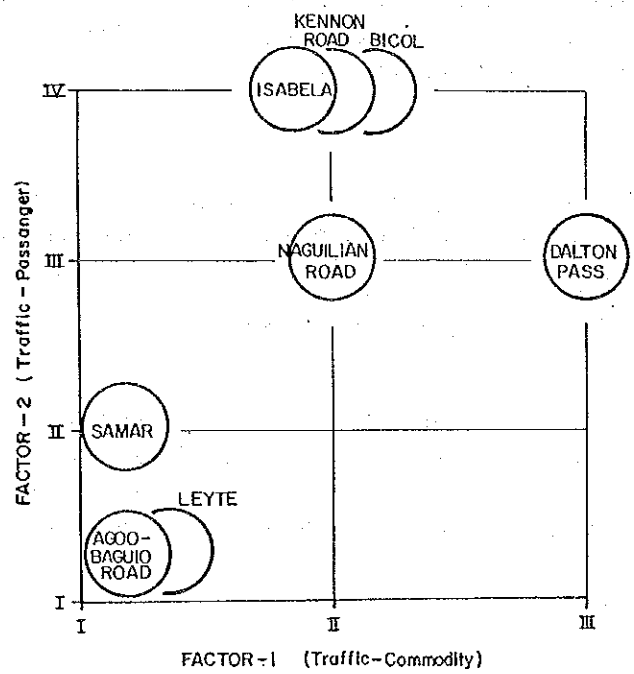


FIGURE 4.2-5 FUNCTIONAL CHARACTERISTICS OF EACH SECTION

4.3 ROAD NETWORK ISSUES

Figure 4.3-1 shows the conceptual structure of trunk road network in the Study Area.

The Maharlika Highway and Manila North Road are the two axes in North Luzon. Road network leading to various areas branch off from the two axes, but the Luzon Central Cordillera range located in between the two roads prevent them from being linked to each other, with the result that each is functioning independently of the other For this reason, access to the Cagayan Valley Region, for example, can be made only from the Maharlika Highway. If the Highway becomes impassable due to road disaster, the Cagayan Valley is isolated.

South Luzon has only one axis, the Maharlika Highway.

In Samar, the Maharlika Highway is the western coast axis as well as the sole axis in the Island until the eastern coast axis is completed.

Leyte has two axes, the Maharlika Highway on the eastern coast and the West Leyte Road on the western coast. The west Leyte Road, however, is still sub-standard.

Under the current situation, only one axis provides access to most regions. If the axis becomes impassable at any point due to road disaster, the region will become isolated, and if the axis remains impassable for too long a period, the socioeconomic activities of the region will become paralyzed. The structure of the current trunk road network is such that emergency situations cannot be countered effectively or reliably.

The solution to this problem is to provide flexible road network with links between trunk roads so as to have alternative routes within short distances. To achieve this, hewever, huge investments over a long period of time are required.

A more realistic solution, therefore, is to strengthen the weaknesses of existing roads so that traffic can be secured throughout the year. This measure is also necessary to take full advantage of past investment.

Even on the most important trunk roads in this country, like the Maharlika Highway, road disasters due to typhoons of heavy rainfalls occur and often cause traffic interruption. Implementing disaster control measures on existing trunk roads and making them "disaster-proof" in order to secure traffic throughout the year is quite important issue.

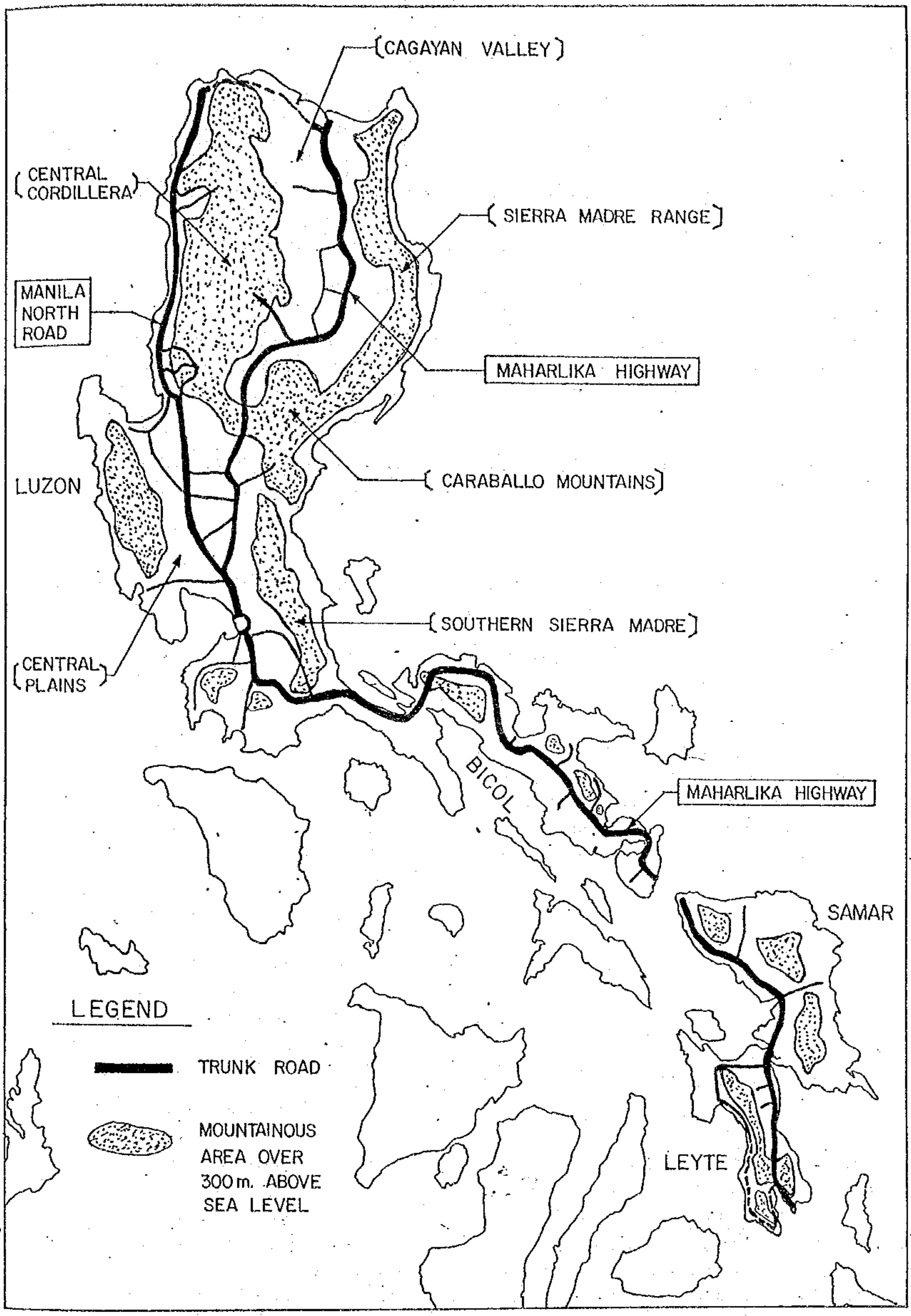


FIGURE 4.3-1 SCHEMATIC TRUCK ROAD NETWORK

CHAPTER 5

ROAD DISASTER

5.1 IDENTIFICATION PROCEDURE

Identification of spots with disaster potential consists of two main tasks, as follows:

- Classification of road disasters
- Identification of spots with disaster potential

Classification of road disasters is the fast task to be conducted in road disaster prevention study. This is because all works, identification of disaster spots, geo-technical surveys, selection of countermeasures etc., should be conducted based on types of disaster classified in advance.

The classification of disasters was made referring to the classifications in existing text books to be consulted and considering characteristics of disasters in the Philippines.

5

The procedure for identifying spots with disasters potential is as follows:

- Collection and analysis of basic data, including topographical, geological, and 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 aboves, soundings, borings, seismic refractions, groudwater surveys, soil tests in relation to these surveys and so on. However, when there are many survey spots, time and funds do not make it possible to conduct these surveys. In the Study, therefore, the identification was done through visual inspection by experienced engineers without these surveys.

5.2 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 rhrough visual inspection. But movement of failure, at any rate,

must be analyzed when designing countermeasures. Thus, both methods have their advantages and disadvantages. In the Study, classification based on the shape was chosen taking of easy discrimination.

Road disasters in the Study were classified into six main types: 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 depending on the cause or shape of disaster.

5.2.1 Cut Slope Failures (inluding natural slopes) (See Table 5.2-1).

Cut slope failures are classified into surface failures and deep failures, which are firther 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 rainfalls.

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 it 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 elevation of groundwater.

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.

5.2.2 Embankment Slope Failures including natural slopes (See Table 5.2-2).

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 embank-ments 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.

TABLE 5.2-1 CLASSIFICATION OF CUT SLOPE FAILURE

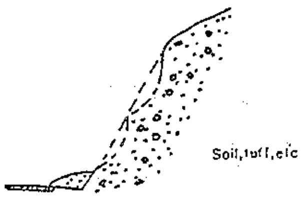
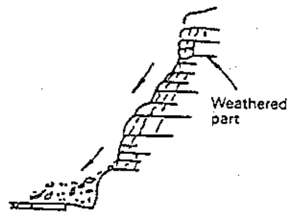
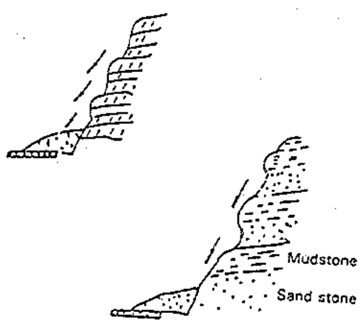
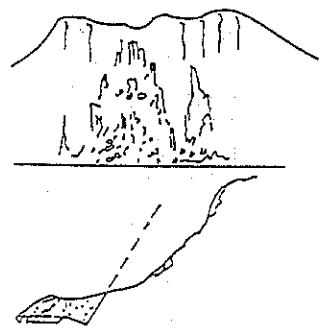
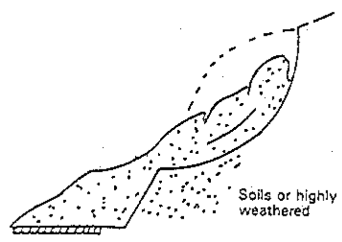
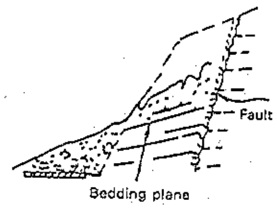
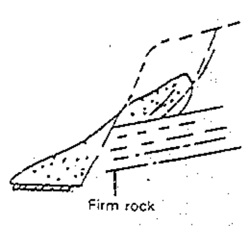
Classification	Description	Type: Type	Type: Description	Illustration	Soil & Rock Susceptible To Failure	Remarks
Surface Failure (C - SF)	Shallow failure on surface of slope caused by erosion, weathering and structural weakness.	(1) Erosion (C-SF(E))	Erosion due to heavy rainfall which often forms gullies 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 5.2-2 CLASSIFICATION OF EMBANKMENT SLOPE FAILURE

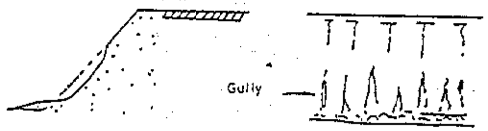
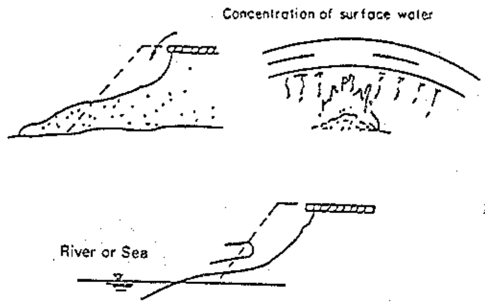
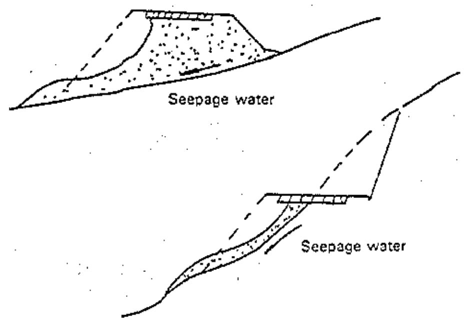
Classification	Description	Type: Type	Type: Description	Illustration	Soil Susceptible To Failure	Remarks
Surface Failure (E - SF)	Shallow failure due to erosion.	Erosion (E-SF(E))	Erosion due to heavy rainfall which often forms gullies on slope surface.		Sandy soil, Masa etc.	
Deep Failure (E - DF)	Deep 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 5.2-3 CLASSIFICATION OF FALL

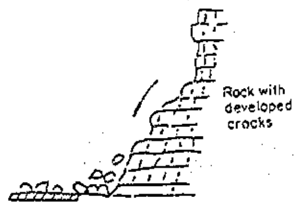
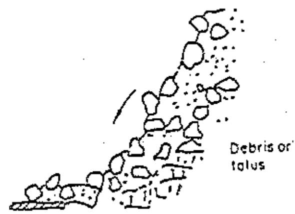
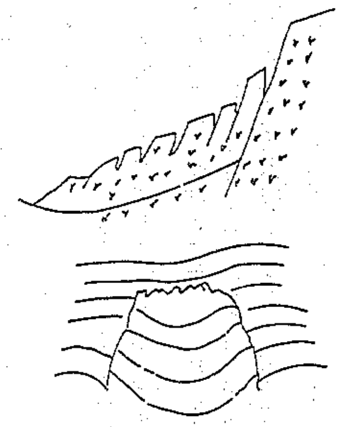
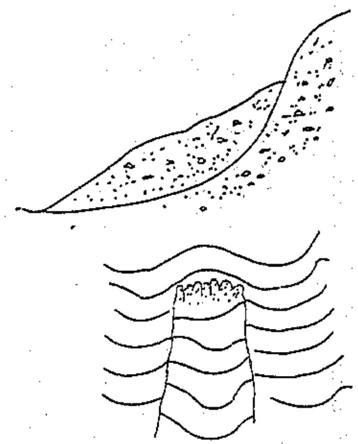
Classification	Description	Type: Type	Type: Description	Illustration	Soil & Rock Susceptible To Failure	Remarks
Falls (C - F)	Free fall of rocks, cobbles etc., detached from a surface of steep slope.	(1) Rock Fall (C-F(R))	Free fall of detached rocks from a surface of slope of bedrocks with developed 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.	

TABLE 5.2-4 CLASSIFICATION OF LANDSLIDE

Classification	Description	Type: Type	Type: Description	Illustration	Soil & Rock Susceptible To Landslide	Remarks
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.

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. Scouring is 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 groundwater seepage into the embankment. These failures have circular sliding planes and often appear on embankment slopes located on inclined ground or semi-cut fill sections.

5.2.3 Falls (See Table 5.2-3)

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.

5.2.4 Landslides (See Table 5.2-4)

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 distiguish between slope failures and landslide, but they are generally differentiated by the following characteristics:

TABLE 5.2-5 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	Gauses	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

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

a) Rock Landslides

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 slow, and sliding is continuous and recurring.

5.2.5 Debris Flows (See Table 5.2-6)

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 damges.

b) Mud Flows

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

5.2.6 Others

Disasters not included in the above classifications, such as submersions 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.

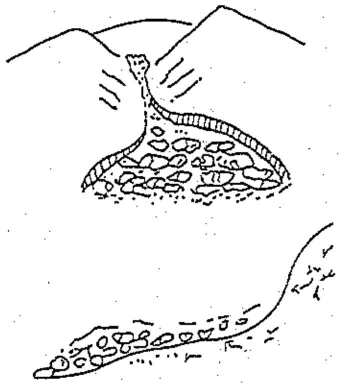
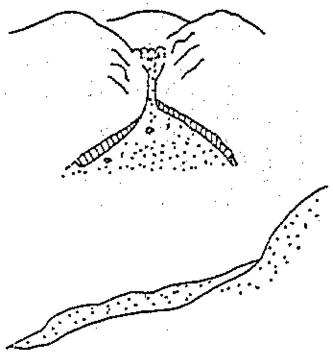
5.3 IDENTIFICATION AND EVALUATION OF SPOTS

5.3.1 Identification of Spots with disaster potential

As mentioned in 5.1, spots with disaster potential are identified on the basis of analysis of existing data and field reconnaissance results.

1) Analysis of Existing Data

TABLE 5.2-6 CLASSIFICATION OF DEBRIS FLOW

Classification	Description	Type: Type	Type: Description	Illustration	Soil & Rock Susceptible To Debris Flow	Remarks
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.	

a) Topographical Data

Main topographical data analyzed are as follows:

- 1/50,000 scale topographical maps: BCGS
- 1/15,000 scale aerial photographs: Of Kennon Road, Agoo-Baguio Road, Mahaplag-Sogod section
- 1/5,000 scale topographical maps: Prepared by JICA for the "Feasibility Study on Dalton Pass Tunnel Project," 1982.

The 1/5,000 scale topographical maps were especially useful in identifying and checking the locations of disaster spots. Aerial photographs of the Agoo-Baguio Road and Mahaplag-Sogod Section were taken before construction of the so that it was not so useful in the identification work.

b) Geological Data

Main geological data analyzed are as follows:

- "Geology and Mineral Resources of the Philippines," Bureau of Mines and Geo-Sciences, Ministry of National Resources, 1982.
- "Geological Map of the Philippines, "Bureau of Mines and Geo-Sciences.
- Report on the Geotechnical Investigation in Connection with the Project Study of Mass-Movement Affecting Kennon Road," 1982, Bureau of Mines and Geo-Sciences.
- "Geology and Mineral Resources," Bureau of Mines and Geo-Sciences (for relevant provinces).
- and so on.

All these information were useful in obtaining an outline understanding of the country's geology. Especially useful were the information on Kennon Road and Dalton Pass.

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 aboves provided useful information. However, while areas where disasters occur frequently are mostly high-altitude mountainous sections, weather stations are generally located in low attitude 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 typhoon damage reports (prepared by MPWH's Bureau of Maintenance, regional offices or district/city engineering offices). However, these reports have deficiencies as follows:

- Disaster spots are not indicated precisely. 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 authorized, and causes, topographical and geological conditions, etc. are also not described.
- 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, 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 at MPWH's regional or district/city engineering offices. Factors which would influence disaster occurrence the check table by type of disaster An example of the check table made by type of disaster is shown in Appendix 5-1. The factors checked are: Slope height and gradient, type of soil or rock comprising the slope and geological conditions, surface water and groundwater conditions, evidences of past disasters, date of occurrence, rainfall intensity.
Sketches and photographs of the spots are attached to the check tables. During field reconnaissances, nearby residents were interviewed on any disasters which may have occurred in their areas.

5.3.2 Evaluation of Disaster Potential

For the spots with disaster potential are identified through the procedure given above, the disaster potential is evaluated by observations of experienced engineers according to the criteria given in Table 5.3-1.

The following points were taken into account in the evaluations:

- Slope gradient and height
- Type of rock
- Conditions of weathering, crack, alterations, fractures and faults.
- Thickness and compactness of top soil
- Possibility of concentration of surface water and quantity of groundwater.

TABLE 5.3-1 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 out on pavement part.	. 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 to required)	. Failure or moved materials may not extend to carriage-way	. Fallen materials may not extend to carriageway	. Shoulder may partially collapse.

- Deformation of the slope and evidence of past disasters
- Influence of river flow or ocean waves

Disaster potential thus evaluated might be rather under estimate considering the Philippines severe climate conditions. Because it was made base on experiences in Japan whose climate conditions are gentler than that in the Philippines.

As mentioned above in the Study the evaluation of disaster potential was carried out by observation of experienced engineers. Disadvantages of this method is that this method requires extensive experience and high technical knowledge on disaster and personal differences in evaluation affect inevitably evaluation result.

On the other hand, there is the evaluation method by rating. This can evaluate disaster potential mechanically based on factors selected and rating criteria established in advance. Deep experience and knowledge on disaster are not required and personal differences in evaluation become negligibly small in the rating method.

Because of such advantages mentioned above, the rating method was investigated in the Study to evaluate properly disaster potential.

The Japanese Ministry of Construction recently established a rating method and use this to evaluate disaster potencial of each disaster spot on the all road in Japan (hereinafter called the MOC Method)

The rating method for the Study was developed based on MOC Method considering characteristics of disasters in the Philippines, and slight modifications of MOC Method were made to suit Philippine conditions.

The rating method thus made by type of disaster is shown in Chapter 3 of Volume V, An Approach in Road Disaster Prevention.

Reliability of evaluation results in the rating method depends on selection of factors to be rated and rating criteria for each factor. In order to select appropriate factors and establish proper criteria, collection and analysis of vast data are required.

Considering number of data collected, the rating method established in the Study is not always perfect. For making this more perfect, it is necessary to improve gradually by conducting surveys on more disaster spots.

5.3.3 Distribution of Spots with Disaster Potential

A total of 545 potential disaster spots, 390 along the Maharlika Highway and 155 along the three roads loading to Baguio were identified. Table 5.3-2 gives the number of spots with disaster potential by Region, type of disaster and potential. Summary information and locations of the spots are presented in Appendix and 5-3.

The following observations can be concluded from Table 5.3-2.

Region I has the greatest number, at 155, of spots with disaster potential, followed by Region VIII, at 134, and Region III, at 86. All three Regions contain mountainous sections, where disasters occur frequently. Region I includes the mountainous sections of the Kennon, Agoo-Baguio and Naguilan Roads; Region VIII includes the mountainous and hilly sections of southern Leyte and northern Samar; and Region III includes most part of the Dalton Pass Section.

The remaining Regions, Regions II, V and IV-A, have 63, 59 and 48 spots with disaster potential, respectively. Region II includes a part of the Dalton Pass Section, Region V the mountain section in Camarines Norte, and Region IV-A the mountainous section near Lucena. However, the lengths of mountainous sections in these three regions are shorter than in those three regions above, so that there is less number of spots with disaster potential.

As shown in Table 5.3-1 in 5.3.2, spots evaluated as having potential H or M are those requiring immediate countermeasures. Of the 545 spots identified, 67 spots (12 percent) are evaluated as A, 156 spots (29 percent) as B and 322 spots as C (59 percent). Spots evaluated as A or B together represent 41 percent of all spots identified. Region I has the greatest number of spots evaluated as A and B at 76, followed by Regions VIII, III, II, V and IV-A. at 71, 55, 48, 22, 17 and 10 spots, respectively.

5.4 CAUSES OF ROAD DISASTER

According to Table 5.3-2, the number of spots of cut slope failures, falls and embankment slope failures, is extremely great, at 256, 153 and 90, respectively. To the total number of spots with disaster potential, they share 47, 28 and 17 percent, respectively, and about 90 percent together. Of the remaining types of disasters, there are 15 spots of "other" (mainly submersions due to floods of rivers), 12 of debris flow, and 10 of landslide.

TABLE 5.3-2 SUMMARY OF DISASTER SPOTS BY TYPES OF DISASTER, DISASTER POTENTIAL AND REGION

Road	Region	Disaster Potential	C-S.F,D.F	E - D.F	C - F	L.S	D.F	Others	Total
Maharlika Highway	III	H	11	-	-	-	-	-	11
		M	25	4	2	-	4	2	37
		S	21	8	4	-	3	2	38
		Sub-Total	57	12	6	-	7	4	86
	II	H	4	3	-	1	1	-	9
		M	7	4	2	-	-	-	13
		S	22	10	1	1	-	7	41
		Sub-Total	33	17	3	2	1	7	63
	IV-A	H	1	1	2	-	-	-	4
		M	-	3	2	1	-	-	6
		S	17	6	13	-	-	2	38
		Sub-Total	18	10	17	1	0	2	48
	V	H	-	-	1	-	-	-	1
		M	5	8	1	-	2	-	16
		S	33	4	3	-	-	2	42
		Sub-Total	38	12	5	0	2	2	59
	VIII	H	3	9	3	2	-	-	17
		M	18	6	10	2	2	-	38
		S	40	13	24	2	-	-	79
		Sub-Total	61	28	37	6	2	0	134
	Total	H	15	13	6	3	1	-	42
		M	55	25	17	3	8	2	110
		S	133	41	45	3	3	13	238
		Total	207	70	68	9	12	15	390
Kennon	B-1	H	1	-	10	1	-	-	12
		M	3	3	15	-	-	-	21
		S	4	-	11	-	-	-	15
		Sub-Total	8	3	36	1	0	0	48
Agoo-Daguio	B-2	H	1	-	10	-	-	-	11
		M	8	-	11	-	-	-	15
		S	33	6	15	-	-	-	54
		Total	42	6	36	0	0	0	84
Naguilian	B-3	H	1	-	1	-	-	-	2
		M	1	1	4	-	-	-	6
		S	6	1	8	-	-	-	15
		Total	8	2	13	-	0	0	23
Total		H	3	-	21	1	-	-	25
		M	12	4	30	-	-	-	46
		S	43	7	34	-	-	-	84
		Total	58	11	85	1	0	0	155
Grand Total		H	22	13	27	4	1	-	67
		M	67	29	47	3	8	2	156
		S	176	49	79	3	3	13	322
		Grand Total	265	90	153	10	12	15	545

Type of Disaster

(1) Cut Slope Failure
C - S.F = Surface Failure
C - D.F = Deep Failure

(2) Embankment Slope Failure
E - S.F = Surface Failure
E - D.F = Deep Failure

(3) Fall
C - F
(4) Landslide
L.S.
(5) Debris Flow
D.F
(6) Others

Disaster Potential

H ; Heavy
M ; Medium
S ; Light

Note : Figure show number of spots.

a) Cut Slope Failure

As mantioned above, the most numerous type of disaster was cut slope failure. Cut slope failures were seen in all the mountainous sections and especially in the Dalton Pass Section, the Agoo-Baguio Road, the Mahaplag-Sogod Section in southern Leyte, and the mountainous section between St. Elena and Daet of Camarines Norte. Because these sections have many high cut slopes and the rocks are highly weathered and also fractures due to faults.

Cut slope failures were seen on slopes of soil and rocks such as diabase, andesite, limestone, sandstone, mudstone, tuff, tuff breccie, conglomerates, etc.
Nearly all of cut slope failures observed are caused by the effect of water. Many are brought by erosion or scouring resulting from the flow of surface water during rainfalls, and some by groundwater seepage. There is a large-scale failure at km 1,010+450, in the Mahaplag-Sogod Section, where a slope of over 100 in height was drastically scoured by the flow of surface water and subsurface water which is seeping out.

It is measured that cut slope failures could not be prevented from recurrence because of the following deficiencies:

- Drainage facilities are inadequate. None of the followings have been provided: Top slope ditch which prevents surface water flowing into the slope; berm ditch which collects surface water on the slope; and vertical ditch which drains surface water collected in the above ditches.
- No berms have been provided. Berms not only increase the stability of a slope, they also decrease the speed of surface water flow, so that they are effective in preventing erosion and scouring. Berms were seen on only one or two cut slopes in the Dalton Pass and Mahaplag-Sogod Sections.
- No appropriate slope protection is provided. There are some slopes which are covered naturally with vegetation but no slopes protected artificially.

b) Embankment Slope Failures

Embankment slope failures are mainly caused by scouring and were mainly seen in the following sites:

- At inside curves of roads with steep vertical gradients. Surface water on the road surface concentrates and flows down the embankment slope, causing erosion and scouring. Large-scale examples of this are seen at km 1,017+700 and km 1,016+850 in the Mahaplag-Sogod Section.
- Sections along rivers and coastlines. Waves and flood water scour embankment slope in such sections. Large-scale examples of failures caused by river flow are seen at km 224+400 and km 225+000, adjacent to the Sta. Fe River. A typical example of failures caused by waves is seen near Calbayog in Samar.
- Approach to bridges. Many bridges are built with short span and their approaches protrude into the river probably to cut down construction cost. Most of such approaches have been scoured during floods. Large-scale example of this, which occurred during typhoon Bebeng in 1983, is seen near km 120+000 in Region IV-A.

It is thought that embankment slope failures could not be prevented, because of the following deficiencies:

- Insufficient number and capacity of side ditch and cross drain especially in mountain section: Surface water flowing down on the road surface as if it is river, was seen often in many mountainous section during field reconnaissances. This is caused by lack of side ditches and cross drains and brings the embankment slope failures.

- No slope protection or protection with unsatisfactory structure: There are slopes covered naturally with vegetation but very purely protected artificially. At considerable number of spots, collapsed stone masonries applied to embankment slopes were seen. It is presumed that they may be unsufficient to external force such as earth pressure, force of river flow etc.

c) Falls

Falls are categorized into debris falls and rock falls, but all falls in the subject sections, expect for ten spots of debris falls on the Agoo-Baguio Road, were rock falls.

Falls mainly occur in slopes of debris or diorite, andesite, sandstone, conglomerates, limestone, etc. Slopes of highly weathered or fractured rocks usually produce cut slope failures, while falls mainly occur on slopes of hard rock with developed open cracks or on slopes containing borders of different rock layers.

Ten landslide spots have been identified. Of the ten, four are large-scale landslides, at km 296+700 (near Didai) in North Luzon, km 247+000 in Kennon Road, km 1,005+ Other sections with many falls are the San Isidro-Calbayog Section in Samar, the Pagbilao-Atimonan Pass In Quezon, Dalton Pass, and Mahaplag-Sogod Section. Most of the fallen rocks were 10 to 50 centimeters in size, but these of over 3.0-meter size were seen on the Agoo-Baguio Road and the Pagbiloa-Atimonan Pass Section.

Falls are caused by the same deficiencies in design or construction as described in cut slope failures.

d) Landslides

Landslides are classified into soil and rock landslides, but only soil landslides were seen in sections subject to the Study.

Ten landslide spots have been identified. Of the ten, four are large-scale landslides, at km 296+700 (near Didai) in North Luzon, km 247+000 in Kennon Road, km 1,005+ 000 (near Layog Bridge) in the Mahaplag-Sogod Section and km 1,054+750 (near Libagon) in South Leyte.

The landslide at km 296+700 in North Luzon is a movement of a thick layer of soil over sandstone and tuff. Because of continuous movement, the pavement has been left in its damaged state, and there remains a house collapsed by the landslide. A large quantity of spring water at the toe of the slope was observed, and so the landslide is thought to have been caused by high groundwater level.

The landslide at km 247+000 on the Kennon Road is the sliding of volcaniclasties covering over the tuff layer. According to a Baguio city engineer there may be continuous movement of about 10 centimeters a year.

The landslide at km 1,005+100 occurs in strongly weathered mudstone. From the fact that spring water at the foot of the slope is observed, the landslide is judged to have been caused by high groundwater level. The pavement is left in its damaged state because of the continuous movement.

The landslide at km 1,054+750 occurs in weathered mudstone and sandstone. According to nearby residents, the slides are repeated and materials slided covers the carriageway every year. No spring water was observed during the field reconnaissances. However, judging from the landform which surface water easily concentrates the landslide might also be caused by affect of water.

e) Debris Flows

Among a total of twelve spots of debris flows identified, eight are in the Dalton Pass Section and two are in the Sorsogon-Matong Section in South Luzon and two are near Calbayog in Samar.

The largest scale debris flow occurred at km 221+200 of the Dalton Pass section during typhoon Aring in 1980. This caused many deaths, and the materials flowed down covered about 200 meters of road in length. The rock in the area is granite transfigured by weathering susceptible to debris flow.

The next largest scale of debris flow was seen at 194+400 of the Dalton Pass Section. The evidence indicated that large quantities of materials were flowed out in the past. However, this spot is thought to be fairly stable in recent years and no major disasters have occurred.

Other debris flows are all caused in torrents. Due to no countermeasures such as cross drains, water ways, smallscale sabo dams etc. materials flow over the road surface and interrupt traffic every time it rains.

f) Others

The main disaster classified as others is submergence of roads due to floods of rivers. Nearly all disasters observed in flat lands were such disasters, but since they require largescale riparian works to be controlled, they are out of the scope of the Study.

5.5 ROAD DISASTER AND RAINFALL

Rainfall is, most of cases, the primary inducement of road disasters among various causes such as topographical, geological and vegetative conditions. If the interrelation between road disaster occurrence and rainfall intensity is developed based on the past disaster records, probability of disaster will be predicted by estimating maximum rainfall intensity for probable period. This relationship can be used to inform road users possible occurrence of disaster or to close a road to traffic for preventing any accidents when rainfall reaches to a critical height.

The Study Team's intention to find out the critical height of rainfall which induces a certain type of disaster such as cut slope failure or rock fall, had to be given up due mainly to lack of enough samples by type of disaster. Instead, the relationship between disasters (whatever they are) occurrence and rainfall was developed.

Table 5.5-1 shows 24-hour rainfalls of various tropical cyclones at respective weather stations nearest to the selected road sections.

Dalton Pass Section

Minimum rainfall height which caused road disaster was 71 millimeters, whereas maximum rainfall height which did not cause any road disaster was 73 millimeters. Rainfall height of about 70 millimeter seems to be critical height to induce road disaster at the Dalton Pass Section.

Mahaplag-Sogod Section

As two (2) weather stations are located rather far from this section and at lower elevation than this section, rainfall height does not necessarily represent that of the section. Rainfall height recorded at two weather stations seems to be lower than that at the section.

When based on rainfall height of the Baybay weather station, rainfall height of about 50 millimeters seems to be critical height. As to the Oticon weather station, 24-hour rainfall of typhoon "Osang" in 1980 might be miss-recorded. When neglecting the said record, critical height seems to be 30 to 40 millimeters.

Due to unfavorable geological and topographical conditions at this section road disasters seems to be caused at lower rainfall height than other sections.

Kennon Road

Minimum rainfall height which caused road disasters was 88 millimeters. Maximum rainfall height which did not cause road disaster was 110 millimeters. Rainfall height of about 90 millimeters seems to be critical height at Kennon Road.

The relationship mentioned above were developed based on a small number of samples available, therefore, accuracy can not be assured. To develop more accurate relationship between disaster occurrence and rainfall height, disaster records as well as rainfall data should be compiled more comprehensively.

TABLE 5.5-1 ROAD DISASTER OCCURRENCE AND 24-HOUR RAINFALL

Section / Weather Station		Dalton Pass Section		Mahaplag-Sogod Section				Kennon Road	
		Sta. Fe Station		Baybay Station		Oticon Station		Baguio Station	
Year	Name of Cyclone	Disaster Occured	No Disaster	Disaster Occured	No Disaster	Disaster Occured	No Disaster	Disaster Occured	No Disaster
1983	Diding	-	-	-	-	-	-	104	-
1982	Weling	-	-	-	1	-	8	-	103
	Ruping	-	-	-	22	-	18	229	-
	Norming	-	-	-	64	-	1	88	-
	Iling	-	15	-	6	-	15	-	14
	Emang	-	73	-	24	-	10	-	42
	Deling	-	20	-	29	-	22	-	4
	Bising	-	-	54	-	31	-	-	4
1981	Anding	(-)	-	-	12	-	-	145	-
	Yeyeng	-	-	-	6	-	32	-	4
	Unsing	-	-	-	4	-	32	-	5
	Saling	-	-	99	-	50	-	-	12
	Elang	71	-	-	29	-	27	-	110
	Daling	-	-	-	22	-	23	-	8
1980	Aring	732	-	86	-	95	-	699	-
	Yoning	-	50	-	34	-	21	-	36
	Osang	324	-	58	-	8	-	536	-
	Nitang	128	-	-	24	-	41	165	-
	Abiong	-	-	(-)	-	(-)	-	-	-
		Min. 71	Max. 73	Min. 54	Max. 64	Min. 8	Min. 8	Max. 41	Max. 110

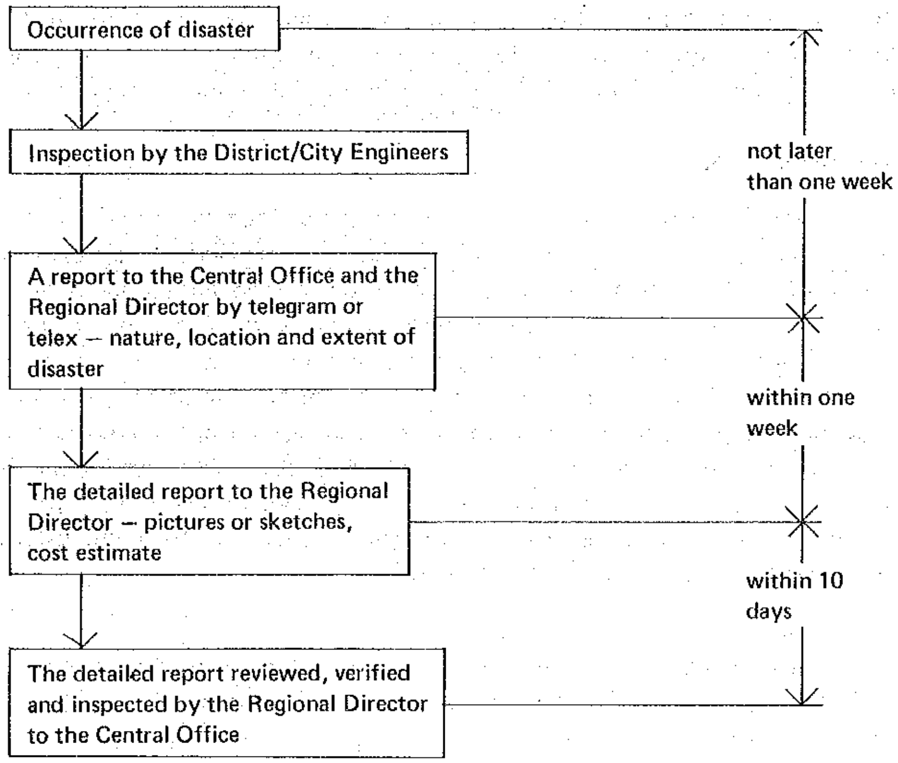
Note:

(-) shows that road disaster occured, however, no rainfall data available.

5.6 CURRENT RESTORATION OF DISASTER

5.6.1 Procedure to Restore Road Disasters

The guideline on what measures to take when disaster occurs on national roads was issued as a ministry order in August 1982. When road disaster occurs, the following reports must be made:



For urgent restoration of road disasters interrupting or greatly hindering traffic, the Regional Director's discretionary fund, which represents five (5) percent of the Highway Maintenance Fund, is used. When the discretionary fund is spent, the Highway Maintenance Fund is used until the road is made passable. Further resotoration work is conducted only after the contingent or calamity fund has been released. The work is planned by the District/City Engineers and implemented in accordance with the work schedule submitted to the Regional Director. The highway maintenance crew generally conducts restoration work, but when this disrupts regular maintenance work, an emergency crew is employed instead. Each District/City Engineer submits monthly progress reports to the Regional Director, and the Regional Director submits a consolidated report to the Central Office.

5.6.2 Current Restoration Work

Disaster restoration work currently being conducted are all temporary measures, and countermeasures which prevent the disaster from recurring are hardly applied. Descriptions of the kind of restoration work currently being implemented, by type of disaster, are given below;

1) Cut Slope Failures

Restoration work is limited to removing fallen soil mass from the road surface by pushing the soil mass off the valley-side slope with a bulldozer. Drainage facilities to drain surface or ground water, slope protection, and the like are hardly applied. Therefore, everytime there is a typhoon or intensive rainfall, failures occur again.

2) Embankment Slope Failures

Stone masonry work is usually adopted to restore embankment slope. There are, however, many cases of repeated failures because; 1) no berms were provided on stone masonry over 10 meters high, ii) concentration of road surface water on shoulder was not solved, iii) no thought was given to groundwater drainage, and iv) back-filling was not compacted well enough. Among embankment slopes running parallel to a river, there are many in danger of failing because the foundation of the stone masonry is not embedded deep enough or foot protection has not been provided, causing scouring. There are also many cases of failures caused by surface water overflowing the side ditch on the mountain side and running over the road surface, thus causing the road shoulder on the valley side to be eroded. If no measures are taken to drain surface water, the section adjacent to the restored section may be affected next.

Of restoration methods currently being used, stone masonry is the most expensive. Therefore, it takes a while for funds to be released, so that restoration work is not implemented immediately and the road is left in its damaged state for long periods of time (often over six months).

3) Falls

Restoration work is limited to removing rocks which fell on the road surface. When the fallen rock is very large, dynamite is used to break the rock into little pieces. No protection work is done on the slope causing the fall.

4) Landslide

Overlay is usually applied when the landslide caused the road surface to sink, and removal is usually applied when the landslide caused the road surface to rise.

5) Debris Flow

Restoration work is limited to removing earth and sand which flowed onto the road surface.

5.6.3 Fund for Restoration Work

There are five (5) sources of restoration funds, as follows:

- Regional Director's discretionary fund: Represents five (5) % of the Highway Maintenance Fund. Mainly used to effect urgent restoration work.
- Highway Maintenance Fund: Made available only when the Regional Director's discretionary fund is expended for urgent restoration work.
- Contingent Fund: Kept as a reserve for maintenance fund but also, used for restoration work. Requires the President's approval on use.
- Calamity Fund: Fund amount depends on the scale of disaster, and the President's approval is also required on use.
- BBKN Fund (Baguio-Bontoc, Kennon, Naguilian Fund): The source of the fund is tolls collected on Kennon and Baguio-Bontoc Roads. Most of the toll income is used for maintenance of Kennon, Naguilian, Agoo-Baguio and Baguio-Bontoc Roads, and some are used for restoration work.

Allocations of the above funds during the three years from 1980 to 1982 are shown in Table 5.6-1.

The Regional Director's discretionary fund is the only fund that can be used immediately when disaster breaks out. It usually takes four to six months for the calamity fund to be released.

5.6.4 Problems on Disaster Restoration

Restoration work currently being conducted are temporary measures. Since no appropriate and lasting countermeasures aimed at removing the cause of the disaster are taken, disasters keep recurring. One reason for this situation is the insufficiency of restoration funds. Since the total amount of restoration work estimated by the District/City engineering office is hardly released, even currently adopted restoration work cannot be implemented sufficiently. The delay in the release of contingent or calamity funds remains the damaged spot without being restored for several months. If another typhoon, for example, strikes the area during that time, the damage will only become aggravated. Another factor delaying disaster restoration work is the amount of time required to mobilize necessary construction equipment.

TABLE 5.6-1 MAINTENANCE FUND

Unit: in Million ₱

	1980	1981	1982
Amount Appropriated By General Appropriations Act			
- Maintenance (EMK) Fund for National Roads	415.5	441.1	447.1
- Contingent Fund	189.2	241.6	278.0
- BBKN Fund	2.7	2.8	2.9
- Operational Support Fund	15.8	17.8	19.9
Maintenance (EMK) Fund Allocated to Regional Offices			
- Region I	38.3	36.5	35.4
- Region II	40.8	48.4	44.7
- Region III	28.1	26.5	27.4
- Region VIII	37.3	37.0	33.2
Maintenance (EMK) Fund Allocated to District Engineering Offices			
- Benguet	6.0	5.4	5.3
- Nueva Vizcaya	4.5	7.1	4.9
- Nueva Ecija	6.6	6.5	6.9
- Leyte First	4.8	3.8	3.9
- Southern Leyte	8.2	6.5	6.5
Regional Director's Discretional Fund (5% of Maintenance Fund)			
- Region I	1.9	1.8	1.8
- Region II	2.0	2.4	2.2
- Region III	1.4	1.3	1.4
- Region VIII	1.9	1.9	1.7
Estimated Maintenance (EMK) Fund Allocated to Subject Sections			
- Dalton Pass Section (20-30%)	2.2-3.3	2.7-4.1	2.4-3.5
- Mahaplag-Sogod Section (15-30%)	1.9-3.7	1.5-3.1	1.6-3.1
- Kennon Road (15-30%)	0.9-1.8	0.8-1.6	0.8-1.6

Source: General Appropriations Acts (1980 - 1982)
Bureau of Maintenance, MPWH

CHAPTER 6

SELECTION OF FEASIBILITY STUDY SECTIONS

6.1 APPROACH OF SELECTION OF F/S SECTIONS

6.1.1 Procedure

The evaluation method currently adopted by the Ministry of Construction, Japan was basically followed. Three (3) factors were considered to evaluate disaster sections;

- Disaster Potential
- Disaster Frequency
- Importance of Section

The procedure adopted by the Study Team is illustrated in Figure 6.1-1. Following is the brief explanation of each step;

1) Evaluation of Disaster Potential of Spots

Disaster spots identified by the field reconnaissance were evaluated their disaster potential. Evaluation was made by the experienced engineer's judgement in the field. In general, a road disaster is caused by the several crisscrossed factors such as type of rock or soil, grade of slope, toporaphy, height of slope, slope drainage condition, etc., therefore, disaster potential of a spot is best judged by observation of the experienced engineer. Disaster potential of spots was classified into a, b, or c.

2) Evaluation of Disaster Potential of Sections

The basic policy to evaluate sections is that a section with high concentration of a and b spots has high potential of disaster. To express degree of concentration of disaster spot, concept of "disaster spot density" was introduced.

$$\text{Disaster Spot Density} = \frac{\text{Total length of a and b spots (m)}}{\text{Section Length (km)}}$$

Sections were ranked A, B and C of which criteria are defined below.

Rank A : 30 m/km ≦ Disaster Spot Density

Rank B : 5 m/km ≦ Disaster Spot Density < 30 m/km

Rank C : Disaster Spot Density < 5 m/km

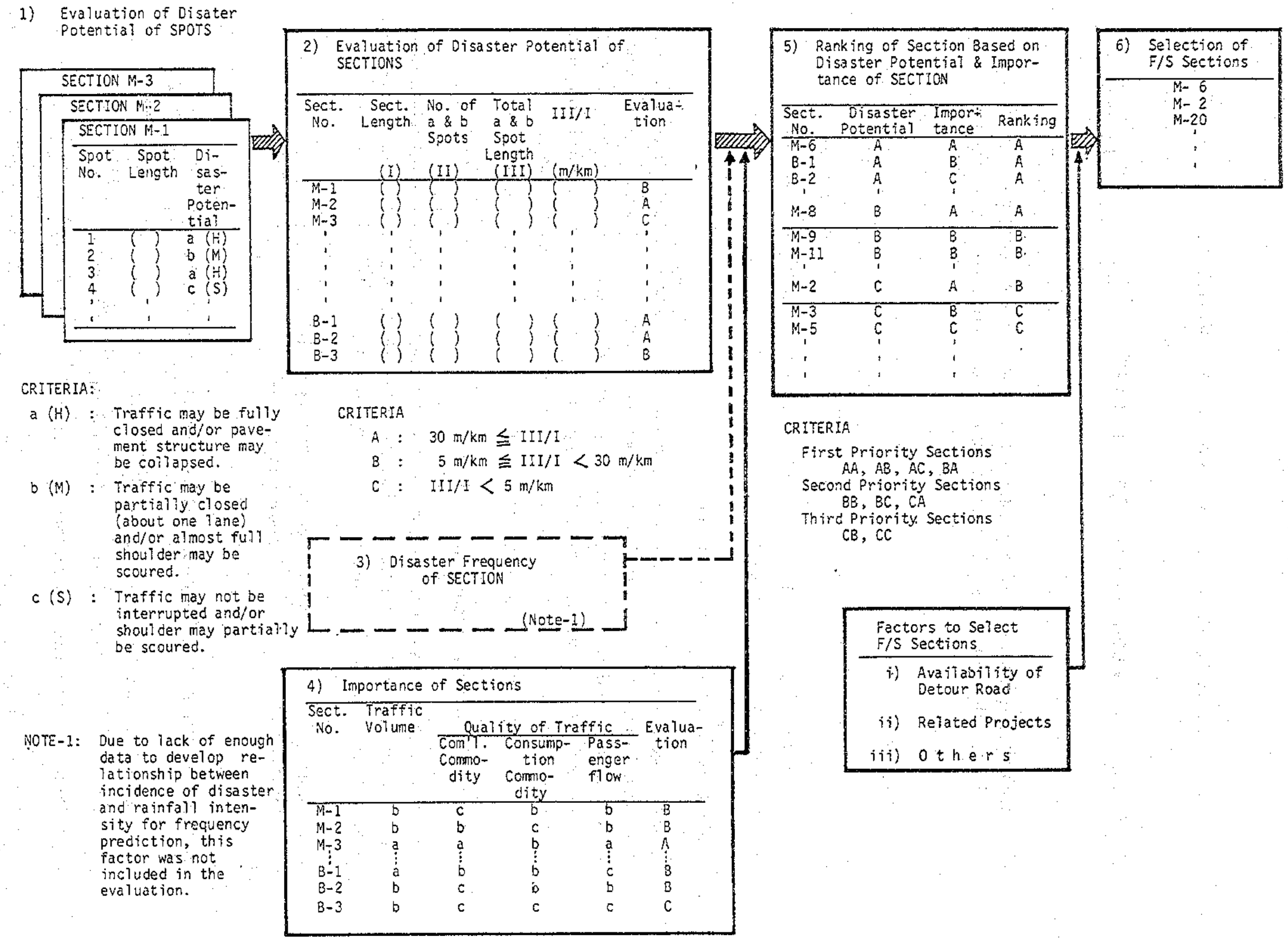


FIGURE 6.1-1 PROCEDURE TO SELECT F/S SECTIONS

3) Disaster Frequency of Section

The study team tried to developed relationship between incidence of disaster and rainfall intensity. By knowing rainfall intensity for probable return period, disaster frequency will be predicted. However, due to lack of enough data, the said relationship could not be developed. This factor, therefore, was not included in the evaluation.

4) Importance of Section

Two (2) factors, i.e. traffic volume and quality of traffic, were considered to determine importance of sections. Elements to determine quality of traffic were how many kinds and volume of selected commodities are transported and how passengers are transported through respective sections. Sections were evaluated A, B or C in the order of importance.

5) Ranking of Section Based on Disaster Potential and Importance of Section

Results of evaluation of disaster potential and importance of a section were integrated, then sections were ranked the first, the second or the third priority sections.

In this step, evaluation results of disaster potential were given higher consideration than those of importance of a section. In other words, sections assessed as A by disaster potential evaluation were always ranked higher than those of B. Importance of a section was used as a tool to rank sections all of which were evaluated as A (or B or C) by disaster potential evaluation. For these sections which were assessed, for example, A by both evaluations of disaster potential and importance of a section, a section which has a higher disaster spot density was ranked higher.

6) Selection of Sections for feasibility study

Sections for a feasibility study in the Phase II of this study were selected from the first priority sections in consideration of disaster potential and importance of a section as well as availability of a detour road, related projects and other factors.

6.2 ESTABLISHMENT OF SECTIONS

In order to evaluate and then select high priority sections for a feasibility study, the project roads were divided into sections. Five factors were considered in dividing the project roads into homogeneous sections. These are as follows:

i) Location of disaster spots

In general, disaster spots are concentrated in mountainous sections and scattered in flat sections. Where there is a concentration of disaster spots, this is considered as a section. In case where spots are scattered, these are grouped together to from a section.

ii) Availability of detour road

The availability of a detour road that can be utilized as an alternative route is one important factor in determining a section. Disaster on a section with a detour road will provide lesser impact on transportation and socio-economic activities. On the other hand, if an alternative route is not available, transportation and socio-economic activities will be adversely affected, when a section is closed to traffic due to a disaster.

iii) Traffic Volume

In characterizing and assessing a section, the traffic volume should be the same throughout a section as much as possible.

iv) Adequate length of a section

In order to provide an even basis for evaluation, the project roads should be divided within a certain range of length.

v) Location of Cities

As much as possible, major cities are considered as section limits in order to easily identify a section.

In cases where some of the above factors do not jibe each other in establishing homogeneous sections, the first two factors (i and ii) are given priority.

Section were illustrated in Figure 6.2-1 and summarized in Table 6.2-1.

TABLE 6.2-1 SUMMARY OF SECTIONS

Project Road		Section No.	Km.	Km.	Length (km.)	Remarks
Maharlika Highway	Central/Northern Luzon	M-1	576+930	485+130	91.750	Allacapan - Tuguegarao
		M-2	485+180	388+483	96.697	Tuguegarao - Naguilian
		M-3	388+483	327+700	60.783	Naguilian - Santiagao
		M-4	327+700	283+474	44.226	Santiagao - Bagabag
		M-5	283+474	236+600	46.874	Bagabag - Aritao
		M-6	236+600	159+100	77.500	Aritao - San Jose
		M-7	159+100	107+400	51.700	San Jose - Sta. Rosa
		M-8	107+400	36+000	71.400	Sta. Rosa - Sta. Rita
	Sub-Total				540.930	
	Southern Luzon	M-9	51+200	136+407	85.207	Calamba - Lucena
		M-10	136+407	232+130	95.723	Lucena - Calauag
		M-11	232+130	339+764	107.634	Calauag - Daet
		M-12	339+764	433+750	93.986	Daet - Naga
		M-13	433+750	524+523	90.773	Naga - Daraga
		M-14	524+523	579+080	54.557	Daraga - Sorsogon
		M-15	579+080	644+440	65.360	Sorsogon - Matnog
	Sub-Total				593.240	
	Samar/Leyte	M-16	663+814	736+750	72.936	Allen - Calbayog
		M-17	736+750	806+100	96.350	Calbayog - Catbalogan
		M-18	806+100	902+150	96.050	Catbalogan - Tacloban
		M-19	902+150	988+800	86.650	Tacloban - Mahaplag
		M-20	988+800	1025+450	36.650	Mahaplag - Sogod
		M-21	1025+450	1059+750	34.500	Sogod - Liloan
	Sub-Total				395.936	
	Total				1530.106	
Baguio Access Road		B-1	213+630	247+860	34.230	KENNON ROAD Rosario - Baguio
		B-2	236+130	255+000	48.870	MARCOS HIGHWAY Agoo - Baguio
		B-3	259+220	306+445	47.225	NAGUILIAN ROAD Bauang - Baguio
	Total				130.325	
Grand Total					1660.431	

*Note Jct. of C.V.R. to Allacapan : Km. 557+200
Distance from above Jct. to Allacapan : 19km. 680m.

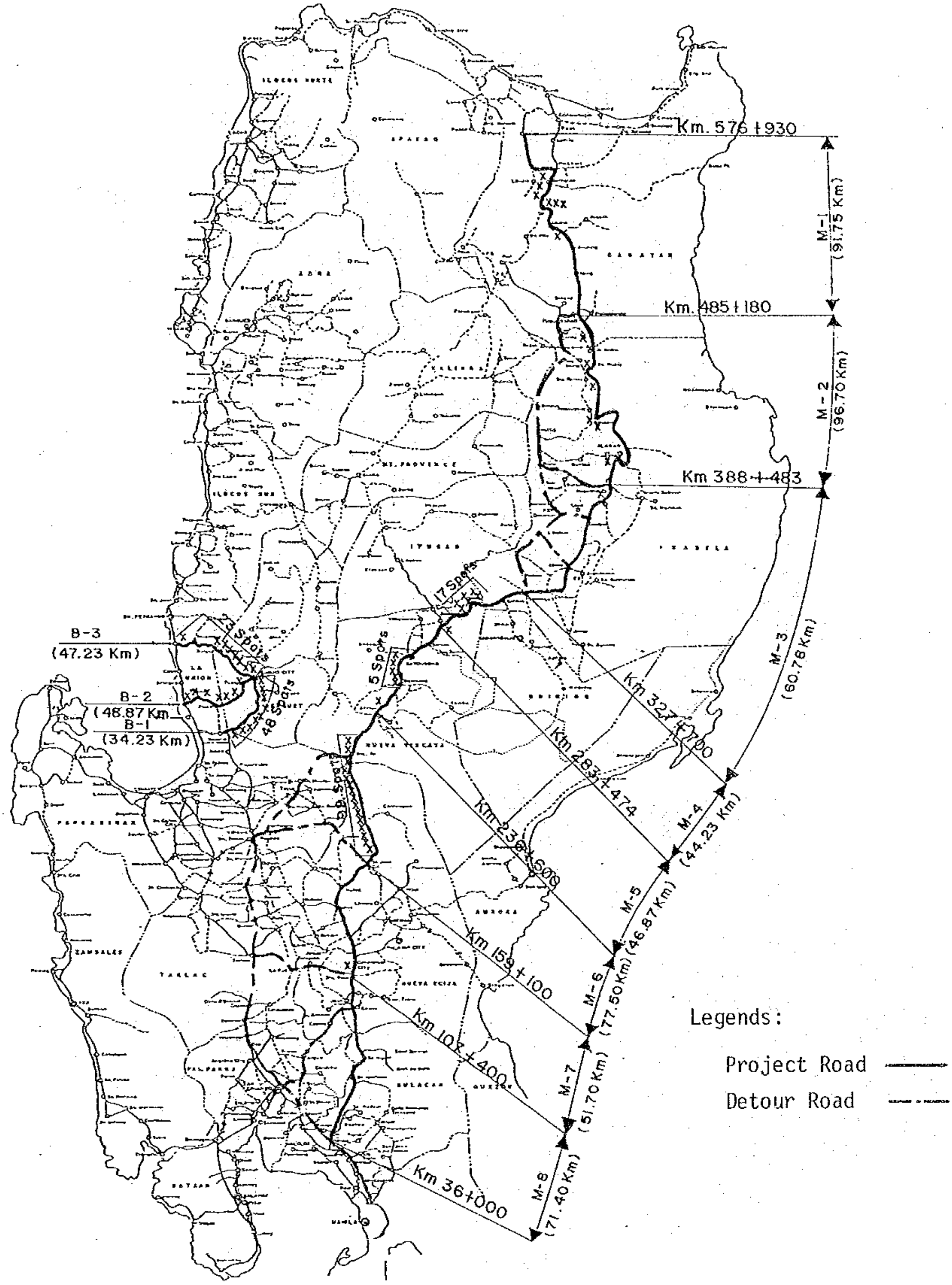


FIGURE 6.2-1 (1) ROAD SECTIONS (CENTRAL AND NORTHERN LUZON)

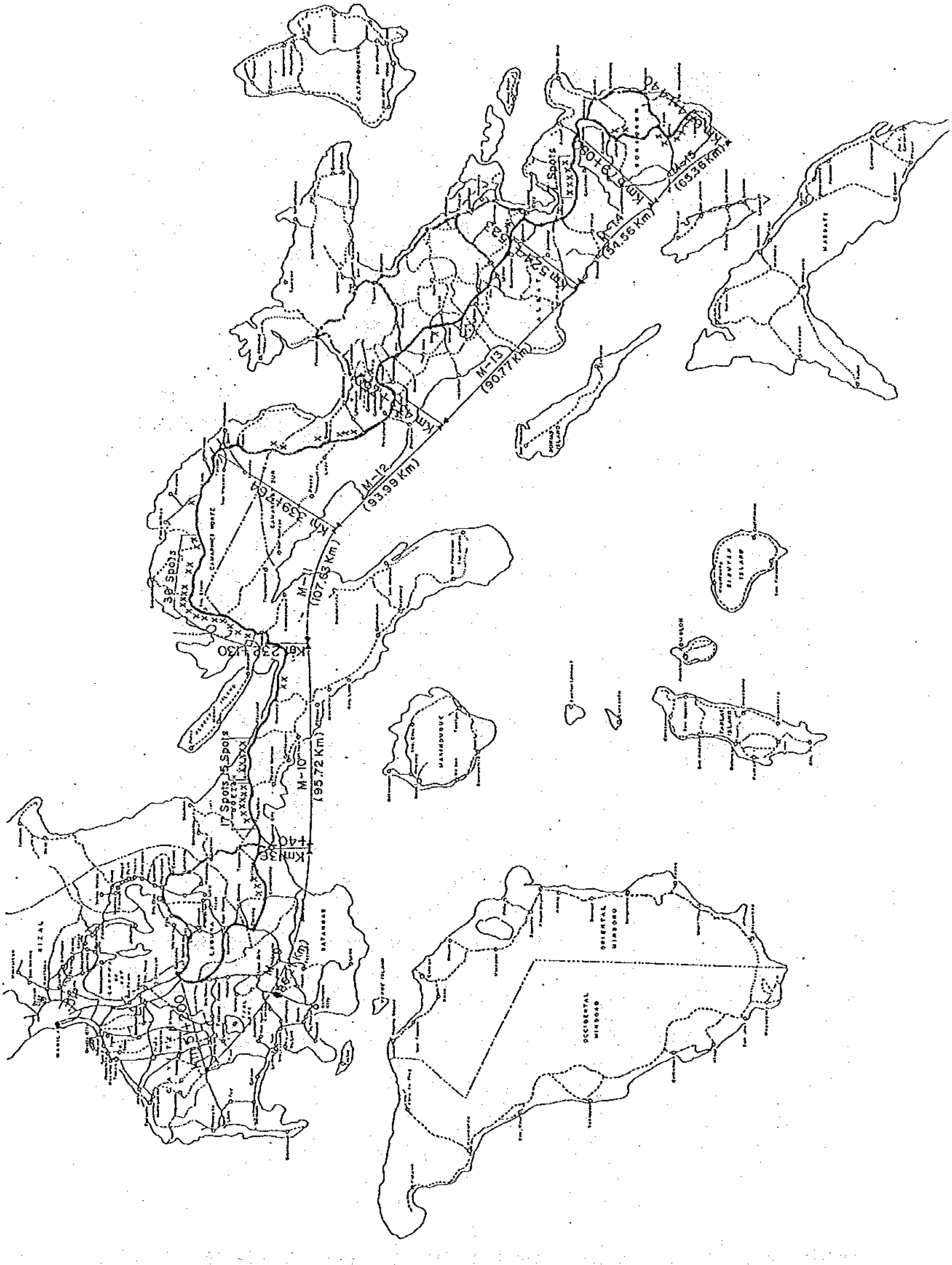


FIGURE 6.2-1 (2) ROAD SECTIONS (SOUTHERN LUZON)

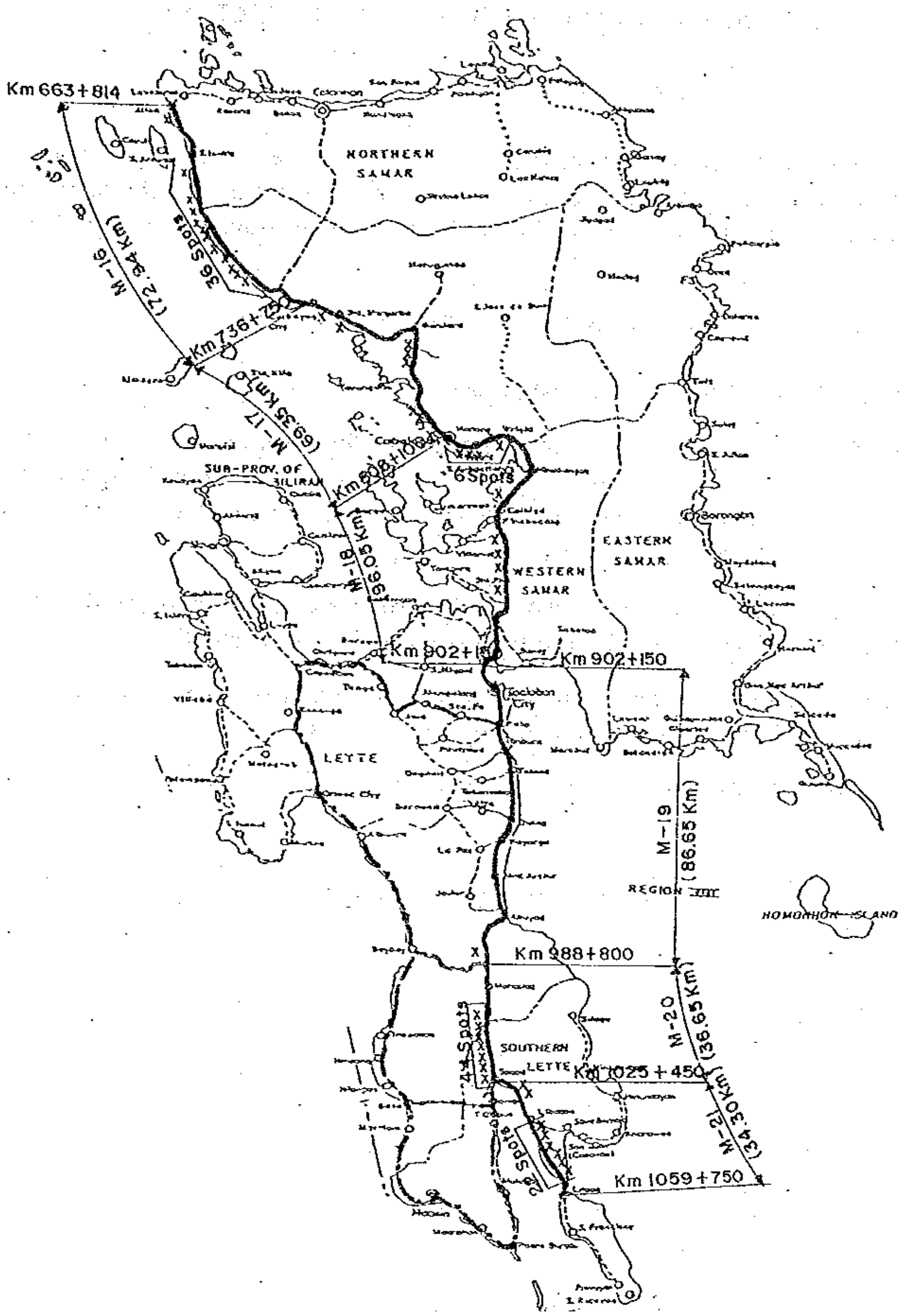


FIGURE 6.2-1 (3) ROAD SECTIONS (SAMAR AND LEYTE)

6.3 EVALUATION OF DISASTER POTENTIAL OF SECTION

6.3.1 Evaluaton of Disaster Potential of Spot

During field reconnaissance, each spot was evaluated and classified into H, M or S depending upon its degree of impacts on traffic when it is caused disaster. In evaluating disaster potential of spots, H, M and S were simply translated into a, b and c, respectively.

Results of evaluation are presented in Appendix 6-1.

6.3.2 Evaluation of Disaster Potential of Seciton

As explained in Section 6.1 of this chapter, disaster potential of a section was evaluated by disaster spot density. Figure 6.3-1 shows disaster spot density of each section. Based on the established criteria, each section was evaluated disaster potential as shown in Table 6.3-1 and Figure 6.3-2.

Five (5) sections were evaluated as A (highest potential of disaster), 3 sections from the Maharlika Highway and 2 from the Roads leading to Baguio City.

Seven (7) sections were evaluated as B, 6 sections from the Maharlika Highway and 1 from the Roads leading to Baguio City.

The rest of 12 sections were evaluated as C.

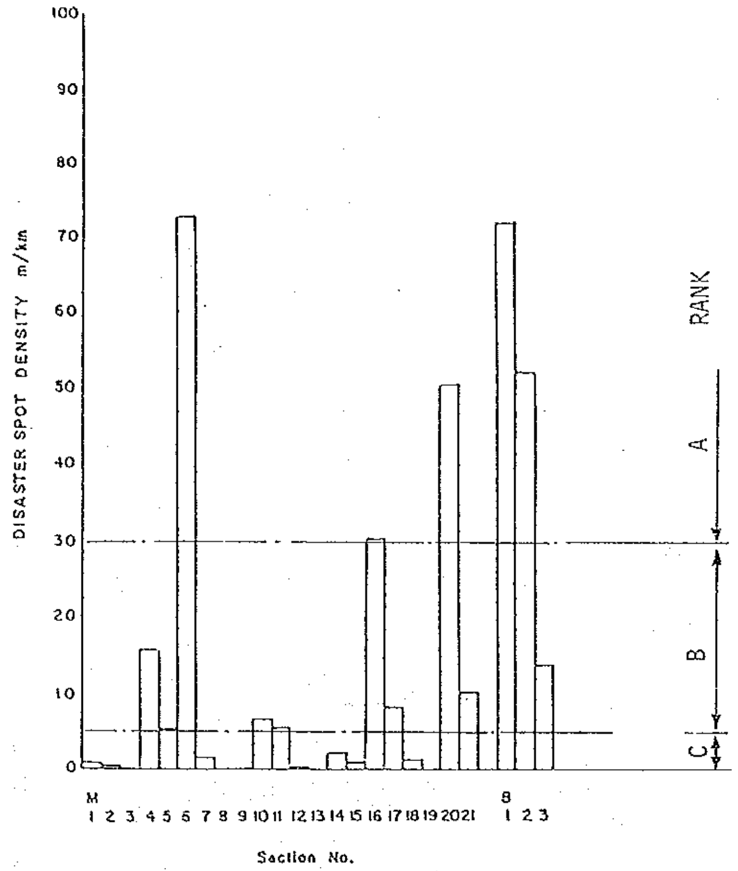


FIGURE 6.3-1 (1) DISASTER SPOT DENSITY OF SECTION

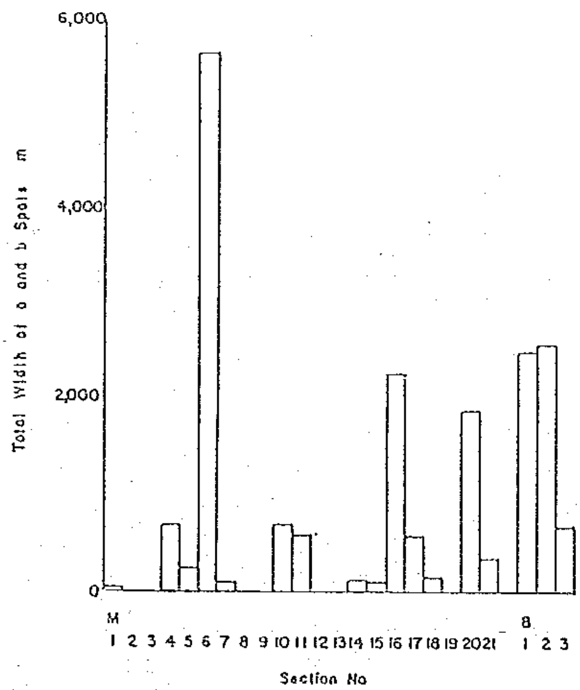


FIGURE 6.3-1 (2) WIDTH OF SPOTS WITH A AND B DISASTER POTENTIAL

TABLE 6.3-1 EVALUATION OF DISASTER POTENTIAL OF SECTIONS

Section	Origin and Destination	Length (km)	Number of a and b Spots			Total Width of a and b Spots (m)			Disaster Density 1/	Ranking	Evaluation	Remarks
			a	b	Total	a	b	Total				
M - 1	Allacapan - Tuguegarao	91.750	1		1	50		50	0.55	17	C	
- 2	Tuguegarao - Naguilian	96.697		1	1		30	30	0.31	18	C	
- 3	Naguilian - Santiago	60.783			0			0	0		C	
- 4	Santiago - Bagabag	44.226	2	5	7	250	450	700	15.83	6	B	
- 5	Bagabag - Aritao	46.874		3	3		240	240	5.12	12	B	
- 6	Aritao - San Jose	77.500	17	40	57	2,020	3,630	5,650	72.90	1	A	
- 7	San Jose - Sta. Rosa	51.700		1	1		100	100	1.93	14	C	
- 8	Sta. Rosa - Sta. Riza	71.400			0			0	0		C	
- 9	Calamba - Lucena	85.207	1		1	10		10	0.12	20	C	
- 10	Lucena - Calauag	95.273	3	4	7	440	220	660	6.89	10	B	
- 11	Calauag - Daet	107.634	1	11	12	60	325	585	5.44	11	B	
- 12	Daet - Naga	93.986		1	1		20	20	0.21	19	C	
- 13	Naga - Daraga	90.773			0			0	0		C	
- 14	Daraga - Sorsogon	54.557		3	3		120	120	2.20	13	C	
- 15	Sorsogon - Matnog	65.360		3	3		80	80	1.22	16	C	
- 16	Allen - Calbayog	72.936	4	13	17	1,090	1,140	2,230	30.57	5	A	
- 17	Calbayog - Catbalogan	69.350	2	3	5	250	320	570	8.22	9	B	
- 18	Catbalogan - Tacloban	96.050	1	1	2	40	90	130	1.35	15	C	
- 19	Tacloban - Mahaplag	86.650			0			0	0		C	
- 20	Mahaplag - Sogod	36.650	9	19	28	660	1,190	1,850	50.48	4	A	
- 21	Sogod - Liloan	34.300	1	2	3	200	150	350	10.20	8	B	
Sub-Total		1,530.106	42	110	152	5,070	8,105	13,375	8.74			
B - 1	Kennon Road (Rosario-Baguio)	34.230	12	21	33	1,210	1,250	2,460	71.87	2	A	
- 2	Marcos Highway (Agoo-Baguio)	48.870	11	19	30	1,080	1,480	2,560	52.38	3	A	
- 3	Naguilian Road (Bauang-Baguio)	47.225	2	6	8	250	400	650	13.76	7	B	
Sub-Total		130.325	25	46	71	2,540	3,130	5,670	43.51			
Total		1,660.431	67	156	223	7,610	11,235	19,045	11.47			

Note: 1/ Disaster Density = Total Width of a and b spots (m) / Section Length (km)

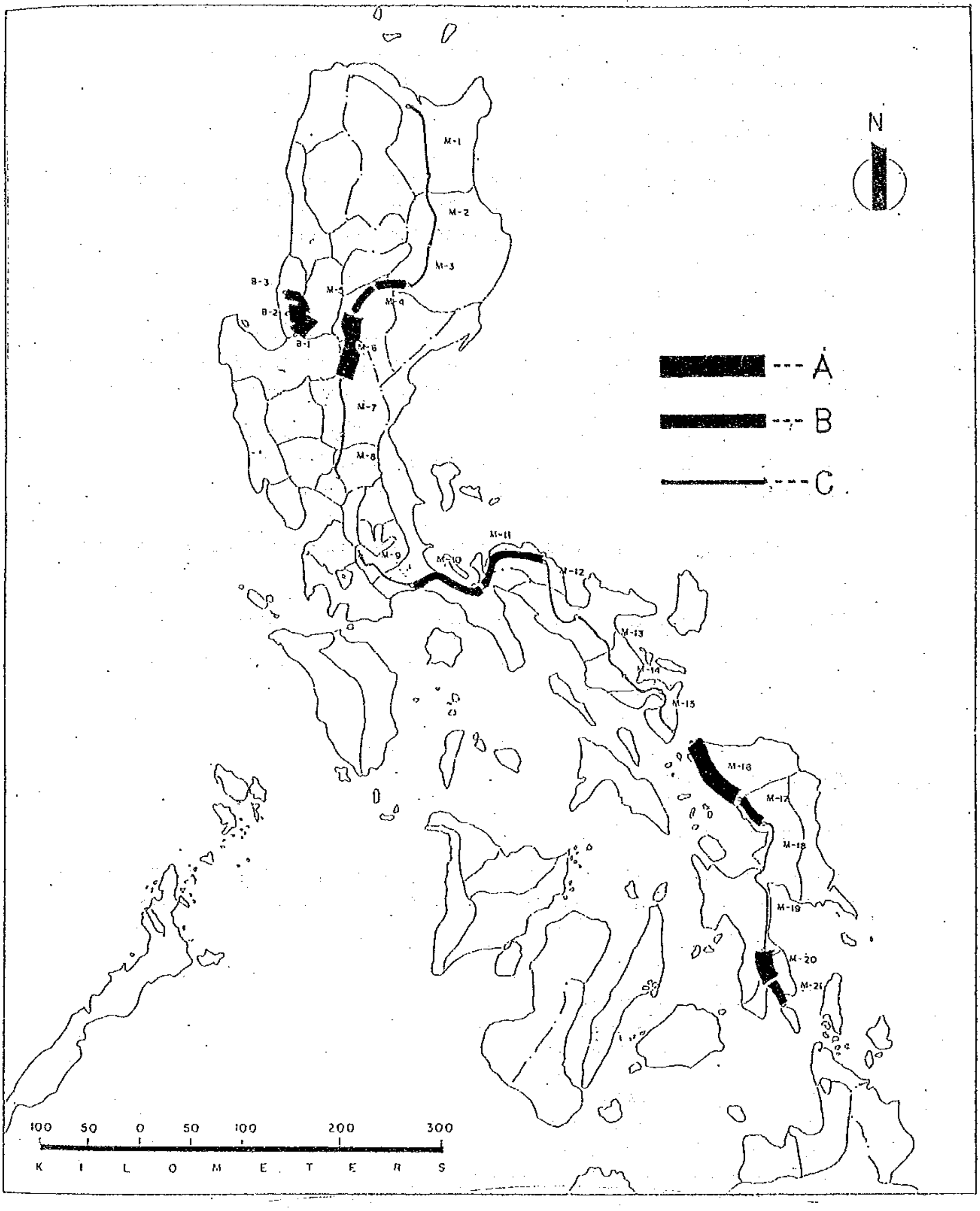


FIGURE 6.3-2 EVALUATION OF DISASTER POTENTIAL OF SECTION

6.4 EVALUATION OF IMPORTANCE OF ROAD SECTIONS

6.4.1 Methodology

Figure 6.4-1 illustrates the general procedure to assess the importance of sections by quantitative and qualitative aspects of road traffic.

1) Factors for Evaluation

Two factors; namely, traffic volume and quality of traffic were considered, the latter of which is expressed by the variety and volume of selected commodities and travel characteristics of passengers passing through respective sections.

2) Criteria and Categories

The basic criteria to determine the factors for road evaluation have been formulated based on the characteristics/conditions of the project roads and their influence areas (refer to Appendix 6-2). The quantitative assessment was made by traffic volume.

Three (3) categories were selected to evaluate quality of traffic, namely, commercial commodities, consumption commodities and passenger flow. The degree of importance of each road section was assessed in three stages as follows;

i) primary assessment — each category was assessed by selected varieties of traffic flow

ii) secondary assessment — integrated assessment of three categories

iii) final assessment — importance of the road section was assessed by traffic volume and quality of traffic

6.4.2 Assessment by Factor

1) Traffic Volume

Traffic volume on each section was utilized for the quantitative assessment of road traffic. A section with heavier traffic was assessed more important. Evaluation criteria were as follows;

Evaluation Criteria

Rank	Traffic Volume (veh/day)
A	2000 or more
B	1000 – 2000
C	1000 or less

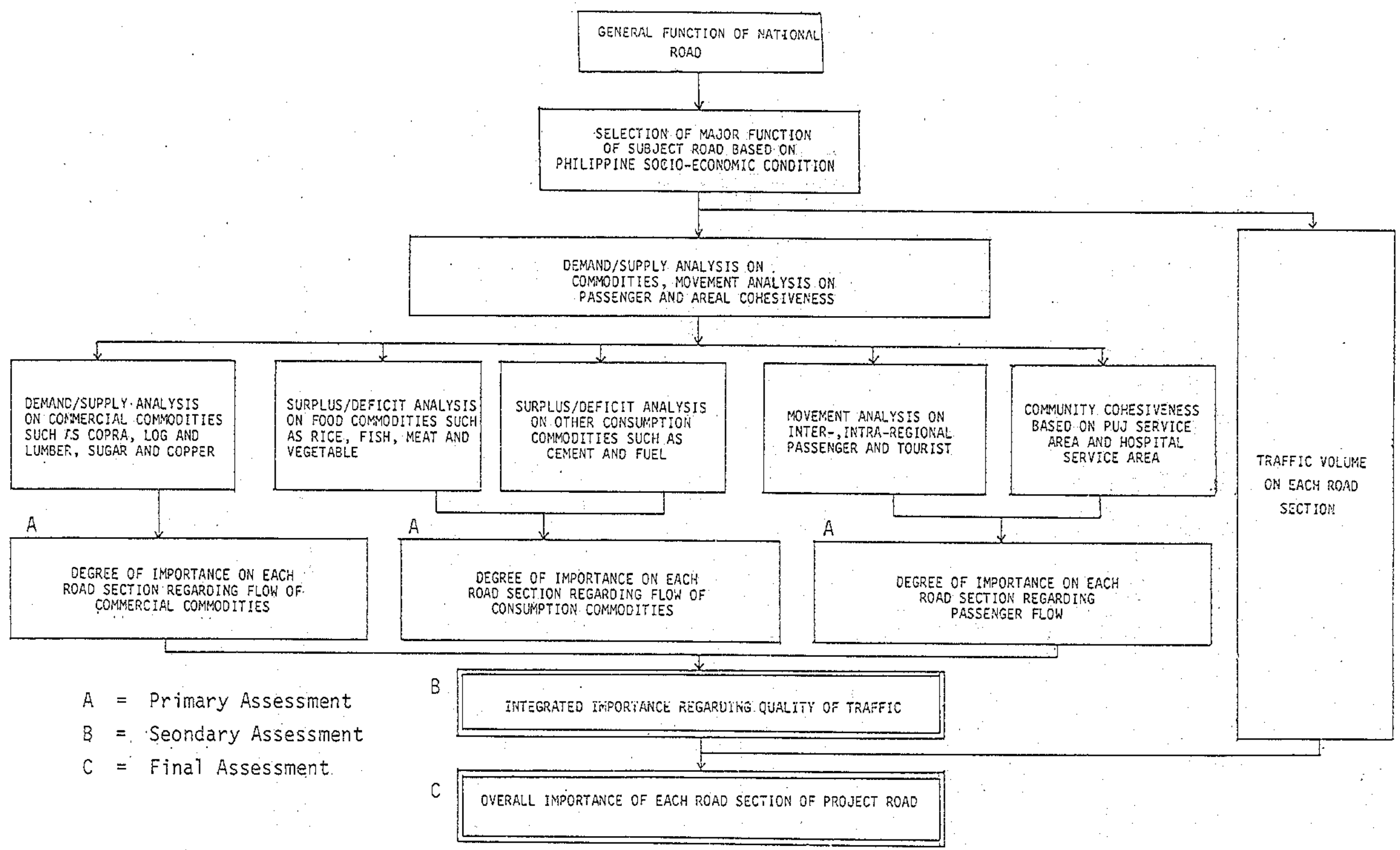


FIGURE 6.4-1 STUDY ON SOCIO-ECONOMIC ASPECT: IMPORTANCE OF ROAD SECTION ON SUBJECT ROADS

2) Quality of Traffic

Commercial Commodity

The qualitative aspects of assessment involved the assessment of the quality of traffic in terms of volume and variety of traffic flow (commodity and passenger). There were three categories considered in this assessment, one was the movement of commercial commodity. This included copra, sugar, log and lumber and copper. Analysis was made on the flow of these commodities using the demand/supply method. This method involved the analysis of the flow of commodities from the production (supply) site to the consumption (demand) sites passing through each section. The total commodity volume passing through each section, after deducting the estimated consumption of each provinces along the road, were estimated and served as the weights of each section.

The percentage share of each section to total flow by commodity and the criteria and ranking of each section under this factor are all presented in Appendix 6-2.

Consumption Commodity

The flow of consumption commodity was another factor for qualitative assessment. The commodities included in this group were: a) the basic food commodities such as rice, meat and fish, and b) other consumption commodities such as cement and fuel. The surplus-deficit analysis was used to analyze the movement of these commodities by section, except for fuel which was analyzed based on the service territories of each oil depot. Major flow was assumed to take place from the surplus areas to the deficit areas. The general flow and the percentage share of each section to the total flow by commodity type and the criteria and ranking of each section are presented in Appendix. 6-2.

Passenger Flow and Community Cohesiveness

The passenger flows considered were the long distance passenger flow represented by long distance bus service frequencies, short distance passenger flow by local bus service frequencies and tourist. Under the community cohesiveness, Public Utility Jeepneys (PUJ's) and hospital service areas were considered.

6.4.3 Overall Evaluation

Table 6.4-1 and Figure 6.4-2 show the result of evaluation regarding the relative importance of road sections.

TABLE 6.4-1 IMPORTANCE OF ROAD SECTION

No. of Section	Traffic Volume (1)	Quality of Traffic: Rank of Commercial Commodity (2)	Rank of Consumption Commodity (3)	Rank of Passenger Flow (4)	Integrated Importance Regarding Quality of Traffic (5)	Importance of Road Section (6)
M - 1	C	c	c	c	C	C
2	C	c	c	c	C	C
3	B	c	c	c	C	C
4	A	c	c	c	C	B
5	B	b	b	c	B	B
6	B	b	b	c	B	B
7	A	a	b	c	B	A
8	A	a	a	c	A	A
9	A	a	a	b	A	A
10	B	a	a	b	B	A
11	B	a	b	b	B	B
12	B	b	c	a	B	C
13	A	b	c	b	C	C
14	B	c	c	c	C	C
15	C	c	c	c	C	C
16	C	c	c	c	C	C
17	C	c	c	c	C	C
18	C	b	c	c	C	C
19	C	c	c	c	C	C
20	C	c	c	c	C	C
21	C	c	c	c	C	C
B - 1	A	c	c	b	C	B
2	C	c	c	c	C	C
3	B	b	c	b	B	B

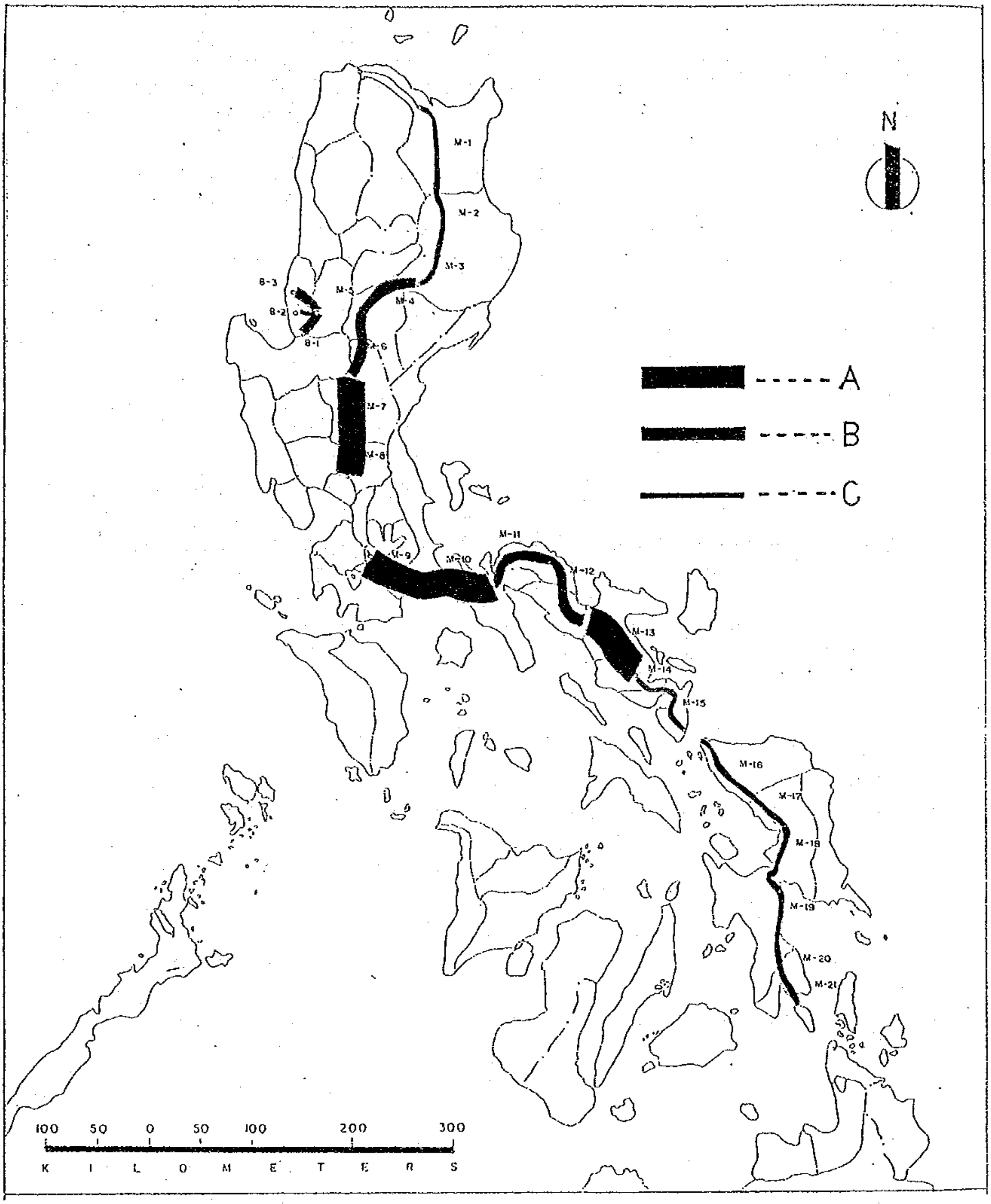


FIGURE 6.4-2 IMPORTANCE OF ROAD SECTION

6.5 PRIORITY OF SECTIONS AND SELECTION OF SECTIONS FOR FEASIBILITY STUDY

6.5.1 Ranking of Section Based on Disaster Potential and Importance of Section

1) Criteria for Ranking Sections

Sections were ranked the First, the Second or the Third Priority sections. The First Priority sections included all sections which were assessed as A by disaster potential evaluation and sections which were assessed A by evaluation of importance of section, even if disaster potential evaluation was B. Likewise, criteria for Second and Third Priority section were established and summarized below.

Ranking	Disaster Potential	Importance of a Section
First Priority Sections	A	A
(Integrated Evaluation A)	A	B
	A	C
	B	A
Second Priority Sections	B	B
(Integrated Evaluation B)	B	C
	C	A
Third Priority Sections	C	B
(Integrated Evaluation C)	C	C

2) Results of Evaluation

Result of evaluation is shown in Table 6.5-1. Six (6) sections were evaluated as the First Priority Sections among which five (5) have priority from viewpoint of disaster potential and one (1) has priority from viewpoint of importance of section.

Eight (8) and ten (10) sections were evaluated as the Second and the Third Priority Sections, respectively.

6.5.2 Selection of Sections for Feasibility Study

All sections evaluated as the First Priority Section should be subject to feasibility studies, as their improvement it an urgent need from viewpoints of disaster potential and importance of a section, however, the study period allocated to the Phase -II allowed to select only two (2) to three (3) sections for a feasibility study.

TABLE 6.5-1 RANKING OF SECTION BASED ON DISASTER POTENTIAL AND IMPORTANCE

Section No.	Location	Factors		Ranking	
		Disaster Potential of Section	Importance of Section		
M - 6	Aritao - San Jose (Dalton Pass)	A (72.9)	B	A	
B - 1	Kennon Road	A (71.9)	B	A	First
B - 2	Marcos Highway	A (52.4)	C	A	Priority
M - 20	Mahaplag - Sogod (Leyte)	A (50.5)	C	A	Sections
M - 16	Allen - Calbayog (Samar)	A (30.6)	C	A	
M - 10	Lucena - Calauag (Region IV)	B (6.9)	A	A	
M - 4	Santiago - Bagabag (Region II)	B (15.8)	B	B	
B - 3	Naguilian Road	B (13.8)	B	B	Second
M - 11	Calauag - Daet (Region V)	B (5.4)	B	B	Priority
M - 5	Bagabag - Aritao (Region II)	B (5.1)	B	B	Sections
M - 21	Sogod - Liloan (Leyte)	B (10.2)	C	B	
M - 17	Calbayog - Catbalogan (Samar)	B (8.2)	C	B	
M - 7	San Jose - Sta. Rosa (Region III)	C (1.9)	A	B	
M - 9	Calamba - Lucena (Region IV)	C (0.1)	A	B	
M - 12	Daet - Naga (Region V)	C (0.2)	B	C	
M - 14	Daraga - Sorsogon (Region V)	C (2.2)	C	C	Third
M - 18	Catbalogan - Tacloban (Samar)	C (1.4)	C	C	Priority
M - 15	Sorsogon - Matnog (Region V)	C (1.2)	C	C	Sections
M - 1	Allacapan - Tuguegarao (Region II)	C (0.6)	C	C	
M - 2	Tuguegarao - Naguilian (Region II)	C (0.3)	C	C	
M - 3	Naguilian - Santiago (Region II)	C (0)	C	C	
M - 8	Sta. Rosa - Sta. Riza (Region III)	C (0)	A	C	
M - 13	Naga - Daraga (Region V)	C (0)	A	C	
M - 19	Tacloban - Mahaplag (Leyte)	C (0)	C	C	

Note: Figures in ( ) indicates disaster spot density (Total length of a and b spots/section length).

As the result of assessment of factors listed in Table 6.5-2, the following three (3) sections were selected;

Section No.	Name of Section	Length of a Section (Km)
M – 6	Dalto Pass Section (Aritao-San Jose)	77.5
M – 20	Mahaplag-Sogod Section (Leyte)	36.7
B – 1	Kennon Road	34.2
	Total	148.4 Km.

TABLE 6.5-2 CHARACTERISTICS OF THE FIRST PRIORITY SECTIONS

Section	Disaster Spot Density	AADT (1980)	Availability of a Detour Road	Related Projects	Other Aspects
M-6 (Aritao-San Jose) Dalton Pass Section	72.9	1,670	. None	. Cagayan Integrated Agricultural Development Project . Chico River Irrigation Project . Magat River Multi-purpose Project	This section is the gateway to and provides only access to the Cagayan Valley Region. To maintain this section passable throughout the year is quite important to support socio-economic, industrial and agricultural development of the Region.
B-1 Kennon Road	71.9	2,050	. Naguilian Road . Additional 58.6 Kms.	. Baguio City Export Processing Zone	This road provides the shortest link between Metro Manila and Baguio City and is utilized by most of the road users going to Baguio City.
B-2 Agoo-Baguio Road	52.4	230	. Naguilian Road . Additional 21.4 Km.	. Marcos Sport Complex	Although constructed only in 1980, due to incessant occurrences of disaster, passenger and cargo traffic is not attracted. Investment on this road will be wasted, if no measures are taken, however, no rapid increase in traffic is expected. Improvement is not an urgent need.
M-20 Mahaplag-Sogod Section, Leyte	50.5	140	. Mahaplag-Baybay-Bato-Bontoc-Sogod (in Bad Condition) . Additional 69.2 kms.	. Ferry Service Between Liloan and Surigao	When the ferry service between Leyte and Mindanao is in operation, the Maharlika Highway will finally link 4 major islands of the Philippines. Passability of this section throughout the year is the key for effective use of this ferry service.
M-16 Allen-Calbayog Section, Samar	30.6	170	. Allen-Catarman-Calbayog Road (in bad condition) . Additional 53 Kms.	. Ferry Service Between Matnog and Allen . Samar Integrated Rural Development Project	This section is important to support developemnt as well as to maintain peace and order of this island.
M-10 Lucena-Calauag Section, Quezon	6.9	1,830	. None	Bicol River Basin Integrated Development Project	Linkage between Metro Manila and Bicol Region is secured solely by this section and no detour road exists. To maintain this section passable throughout the year is quite important to support all kinds of activities of Bicol Region.