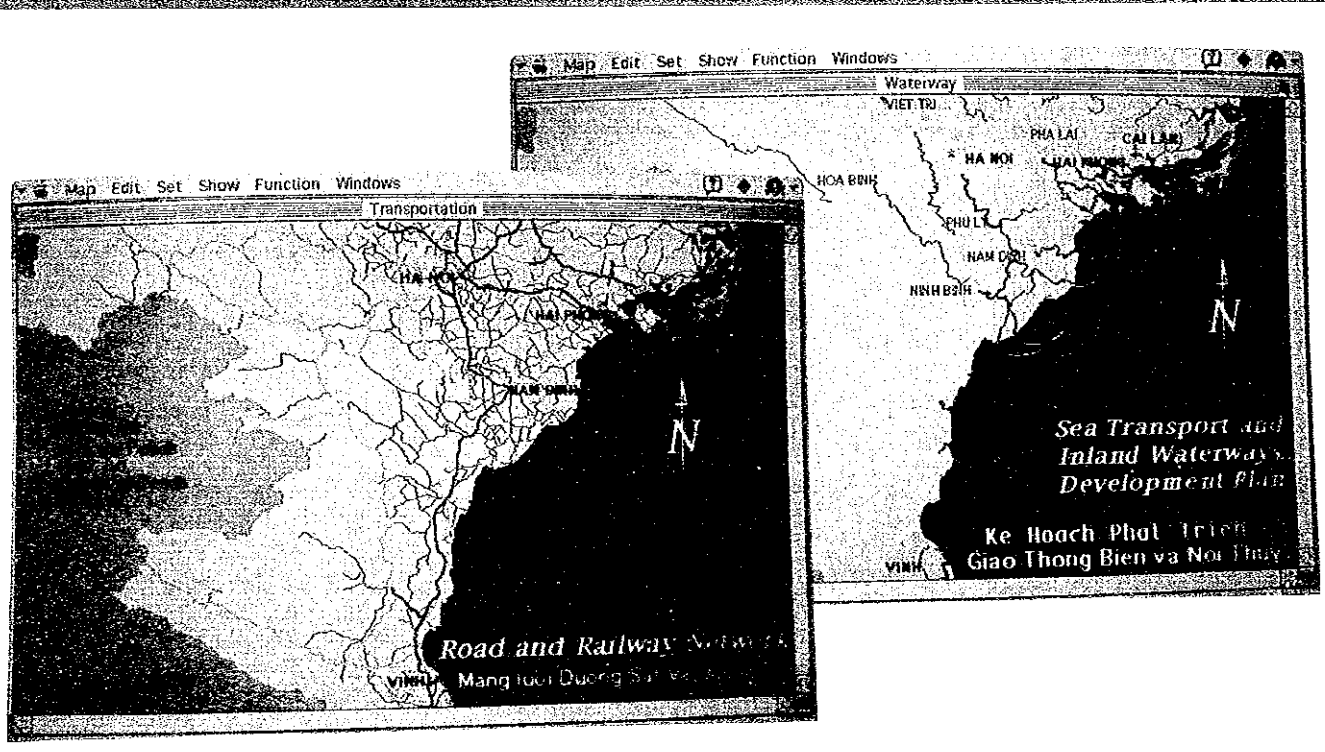
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF TRANSPORT AND COMMUNICATIONS
THE SOCIALIST REPUBLIC OF VIET NAM

NO. 53

THE MASTER PLAN STUDY ON THE TRANSPORT DEVELOPMENT IN THE NORTHERN PART IN THE SOCIALIST REPUBLIC OF VIET NAM

FINAL REPORT
VOLUME 2: TRANSPORT DEVELOPMENT PLAN



JUNE 1994

PACIFIC CONSULTANTS INTERNATIONAL

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The following foreign exchange rate is applied in the study:

US$1.00 = 10,880 Dong (as of October 1993)

PREFACE

In response to a request from the Government of the Socialist Republic of Viet Nam, the Government of Japan decided to conduct a master plan study on the Transport Development in the Northern Part in the Socialist Republic of Viet Nam and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Viet Nam a study team headed by MR. MINORU SHIBUYA, Executive Vice President of Pacific Consultants International, twice between June 1993 and March 1994.

The team held discussions with the officials concerned of the Government of Viet Nam, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the projects and programs and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Socialist Republic of Viet Nam for their close cooperation extended to the team.

June 1994

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

June, 1994

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir,

Letter of Transmittal

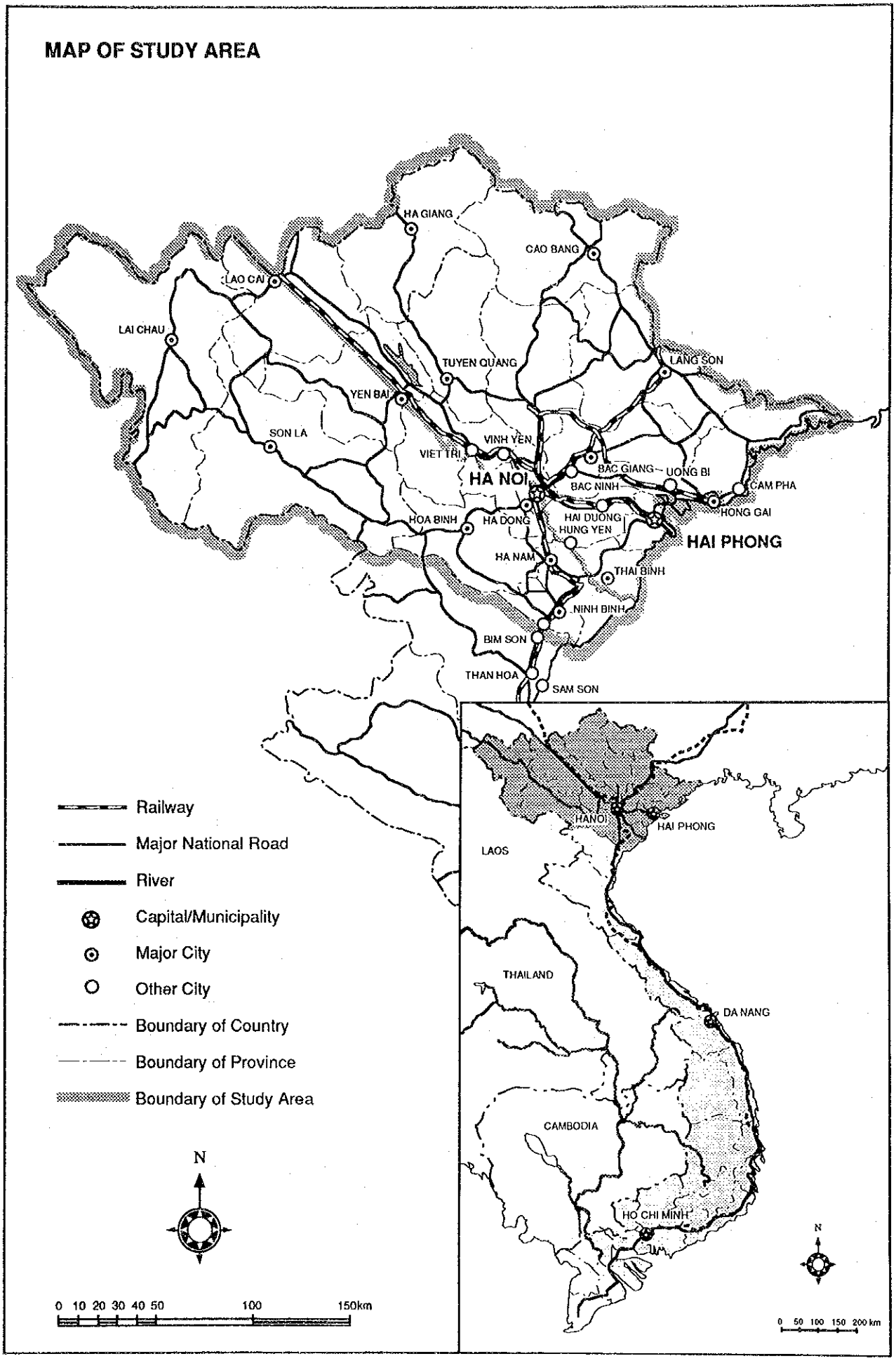
We are pleased to submit to you the report on the Master Plan Study on the Transport Development in the Northern Part in the Socialist Republic of Viet Nam. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the comments made by the Ministry of Transport and Communication, the State Planning Committee, and the authorities concerned in the Socialist Republic of Viet Nam. The report consists of four volumes; a summary report, a report on transport development plan, a report on project profiles and initial environmental examination, and a report on analysis of present conditions and future framework. This report presents the master plan for four transport sectors: road, railway, port and sea transport, and inland waterway.

In view of urgency of transport system development in the Northern Part of Viet Nam and of the need for socio-economic development of Viet Nam as a whole, we recommended an integrated transport network plan, and prepared the development project lists for each transport sector. We believe that this master plan provides the basic transport development policy up to the year 2010.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Construction and the Ministry of Transport. We also wish to express our deep gratitude to the Ministry of Transport and Communication and the Governmental Agencies concerned in the Socialist Republic of Viet Nam for the close cooperation and assistance extended to us during our study. We hope this report will contribute to the effort made in the development of the Socialist Republic of Viet Nam.

Very truly yours,

Mr. Minoru Shibuya
Team Leader
The Master Plan Study
on the Transport Development
in the Northern Part
in the Socialist Republic of Viet Nam


MAP OF STUDY AREA
HA GIANG
CAO BANG
LAO CAI
LAI CHAU
TUYEN QUANG
LANG SON
YEN BAI
SON LA
VINH YEN
VIET TRI
HA NOI
BAC GIANG
UONG BI
BAC NINH
CAM PHA
HOA BINH
HA DONG
HAI DUONG
HUNG YEN
HONG GAI
HAI PHONG
HA NAM
THAI BINH
NINH BINH
BIM SON
THAN HOA
SAM SON
Railway
Major National Road
River
Capital/Municipality
Major City
Other City
Boundary of Country
Boundary of Province
Boundary of Study Area
N
0 10 20 30 40 50 100 150km
HANOI
HAI PHONG
LAOS
THAILAND
DA NANG
CAMBODIA
HO CHI MINH
N
0 50 100 150 200 km

THE MASTER PLAN STUDY ON THE TRANSPORT DEVELOPMENT
IN THE NORTHERN PART
IN THE SOCIALIST REPUBLIC OF VIETNAM
FINAL REPORT - VOLUME 2

Table of Contents

List of Tables

List of Figures

List of Abbreviations

A. Authorities and Agencies

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CIS	Commonwealth of Independent States
COMECOM	Council for Mutual Economic Aid
DOTC	Department of Transport and Communications
FAO	Food and Agriculture Organization
G.D.R.	German Democratic Republic
IBRD	International Bank for Reconstruction and Development (World Bank)
IWB	Inland Waterway Bureau
JARTS	Japan Railway Technical Service
JICA	Japan International Cooperation Agency
JNR	Japanese National Railway
JR	Japan Railway
LAO PDR	Lao People's Democratic Republic
MOTC	Ministry of Transport and Communications
P.R. China	People's Republic of China
R.M.D.	Road Management Divisions
RRMU	Regional Road Management Unit
SCCI	State Committee for Co-operation and Investment
SPC	State Planning Committee
TEDI	Transport Engineering Design Inc.
TESI	Transport Economic Scientific Institute
UK	United Kingdom
UN	United Nations
UNDP	United Nations Development Programme
UNIDO	United Nation, Industrial Development Organization
U.S.A.	United States of America
USSR	Union of Soviet Socialist Republics
VINAMARINE, V.M.	Viet Nam National Maritime Bureau
VINASHIP	Viet Nam Shipping Company
VISERITRANS	Viet Nam Sea - River Transport Enterprise
VITRANSCHART	Viet Nam Sea Transport and Chartering Company
VNR	Viet Nam Railway
VOSCO	Viet Nam Ocean Shipping Company
VRAB	Viet Nam Road Administration Bureau

B. Other Abbreviations

AADT	Average Annual Daily Traffic Volume
AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
As	Asphalt
BOT	Built, Operation and Transfer
CBR	California Bearing Ratio
CIF	Cost Insurance and Freight
DC	Diesel Rail Cars
DID	Densely Inhabited District
DWT	Dead Weight Tonnages (Tons)
EIA	Environmental Impact Assessment
EPZ	Export Processing Zone
FDC	Freight Distribution Center
FIRR	Financial Internal Rate of Return
F/P	Foreign Portion
GDP	Gross Domestic Products
GPP	Gross Provincial Products
GRP	Gross Regional Products
GRT	Gross Registered Tonnage
HCM	Highway Capacity Manual
HCM City	Ho Chi Minh City
HP	Horse Power
IEE	Initial Environmental Examination
L/P	Local Portion
LRT	Light Rail Transit
MG	Meter Gauge
MIS	Management Information System
MxG	Mixed Gauge
NFEA	Northern Focal Economic Area
N.P.	National Park
NTSR	National Transportation Sector Review
ODA	Official Development Assistance
O/D, O-D Survey	Origin-Destination Survey
OJT	On-The-Job- Training
PC	Prestressed Concrete
PCU	Passenger Car Unit
PD	Project Description
PSI	Present Serviceability Index
QC	Quality Control
R.O.W.	Right of Way
RUCM	Road User Cost Model

SD	Site Description
SFEA	Southern Focal Economic Area
StG	Standard Gauge
TEU	Twenty Feet Container Equivalent Units
TQC	Total Quality Control
TRANPLAN	Transportation Planning Modeling Software
TWV	Two-Wheeled Vehicles
V/C Ratio	Volume Capacity Ratio

Chapter 1 Introduction

CHAPTER 1 INTRODUCTION

The main action-oriented outputs of the Master Plan Study comprise this volume. The emphasis is on presenting a cohesive and coordinated set of realistic prescriptions for improvement of transport in the Northern Part of Vietnam, including both short-term remedial measures for bottlenecks needing to be relieved in the near future, and longer-term development strategies designed to anticipate and prepare for the transport demands in the study area, up to and indeed beyond the 2010 time horizon of the study itself.

First there is a brief review of the study team's assumptions about socio-economic factors determining the future demands for surface transport in all modes, coupled with a statement of the broad outlines of future transport demand as forecast for the four main modes of roads, railways, ports and sea transport, and inland waterways.

In conducting the Study each of these transport modes was studied individually and then synthesized into an over-all multi-modal system. In presenting these results for policy and program action, however, the preferred approach is first to look at the overall performance of the transport system as an integrated whole; then to examine the underlying proposals for each individual transport mode in somewhat greater concreteness; lastly to look at the institutional and financial requirements for implementation.

Chapter 2 Planning Framework

CHAPTER 2 PLANNING FRAMEWORK

2.1 SOCIOECONOMIC FRAMEWORK

The basic items of demographic and economic data comprising the socioeconomic framework defined in this study are the starting materials for transport demand forecasting. This in turn contributes to the design of modal transport networks whose purpose is to make it easier for the people of Northern Part of Vietnam to travel, as well as to move the goods needed to support their productive activities.

It has to be mentioned that at this time, trends seen in historical data are limited in usefulness for forecasting because many previous economic relationships are being fundamentally changed in the "Doi Moi" program of transition from central planning to market mechanisms for managing many activities. Nevertheless the basic pattern of settlements and evolution of population will not change very radically even over the 17-year planning horizon of this study.

Likewise there is a fixed locational pattern of the major extractive industry sites generating the major share of bulk freight for rail and waterway transport, and developments in their output are more sensitive to international market developments, than to changes in Vietnam's systems of domestic economic management.

Much more dramatic changes can be anticipated in the secondary production and service sectors, due to the reform program and the rapid economic growth it is fostering. This will be mirrored by substantial changes in passenger movements linked to employment opportunities in these higher-earning sectors. For the same reasons there will be equally dramatic re-alignments in the streams of general cargo which are largely generated by secondary producers.

These several factors are all at least partially taken into account by the forecasting approach taken in this study, which employs mainly two measures. One key indicator is the anticipated growth of population in the Study area, together with foreseeable changes in its interprovincial and urban-versus-rural distributions. Another major determinant is expected development of income-generating production and its corresponding geographic distribution.

By linking these two sets of fundamental variables it is believed that, despite gaps in present data and uncertainties of the future, future traffic patterns can be anticipated with sufficient accuracy to avoid large errors in network capacity design.

As Figure 2.1.1 makes plain, population in the study area is greatly concentrated in the provinces immediately surrounding Ha Noi, with the concentration however not being in the Capital city province itself, but on the fertile delta plain areas of Ha Lung and Nam Ha, between Ha Noi and the coastline.

In 1991, the Study area registered a population of 24.8 million with 16 % living in urban areas. The average population density was 215 persons per km^2. The Red River Delta accounts for 13.3. million people with an average density of 1,065 persons per km^2 and an urban population of 17 %. The North Mountain and Midland Region accounts for 11.6 million people with an average density of 112 persons per km^2 and an urban population of 14 %. Population density in the Red River Delta is almost 10 times higher than that in the North Mountain and Midland Region.

For a full understanding of the basically agrarian foundation of both the social and economic structures, it is important to note that even in this central hub of the Study area, urban population ratios in the Red River Delta as well as North Mountain and Midland Region are below the national average of 20 %.

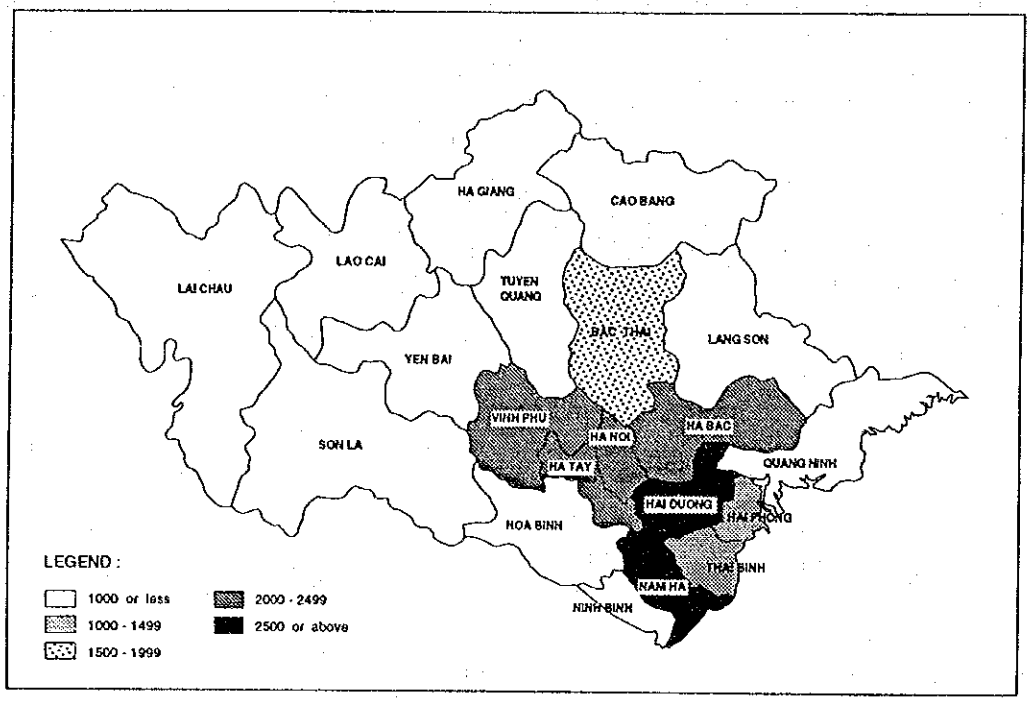


Figure 2.1.1 Population Density of the Northern Part of Vietnam

Figure 2.1.2 shows that geographic distribution of economic activity also tends to be clustered around the Capital. There are, however, other areas of relative prosperity elsewhere in the region, where the best agricultural soils, richest fisheries and commercial mineral deposits are found.

Yen Bai province near the geographical center of the Study area, has levels of income on a par with the provinces immediately surrounding Ha Noi and Hai Phong, in both total and per capita terms. In part because of its relatively lower level of population pressure at present, coastal Quang Ninh enjoys the highest per-capita income after Ha Noi and Hai Phong, even though its total income is relatively lower in ranking among the provinces studied.

Overall, although the Study area accounts for 37 % of the country's population, its GDP share is 25 % and per capita GDP is estimated at US$162. This compares to 67 % of the estimated national per capita GDP of US$240.

The most important requirement for transport planning purposes is to get a clear idea of how those average levels of population, gross economic activity and per-capita income are most likely to evolve over time, up to the planning horizon of the Study. The Study Team's assumptions in this regard are set out in Table 2.1.1.

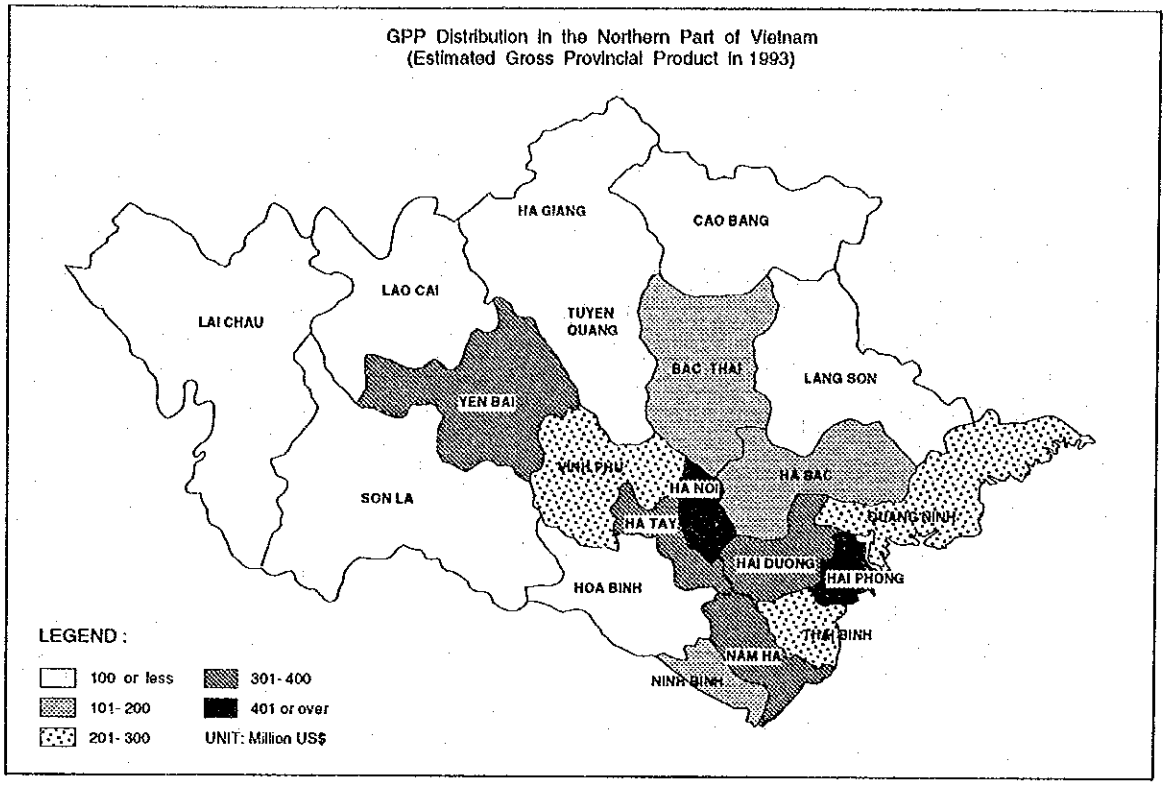
From this, it can be seen that there is an expectation for strong and continuous aggregate economic growth at rates of 8 to 12 percent or more annually. Vietnam's own national economic outlook (7th National Congress, 1991) indicates that the rate of industrial growth may be almost twice that recorded for agriculture, leading to sectoral shifts with significant impact on transport demands.

The present sector shares in GRP in the Study area are assumed to be as follows;

Primary sector	:	43 %
Secondary sector	:	19 %
Tertiary sector	:	38 %

The primary sector, which includes agriculture, forestry and fishery, presently contributes 80 % of employment generation and 40 to 50 % of GDP in this region. The primary-sector GDP share in the Study area is estimated at 43 % in 1993. Rural per capita food production in the North Mountain and Midland Region and the Red River Delta are 239 kg and 315 kg, respectively. This places both these subregions below the national average of 414 kg per capita.

Relatively low agricultural productivity combined with high population density are the main characteristics of the Study area at present, but primary sector production, especially food production, experienced higher growth rates in the past three years due to new incentives for farmers under the economic reform policy.



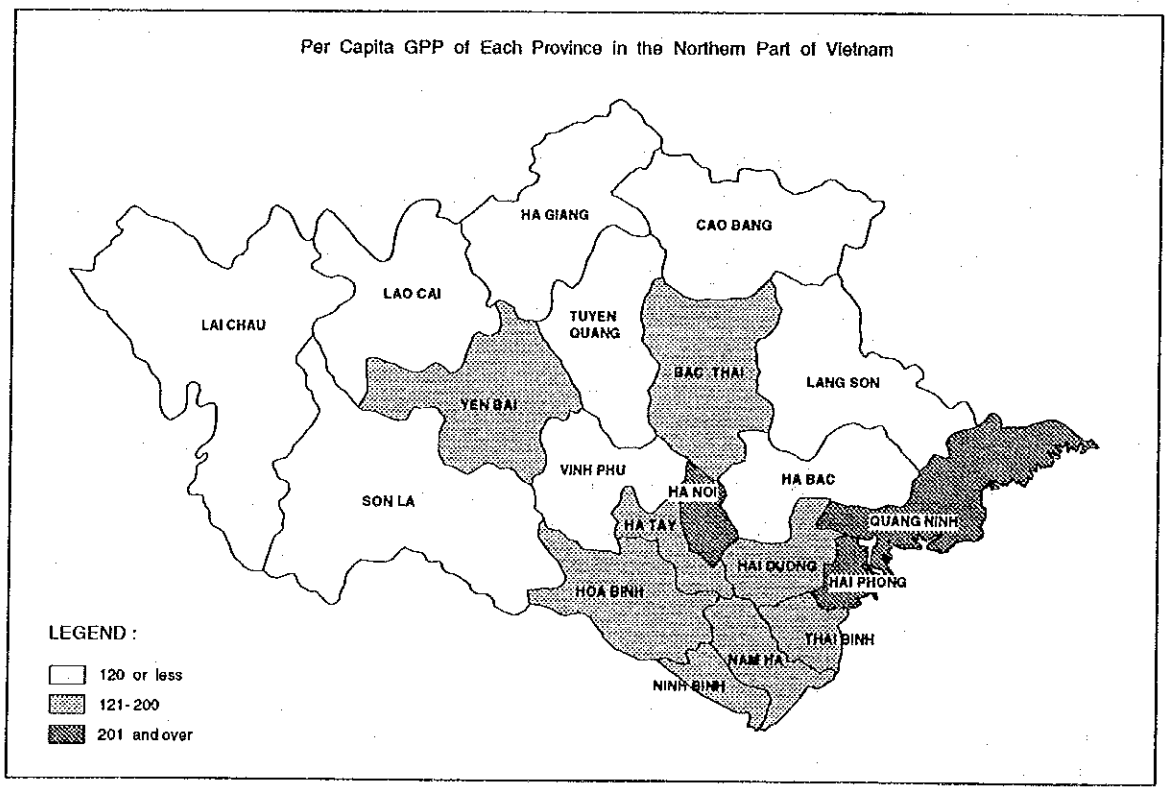


Figure 2.1.2 Absolute and Per Capita GPP of Each Province in the Nothern Part of Vietnam

Table 2.1.1 GDP Forecast for the Whole Country

Year	GDP/Capita (US$)	Population (million)	Population Growth Rate	GDP (mil. $)	GDP Growth Rate
1993	240	69.6	2.20 %	16,704	
2000	333	80.5	2.09 %	26,822	7.0 %
2005	491	88.0	1.80 %	43,198	10.0 %
2010	732	95.0	1.55 %	69,570	10.0 %
			Average growth rate (1993-2010)		8.8 %

Table 2.1.2 GDP Forecast of the Northern Part of Vietnam

(Unit: Constant 1993 US$)

Year	GDP/Capita (US$)	Population (million)	Population Growth Rate	GDP (mil. $)	GDP Growth Rate	Ratio of Target area GDP per Capita to National Avg.
1993	162	25.9	2.20 %	4,190		67 %
2000	240	30.0	2.09 %	7,197	8.0 %	72 %
2005	393	32.8	1.80 %	12,879	12.3 %	80 %
2010	659	35.4	1.55 %	23,334	12.6 %	90 %
			Average growth rate (1993-2010)		10.6 %	

There is still greater potential for overall growth to be attained by accelerating industrialization.

The Study area is known for its rich natural resources and concentration of heavy industries, such as manufacturing of cement and fertilizer, and iron as well as coal mining. Also, the Study area has a high capacity for thermal and hydro-electric power supply. The tertiary sector will also expand its share of GDP, up to 50 % in 2010.

As indicated in Table 2.1.1, these structural changes should be accompanied by aggregate economic growth in the study area at an average rate of 8 percent annually up to the year 2000, accelerating then to more than 12 percent annual growth in Gross Regional Product (GRP), which is expected to be maintained for the remainder of the study period up to 2010.

At the same time the present 2.2 percent annual population growth in the study area is expected to moderate to only 1.55 percent annual growth by 2010. If realized, these different population and economic growth trends will allow for a four-fold increase in GDP per capita in the Study area from 1993 to 2010, narrowing the present difference between the Northern region and the country as a whole.

The anticipated spatial distributions in population and economic activity now and in the future, and the dynamics of change from the one to the other, are translated into a functional schematic in Figure 2.1.3. This framework sets the

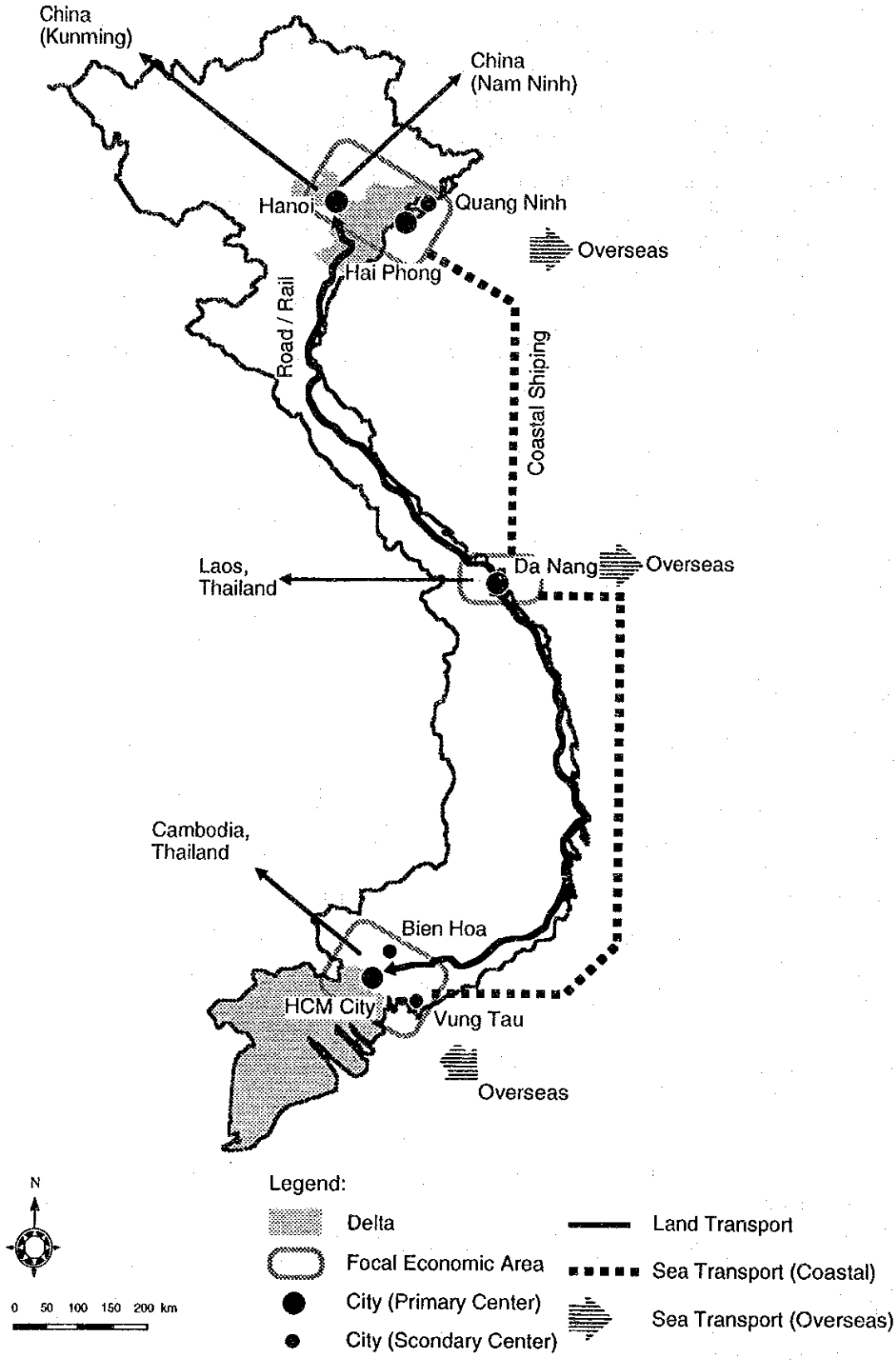


Figure 2.1.3 Regional Settings of Vietnam

study area in the context of its relations to other centers of economic activity, both inside Vietnam and internationally. These flow patterns form the basis of long-distance transport demands.

At the interface between demand-generating economic activity and physical transport systems, modal network systems channel demand (flows) between a series of geographic subdivisions (zones). The 20 provinces, whose landuse composition and activities can be described in socioeconomic and demographic terms, are designated as comprising the Study area's internal zone structure. Figure 2.1.4 and 2.1.5 show the zones applied for this study and NTSR zone structure.

2.2 TRANSPORT DEMAND FORECAST

Summarizing the detailed network results to obtain an overview for the study area as a whole, Table 2.2.1 examines the development of linkages between economic activity and transport. A relative comparison of future-year income and transport levels to the present situation reveals that, if regulatory counter-measures were not taken:

- Car vehicle trips and truck cargo shipments are forecast to grow at a much faster rate than per capita GDP.

- Rail and inland waterway cargo shipments are expected to grow at slightly below the national income rate, with the rail mode exhibiting stronger relative growth in the longer term.

- Growth in bus vehicle trips is likely to equal growth in national income, and rail passenger trip growth is expected to lag somewhat.

- Vehicle trips are expected to more than double by the year 2000, and then again quadruple by the year 2010. Trips by car are expected to grow more rapidly than those by bus and truck.

- Rail passenger travel will roughly double by the year 2010.

- Cargo will increasingly flow by truck, although shipments by rail and inland waterway will also expand from current levels.

In interpreting all of the road-traffic results presented in this report, it is important to recognize that shorter-distance intrazonal or intraurban flows are not included in the analysis. Conclusions about possible future problems are therefore almost certain to be understated to some extent.

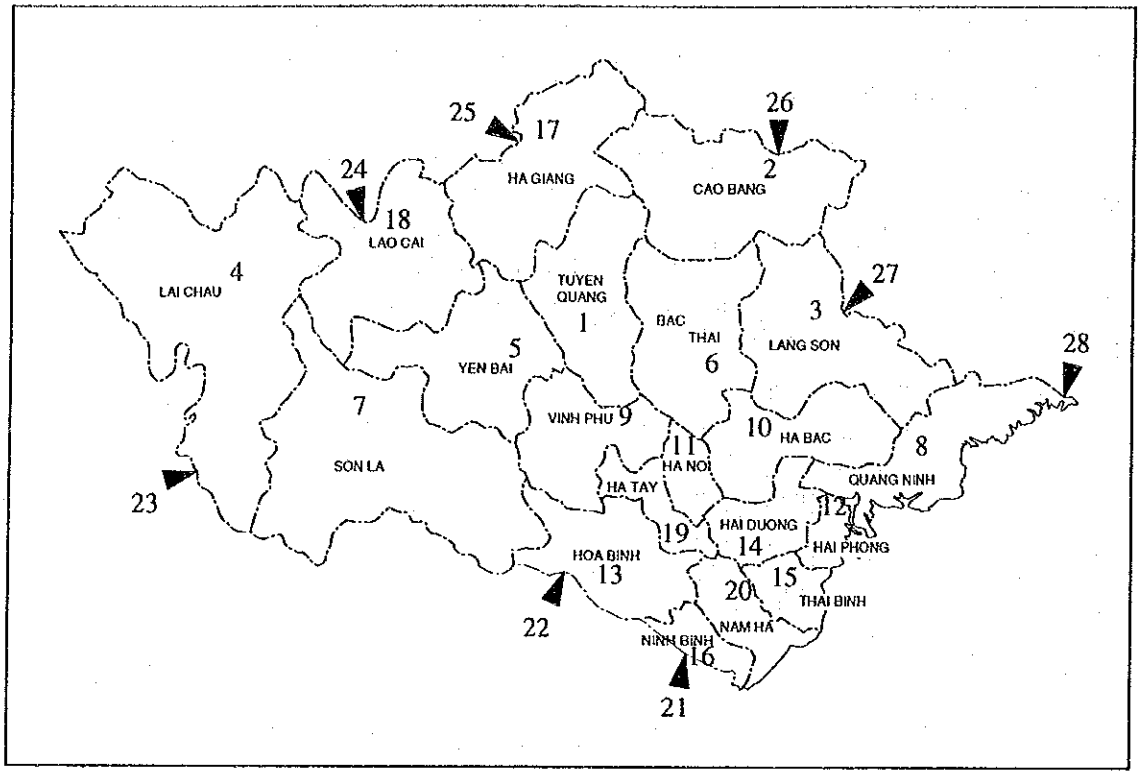


Figure 2.1.4 Study Area and Zone System

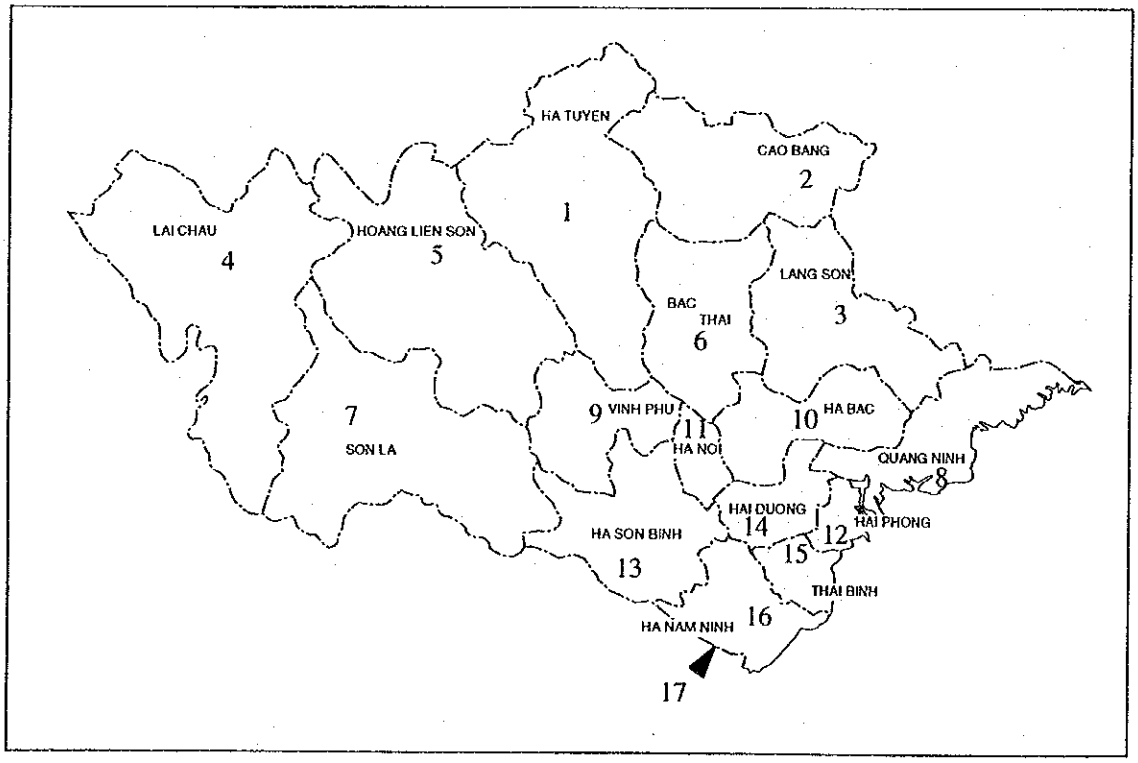


Figure 2.1.5 National Transportation Sector Review Domestic Zone Structure

Table 2.2.1 Overview of Existing and Forecast Transport Demand Indicators in the Northern Part of Vietnam

ITEM (1)	MODE	UNITS	AMOUNT			AVERAGE ANNUAL PERCENT CHANGE		
			Base Year	2000	2010	Base–2000	Base–2010	2000–2010
Population	*	Persons (000)	25938	29984	35402	2.1	1.8	1.7
GDP	*	Million 1993 Constant US$	4190	7197	23334	8.0	10.6	12.5
GDP/Capita	*	1993 Constant US$	162	240	659	5.8	8.6	10.6
Vehicle Trips(2)	Car	Daily Trips	8633	26936	127759	17.7	17.2	16.8
	Bus	Daily Trips	2154	3731	12333	8.2	10.8	12.7
	Truck	Daily Trips	9080	16878	59044	9.3	11.6	13.3
	Total	Daily Trips	19867	47545	199136	13.3	14.5	15.4
Domestic Passengers(3)	Rail	Annual Persons (000)	6429.9	8206.7	13458.8	2.2	3.6	5.1
Domestic Passengers(3)	Rail	Annual Tons (000)	6745.5	15151.2	57926.2	9.4	12.0	14.4
Domestic Cargo (4)	Road	Annual Tons (000)	1987.7	3851.6	9452.4	7.6	8.6	9.4
	Port (5)	Annual Tons (000)	6680.0	11900.0	24200.0	7.2	7.3	7.4
	Inld Wtwy (6)	Annual Tons (000)	5936.2	12516.1	22000.0	8.6	7.1	5.8
	Total	Annual Tons (000)	14669.4	31518.9	89378.6	8.9	10.0	11.0

(1) Background data required derivation of population and GDP forecasts are presented in reports issued by sectorial specialists.

(2) Interzonal trips by four-wheeled vehicles. Northern Vietnam zone system based on 20 internal zones and eight external zones (refer Figure 2.1.4). Base year reflects year 1993 conditions.

(3) Interzonal trips. Northern Vietnam zone system based on 16 internal zones and one external (Southern Vietnam) zone. Base year reflects year 1989 conditions.

(4) Interzonal cargo flows. Northern Vietnam zone system based on 16 internal zones and one external (Southern Vietnam) zone. Base year reflects year 1991 conditions.

(5) Includes international cargo flows.

(6) Inland waterway (river) mode; exclude coastal shipping.

The magnitude of the potential for vehicular overcrowding, if unchecked, and traffic stagnation are portrayed in Figure 2.2.1. On the other hand it is unlikely that a wholesale restructuring of Vietnam's physical transport facilities will take place within the Study's planning horizon. Likewise, locations of cities, borders and natural terrain features will largely remain.

The growth in vehicle registrations within the Study area is linked to forecast changes in GDP among the several provinces of the study area. Thus, for the Northern part of Vietnam:

- The vehicle fleet is expected to grow to 163,000 vehicles by the year 2000, and 645,100 vehicles by the year 2010 (Figure 2.2.1).
- Cars, which represent 31 % of the current fleet, are forecast to total 44 % and 53 % by the years 2000 and 2010, respectively.
- The Study area, while containing about one third of national vehicle registrations in 1991, is likely to contain about 45 % of national registrations in the year 2010.

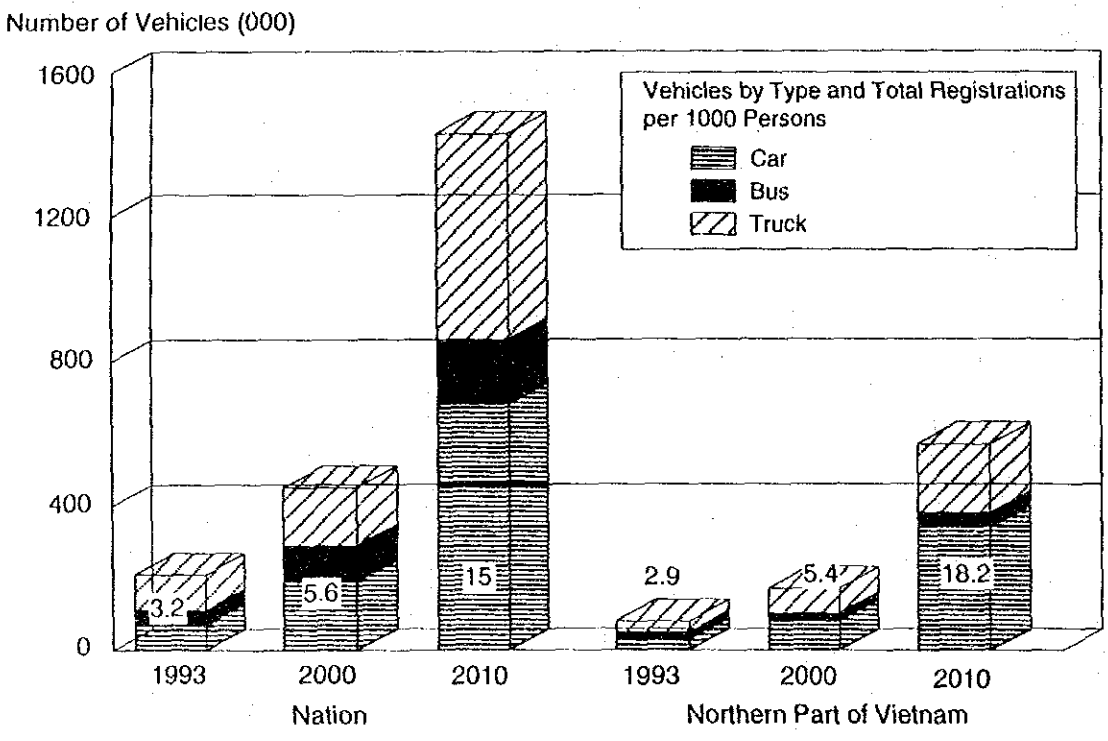


Figure 2.2.1 Existing and Forecast Registered Vehicles: Northern Part of Vietnam and Nation

At least with respect to the present situation of road traffic, it is important to be aware of two significant and inter-related definitional issues: First, the term "vehicle" as used in this study refers only to three or four-wheeled, motorized cars, buses and trucks; it does not include the bicycles and "cyclo" bicycle taxis which today are still the predominant form of transport. Second, a vehicle-trip is defined as an inter-provincial journey; it does not include shorter intra-provincial and local use of vehicles.

On the basis of a comparison of data with Indonesia, it has been assumed that, as Vietnam develops from its current US$240 per capita GDP to higher ranges, motorcycles will increasingly be used for journeys now accomplished by bicycle. This may well be appropriate in the case of inter-urban and inter-provincial trips, but in a compact and flat city center like that of Ha Noi, much can be said in favor of measures to foster the continued use of non-motorized personal transport. Benefits include controlling noise and emissions, and more efficient use of streetways and parking spaces.

Even with these qualifications, however, between 1993 and 2010 the expected rise in interprovincial motorized vehicle trips is dramatic: a ten-fold increase from a bout 20,000 to 200,000 trips annually for the study area as a whole, as shown in Table 2.2.2. Although the starting base is certainly extremely low, there can be no doubt that this order-of-magnitude change will substantially impact the travelling conditions.

Road freight carriage displayed in Table 2.2.3, is expected to post a similarly sharp increase, rising by a factor of 9 approximately; rail and even inland waterway traffic anticipate five- and four-fold increases, respectively, over the study area as a whole. And of course, these averages include certain key linkages such as the Ha Noi - Hai Phong corridor already discussed, over which the intensification of traffic could clearly be expected to cause severe congestion if corrective measures were not taken.

The remaining chapters of this volume discuss the overall plan of action and specific projects, mode by mode, which the present study team proposes in order to deal with this situation. Included are not only investments to restore, upgrade and expand physical capacities; also highly recommended are improved and strengthened "software" traffic control measures for all modes, but especially for roads.

Table 2.2.2 Existing and Forecast Vehicle Trip Activity Analysis Zones in the Study Area

ANNUAL CARGO FLOW (000 TONS) (2)

	ROAD MODE						RAIL MODE					
	1991		2000		2010		1991		2000		2010	
ZONE(1)	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW
1	31.3	40.9	81.8	167.1	312.7	638.9	0.0	0.0	0.0	0.0	0.0	0.0
2	12.1	18.2	26.5	43.5	101.3	166.3	0.0	0.0	0.0	0.0	0.0	0.0
3	127.6	56.0	312.2	129.3	1193.6	494.3	126.4	25.4	591.1	39.3	1090.1	100.8
4	12.7	34.9	25.9	61.1	99.0	233.6	0.0	0.0	0.0	0.0	0.0	0.0
5	29.0	56.4	90.3	188.5	345.2	720.7	233.2	101.2	605.4	133.1	1552.7	341.4
6	506.3	288.0	1053.0	607.9	4025.8	2324.1	67.4	48.5	99.9	68.0	256.2	174.4
7	58.7	43.1	122.7	77.9	469.1	297.8	0.0	0.0	0.0	0.0	0.0	0.0
8	376.7	60.4	1440.0	752.5	5505.4	2877.0	484.0	5.7	684.4	19.4	1755.3	49.8
9	481.8	325.7	1949.1	683.1	7451.8	2611.8	156.3	358.0	227.2	717.1	582.7	1839.1
10	194.3	489.6	477.6	1321.4	1826.0	5052.0	15.7	58.8	37.5	472.8	96.2	1212.6
11	1103.4	3080.8	2065.8	5985.8	7898.0	22884.9	129.7	388.1	228.5	664.5	586.0	1704.2
12	1280.8	253.4	3281.3	1132.6	12545.1	4330.2	267.5	133.4	468.3	396.8	1201.0	804.7
13	375.9	261.1	1190.3	939.4	4550.8	3591.5	0.1	3.3	61.5	181.3	157.7	465.0
14	467.0	413.3	883.5	926.9	3377.8	3543.7	4.3	354.7	18.3	236.2	46.9	392.8
15	13.8	137.6	32.3	282.6	123.5	1080.4	0.0	0.0	0.0	0.0	0.0	0.0
16	786.6	487.0	988.5	859.7	3702.8	3286.8	228.5	36.5	279.1	134.3	715.8	344.4
EXT	587.4	699.0	1150.4	991.9	4398.3	3792.3	274.6	472.2	550.4	788.8	1411.7	2023.1
TOTAL	6745.4	6745.4	15151.2	15151.2	57926.2	57926.2	1987.7	1987.7	3851.6	3851.6	9452.4	9452.3

	INLAND WATERWAY MODE						ALL MODES					
	1991		2000		2010		1991		2000		2010	
ZONE(1)	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW
1	0.0	0.0	0.0	0.0	0.0	0.0	31.3	40.9	81.8	167.1	312.7	638.9
2	0.0	0.0	0.0	0.0	0.0	0.0	12.1	18.2	26.5	43.5	101.3	166.3
3	0.0	0.0	0.0	0.0	0.0	0.0	254.0	81.4	903.3	168.6	2283.7	595.1
4	0.0	0.0	0.0	0.0	0.0	0.0	12.7	34.9	25.9	61.1	99.0	233.6
5	0.0	0.0	0.0	0.0	0.0	0.0	262.2	157.6	695.7	321.6	1897.9	1062.0
6	0.0	0.0	0.0	0.0	0.0	0.0	573.7	336.5	1152.9	675.9	4282.0	2498.5
7	0.0	0.0	0.0	0.0	0.0	0.0	58.7	43.1	122.7	77.9	469.1	297.8
8	3797.7	444.2	6269.7	411.4	11020.3	723.1	4658.4	510.3	8394.1	1183.3	16281.0	3649.8
9	1044.6	491.4	2584.9	819.2	4543.6	1440	1682.6	1175.1	4761.2	2219.4	12578.1	5890.8
10	9.5	135.6	27.8	35.3	48.9	62	219.5	684.0	542.9	1829.5	1971.0	6326.6
11	98.3	1355.3	486.4	4874.5	855	8567.9	1331.4	4824.2	2760.7	11524.8	9339.0	33157.1
12	687.5	1235.2	1008.1	1910.1	1772	3357.5	2235.9	1622.0	4757.7	3439.5	15518.1	8492.4
13	1.0	75.2	3.1	13.6	5.4	23.9	377.0	339.6	1254.9	1134.3	4713.9	4080.4
14	111.0	1052.4	461.6	1978.4	811.4	3477.6	582.3	1820.4	1363.4	3141.5	4236.1	7414.1
15	4.6	73.2	8.7	202.1	15.3	355.2	18.4	210.8	41.0	484.7	138.8	1435.6
16	40.6	1005.7	1314.7	1983.6	2310.9	3467.1	1055.7	1531.2	2562.3	2977.8	6729.5	7116.3
EXT	141.3	68.0	351.1	287.7	617.2	505.7	1303.3	1239.2	2051.9	2068.4	6427.2	6321.3
TOTAL	5936.2	5936.2	12516.1	12516.1	22000.0	22000.0	14669.3	14669.3	31518.9	31518.9	89378.6	89378.6

(1) Totals represent domestic interzonal flows per NTSR zone structure (refer Figure 2.1.5).

(2) Year 2010 demand should be viewed as a target potential.

Table 2.2.3 Existing and Forecast Domestic Cargo Volumes: Northern Part of Vietnam and Nation

ZONE(1)(2)	VEHICLE TRIPS(3)			PERCENT CHANGE (4)		
	1993	2000	2010	1993–2000	1993–2010	2000–2010
1	195	740	3038	21.0	17.5	15.2
2	167	632	2885	20.9	18.2	16.4
3	643	2058	8587	18.1	16.5	15.4
4	85	398	2024	24.7	20.5	17.7
5	170	437	1553	14.4	13.9	13.5
6	718	1369	3985	9.7	10.6	11.3
7	119	246	815	10.9	12.0	12.7
8	686	2689	8052	21.5	15.6	11.6
9	776	1776	7915	12.6	14.6	16.1
10	1457	3455	18688	13.1	16.2	18.4
11	6284	13032	49422	11.0	12.9	14.3
12	1459	3656	16610	14.0	15.4	16.3
13	462	1174	3714	14.3	13.0	12.2
14	973	2220	11845	12.5	15.8	18.2
15	395	875	3259	12.0	13.2	14.1
16	623	1161	5138	9.3	13.2	16.0
17	93	231	1121	13.9	15.8	17.1
18	102	703	3751	31.8	23.6	18.2
19	2133	5680	25547	15.0	15.7	16.2
20	1271	2247	9417	8.5	12.5	15.4
21	923	1869	6523	10.6	12.2	13.3
22	26	51	171	10.1	11.7	12.9
23	7	35	210	25.8	22.1	19.6
24	13	251	1506	52.6	32.3	19.6
25	5	25	150	25.8	22.1	19.6
26	7	35	210	25.8	22.1	19.6
27	9	250	1500	60.8	35.1	19.6
28	66	250	1500	21.0	20.2	19.6
TOTAL	19867	47545	199136	13.3	14.5	15.4

(1) Refer Figure 2.1.4 for zone system

(2) Base-year trip flows at external zones 23 - 28 represent simulated demand based on observed cross-border activity.

(3) Trip origins or trip destinations.

(4) Average percent change per annum, compounded.

Chapter 3 Development Objectives and Future Transport Network in the Northern Part of Vietnam

CHAPTER 3 DEVELOPMENT OBJECTIVES AND FUTURE TRANSPORT NETWORK IN THE NORTHERN PART OF VIETNAM

The complex integrated network of transport systems and services proposed in this study is envisaged not as an end in itself, but as one of the important means contributing to achievement of overall development objectives larger than what can be immediately achieved by these proposed transport sector projects alone.

However, improved access of human settlements, industrial sites and primary production areas to transport networks, and improved mobility of people and goods within those networks, would both contribute directly to overcoming one of the major obstacles most often mentioned as standing in the way of efficient organization of production in Vietnam: while the national and regional markets are large, even domestically, they are at present so fragmented by long travel times or sheer unavailability of transport, so that many economic activities are continued to inefficiently small scales of operation.

In this chapter the first consideration is the extent of integration attainable among the several different transport modes, so that they will complement rather than impeding each other. Then, particular development objectives are set out for each individual transport mode studied. Next the several single-mode networks for road, rail, and water are assembled as components of an over-all multi-mode network among provinces; and finally, the special case of urban transport is taken up briefly, even though it is more properly a subject for a specialized separate study.

3.1 INTEGRATION OF TRANSPORT SYSTEM

Under the market-oriented economy, users of the transport system are presented with choices, and decisions to choose a particular transport mode will be guided by the mode's characteristics, and what is perceived as being the most flexible, convenient and economic choice to meet their personal needs.

First priority should be given, therefore, to the development of road transport, which is presently underdeveloped, yet is in some cases the most efficient mode to handle local, intraregional and interurban passenger transport as well as general cargo transport.

The integration of the different transport modes will partly take shape in line with market driven forces. However, the desirable functional distribution among the modes and their interfacing from a planning point of view are summarized in Table 3.1.1.

Table 3.1.1 Potential Future Role and Function of Each Transport Mode

Transport Mode	Potential Future Role & Function	Selected Key Issues
Road Transport	1) Majority of Local and Intra-Regional Passenger Transport 2) Majority of Inter-Urban Passenger and Freight Transport within the Growth Triangle Ha Noi - Hai Phong - Cai Lan 3) Interface with the Mountain Region for Passenger and Selected Freight Transport 4) Majority of Freight Transport Connecting Regional and Local Distribution Centers	1) Implement in line with "International Standards" and Increasing Number of Heavily Loaded Vehicles (Truck Size) 2) Introduce Suitable "Regulatory Framework" according to International Standards: Set up Appropriate Enforcement Agencies 3) Adopt and Implement Consistent Transport Policy (Roles of Public and Private Sectors: Roles of Public Agencies) 4) Adopt and Enforce Appropriate Environmental Standards 5) Define Strategy and Operational Programme for Public Agencies Concerned
Railway Transport	1) Inter-City between Ha Noi and Hai Phong, Local Passengers and Goods in Remote Areas, where Rail is the Predominant Mode 2) Bulk Cargo and Inland Supply to Places where other Modes Are Absent Note: It is anticipated that some small-volume freight transport will be transferred to the road in appropriate cages. 3) International Connection and Interfacing (Possibly with the P.R. China)	1) Adopt and Implement Consistent Transport Policy (Roles of Private Sectors: Roles of Public Agencies) 2) Upgrade Facilities & Service on High Demand Lines 3) Make Optimal Use of Existing Facilities
Port & Sea Transport	1) International Freight Transport with Concentration on Bulk Cargo and Containers 2) International Freight Distribution Base and Domestic Freight Distribution Centers	1) Net Investment For Capacity Build up Needed: New Deep Sea Port, proposed in Cai Lan 2) Decide on Future Roles of the Public and Private Sectors (Port Management Authority) 3) Establish Overall Sea and Coastal Fleet Strategy
Inland Waterway Transport	1) Vital Energy Supply Route (Coal) 2) Bulk Freight Transport (Construction Materials), Supplementary to Rail Transport 3) Localized and Intra-Regional Small Size Freight (Partly Replaced by Road Transport)	1) Upgrade Specialized Ports which Function as Interfaces with other Modes 2) Maintain and Upgrade Existing Facilities 3) Decide on Roles (Public/Private) of Inland Waterways Fleet and Existing Organizations

Source: Mission team compilation

The functional distribution identified in Table 3.1.1 partly reflects a specialization pattern which has evolved historically in the Study area in line with basic characteristics of each mode. Typically, at that stage of development, road transport is viewed as the most cost-efficient, almost "door-to-door" mode for passenger and general cargo transport, although whether it remains so, is critically dependent on avoidance of congestion. Rail transport encompasses potential advantages over roads, for long distance, inter-city and passenger transport, and bulk cargo transport. Port and sea transport characteristics favor the handling of bulky, heavy, and a large quantity of cargo, while the inland water transport is, given the basic socioeconomic and topographical features of the Study area, a vital mode for transporting coal as an energy supply and construction materials such as sand and gravel.

At the same time it should be constantly borne in mind that even a smoothly-functioning modern transport system, for all its benefits, also may bring loss of social and environmental values previously maintained especially by rural communities in relative isolation: even if traffic safety and vehicle emissions issues are effectively managed, fragile natural areas, and still more fragile ethnic characters, may be gravely jeopardized by the simple fact of exposure to easy access of superficially attractive modern society outside.

3.2 DEVELOPMENT OBJECTIVES OF EACH TRANSPORT MODE

3.2.1 Road Transport Development Principles and Objectives

PRINCIPLE (I): IMPROVE THE ROAD QUALITY OF THE OVERALL NETWORK

Road transport will be the dominant mode in the future. Key parameters for planning, implementation and monitoring purposes are:

- Rehabilitation and upgrading of road surfaces.
- Expansion of road widths.
- Rehabilitation and improvement of bridges.
- Construction of bridges at ferry sites, where necessitated by demand.
- Implementation of regular and reliable programmes of road condition monitoring, and of maintenance and repair.

PRINCIPLE (II): UPGRADE AND/OR ENLARGE THE PHYSICAL INFRASTRUCTURE IN LINE WITH IDENTIFIED NEEDS

It is estimated that some 80 % of the Origin/Destination trips will remain within the Red River Delta. However, all season/all weather roads must be established between all provinces, and all districts should be accessible by road in all seasons.

PRINCIPLE (III): THE DEVELOPMENT PLAN SHOULD BE PHASED INTO TWO DISTINCT STAGES

Development planning and project implementation should cover two principal phases, an interim phase covering the period 1994 to 2000, and a long-term phase covering the decade 2000 to 2010.

In addition to these overall principles the following sectoral development objectives are proposed:

DEVELOPMENT OBJECTIVE (I): ROAD QUALITY STANDARDS

The international standards and norms recommended in this Study should be passed through the legislature and made to be compulsory national standards. These standards should be applied in all future road upgrading and construction works, and an appropriate monitoring and enforcement mechanism should be identified and established.

DEVELOPMENT OBJECTIVE (II): ENHANCE THE AVAILABLE ROAD CAPACITY

Already available capacity should be enhanced mainly through "low-cost" and "software" measures, such as targeted traffic regulation enforcement, public education and improved management.

DEVELOPMENT OBJECTIVE (III): UPGRADE EXISTING INFRASTRUCTURE

In line with the international standards suggested above, primary concern should be:

- To increase the pavement ratio from the current 20 %, to some 40 to 50 % in the year 2010.
- To develop bridges at six crossing points.
- To expand the road width in identified road network sections.

DEVELOPMENT OBJECTIVE (IV): CONSTRUCTION OF NEW/ADDITIONAL INFRASTRUCTURE/HIGH-ORDER ROADS

In cases where pure upgrading is impractical, the construction of new arterial roads should be considered with new alignments. This includes construction of urban bypasses for cities of the 100,000 to 500,000 population range.

High-order access controlled facilities (freeway with or without toll) should only be constructed where demand clearly justifies. Near future candidates are Ha Noi and Hai Phong.

3.2.2 Railway Transport Development Principles and Objectives

The following development principles and objectives are suggested for railway transport in the Study area:

PRINCIPLE (I): UTMOST UTILIZATION OF EXISTING FACILITIES

Anticipated increases in railway transport can be accommodated within the existing system's structure and layout.

PRINCIPLE (II): STREAMLINE SYSTEM'S LAYOUT AND OPERATIONS

The service functions should be concentrated on selected passenger routes (intercity Ha Noi - Hai Phong), handling bulk cargo, containers between the seaports and Ha Noi; and marginal lines and stations should be reviewed to determine whether it is really necessary to keep them open.

PRINCIPLE (III): CONCENTRATE ON REHABILITATION AND UPGRADING

There is no need to renew the locomotive stock before 2005. Efforts and resources should focus on proper maintenance and renovation of locomotives and passenger cars.

The development program should cover the objectives and issues presented hereunder.

DEVELOPMENT OBJECTIVE (I): FUNCTION, MANAGEMENT AND ORGANIZATION OF VNR

VNR has been made "autonomous". However, there is a need for further clarification and fine-tuning of its role and operations with a view to establish a long-term viable entity.

DEVELOPMENT OBJECTIVE (II): MANPOWER TRAINING AND SKILL IMPROVEMENT PROGRAM

VNR lacks qualified personnel at many levels for modern railway operations. Manpower needs (in terms of quality and quantity) should be established and a long-term training and skill upgrading program should be developed and implemented.

DEVELOPMENT OBJECTIVE (III): MAINTENANCE AND UPGRADING OF EXISTING ROLLING STOCK

Priority should be given to (a) the rehabilitation of the stock of existing D4H locomotives to extend their life-span by some 10 to 15 more years, and (b) the rehabilitation of existing passenger cars with particular attention to the express passenger cars. In this context the issue of spare parts manufacturing for the Russian-made D4H locomotives has to be addressed, since they are not made by the Russian supplier anymore.

DEVELOPMENT OBJECTIVE (IV): IMPROVEMENT OF RELATED FACILITIES

This objective should cover the following issues:

- To equip the remaining freight operation stations with suitable loading/unloading equipment.
- To equip the workshop at Gia Lam and the depot at Hai Phong with facilities to overhaul locomotives and passenger cars.
- To undertake a master plan for signaling.
- To systematically inspect and estimate the strength of existing bridges.
- To study the potential role for rail commuter transport in Ha Noi.
- To study the potential for an inland depot close to Ha Noi.

3.2.3 Port and Sea Transport Development Principles and Objectives

The following development principles and objectives are suggested for port and sea transport development:

PRINCIPLE (I): CONSIDERABLE NET INVESTMENT NEEDED FOR PORT CAPACITY BUILD UP

The port of Hai Phong is characterized by severe constraints for capacity build up. There is a clear need for a new deep seaport; possible site for which is Cai Lan.

PRINCIPLE (II): COOPERATION OF THE TWO PORTS, HAI PHONG AND CAI LAN

Both ports of Hai Phong and Cai Lan have the same role and function fundamentally. These two ports complement each other to contribute to the economic and industrial development in the Northern Part of Vietnam.

PRINCIPLE (III): CONTAINERIZATION AND SHIP SIZE DEVELOPMENTS

The port development stages and facilities for both ports should be geared not only towards international standards, but also to reflect the trends in increasing ship sizes and in containerization of international general cargo trade.

PRINCIPLE (IV): ENVIRONMENTAL CONSERVATION AND PROTECTION

Environmental conservation and protection are important issues for developing a new deep seaport in Cai Lan. Thus, it is essential to undertake an indepth environmental impact study.

Development objectives for port and sea transport are:

DEVELOPMENT OBJECTIVE (I): DEVELOPMENT OF A NEW DEEP SEAPORT, POSSIBLY AT CAI LAN

If a port were to be built at Cai Lan, it should be developed for mass foreign trade transport. It should accommodate larger size vessels which cannot enter Hai Phong Port. The construction work of Cai Lan Port had better get started at an early stage of the project period by stage development, considering that Hai Phong Port will be saturated in the near future.

DEVELOPMENT OBJECTIVE (II): ENVIRONMENTAL PROTECTION AND CONSERVATION AROUND CAI LAN

Cai Lan Port is situated in Cua Luc Bay, the inner water area of Ha Long Bay. Ha Long Bay has considerable potential to be developed as centers of tourist activity. The decision on whether or not to proceed further development of the seaport should take account of the following items:

- Coordination with tourism
- Conservation of the beautiful scenery
- Pollution of sea water and air
- Value of the mangrove colony

DEVELOPMENT OBJECTIVE (III): DEVELOPMENT OF HAI PHONG PORT

Hai Phong Port will continue to play an important role for economic and industrial development of Vietnam. Its capacity is currently limited by both shallow depth of the entrance channel and outdated port facilities. Upgrading of its capacity is urgently required so as to use its full potential.

DEVELOPMENT OBJECTIVE (IV): DEVELOPMENT OF PRIVATE AND SPECIAL PORTS

There are three important private and special ports within the Study area, namely Cam Pha, Hon Gai and B-12. They are mainly employed for handling coal and oil. The development of these ports should be harmonized with the development of the overall port infrastructure and upgrading of interfaces between the cargo handling at ports and on other transport modes.

DEVELOPMENT OBJECTIVE (V): STATUS, INSTITUTIONAL SET-UP AND PORT MANAGEMENT

An appropriate institutional set-up should be designed and implemented for efficient port management and operations, incorporating appropriate elements of both public and private sectors. Potential benefits should be identified of giving Cai Lan the status of a transshipment trade base for the P.R. China, versus the environmental and recreational costs of taking such a step. However, such an issue can only be decided within the context of a broader development strategy.

DEVELOPMENT OBJECTIVE (VI): DEVELOPMENT PLAN FOR SHIPPING COMPANIES

A development plan should be drawn up for the future of the national shipping companies currently falling under the control of VINAMARINE. Issues of privatization and the creation of long-term viable entities are the core problems to be addressed.

DEVELOPMENT OBJECTIVE (VII): ADMINISTRATIVE SET-UP

The future function, role and structure of VINAMARINE, which falls under the control of MOTC, should be clarified. For example, VINAMARINE is currently, responsible not only for port management and ship management, but also for ship repair. The proper functional responsibilities should be defined within the context of a transformed/realigned economic order.

3.2.4 Inland Waterway Transport Development Principles and Objectives

The following development principles and objectives should guide the future development of the inland waterway transport subsector:

PRINCIPLE (I): DEVELOP AS ENERGY AND CONSTRUCTION MATERIALS SUPPLY LINES

In the past, inland waterway transport had a predominant relevance for transport of energy supplies and construction materials. This role is to be strengthened in the future.

PRINCIPLE (II): UPGRADE CORE SPECIALIZED PORTS, NAVIGATIONAL WAYS AND NAVIGATIONAL INFRASTRUCTURE

Priority should be accorded to upgrading these facilities to enable increasing transport traffic.

PRINCIPLE (III): DECIDE ON PRIVATIZATION AND PRICING

Viable entities or subentities should be privatized based on an indepth appraisal of their viability. Only clear public-good functions should be retained by the state. Prime candidate for privatization may be the inland waterway fleet. In addition, freight charges are currently not sufficient to meet operating costs. A general pricing review for state entities is called for.

PRINCIPLE (IV): NO MAJOR SYSTEM EXPANSION AND/OR INVESTMENT IS NEEDED FOR MINOR INLAND WATERWAYS

Major development objectives for inland waterway transport are:

DEVELOPMENT OBJECTIVE (I): RENEW AND MODERNIZE INLAND WATERWAY FLEET AND PORTS

The future increase in transport of coal, gravel, sand and cement will depend on inland waterway transport. These trends call for the modernization of the inland waterway fleet in terms of the composition of types of boats and larger boat sizes, as well as major port facilities.

DEVELOPMENT OBJECTIVE (II): REHABILITATE INLAND WATERWAYS AND ESTABLISH SUITABLE MANAGEMENT AND DREDGING SYSTEM

Inland waterways should be classified in line with a suggested technical classification. Priority inland waterway rehabilitation should take place on the following routes:

- Quang Ninh - Pha Lai Route
- Quang Ninh - Ninh Binh Route

DEVELOPMENT OBJECTIVE (III): **ESTABLISH A PROPER NAVIGATION AIDS SYSTEM**

There is a need to upgrade the overall navigational aids system and establish a night navigation aids system on routes used for coal transport.

DEVELOPMENT OBJECTIVE (IV): **UPGRADE AND MODERNIZE RIVER PORTS**

River ports should be categorized into three groups and modernized to handle the increasing volume of cargo.

DEVELOPMENT OBJECTIVE (V): **SET UP A COASTAL SEA ROUTE FROM QUANG NINH TO NINH BINH**

DEVELOPMENT OBJECTIVE (VI): **PRIVATIZE INLAND WATERWAY FLEET**

A cost-benefit analysis should be undertaken with a view to privatizing the inland waterway fleet completely or partly.

3.3 FUTURE TRANSPORT NETWORK

Road traffic demand for the year 2010 would, it left unchecked, increase explosively to the point that the current road network would become severely congested, with not only slowdowns but outright stoppages of traffic a frequent occurrence. To help prevent this, as shown in Figure 3.3.1 the recommendations for the North Mountain and Midland Area are mainly for upgrading of road and bridge quality, but in the Red River Delta substantial road improvements and new construction projects are called for.

Most prominent are the recommendations for Route 5 and parts of Routes 1, 10, 18 and 21 to be upgraded to four lanes, followed by overlaying an additional freeway on the Ha Noi - Hai Phong corridor which now and in the future is expected to carry the heaviest traffic in the entire region. A freeway configuration is considered also in order for one of three recommended Ha Noi ring roads as well as a Hai Phong bypass connector.

As can be seen from the same Figure 3.3.1, the Ha Noi - Hai Phong corridor is also expected to see the heaviest volume of rail passenger traffic as well as container freight transport. Consequently it is along this route more than any other in this study region, that it is believed realistic to plan for a rapid, high-standard rail passenger line within the time horizon of this study. Commuter railways may also come to play an important role in providing public mass transport in urban Ha Noi, which is much needed in order to be able to preserve both the architectural heritage and the quality of street life. An inland freight depot is also proposed for siting in the vicinity of Ha Noi, at the juncture of the main lines carrying general freight.

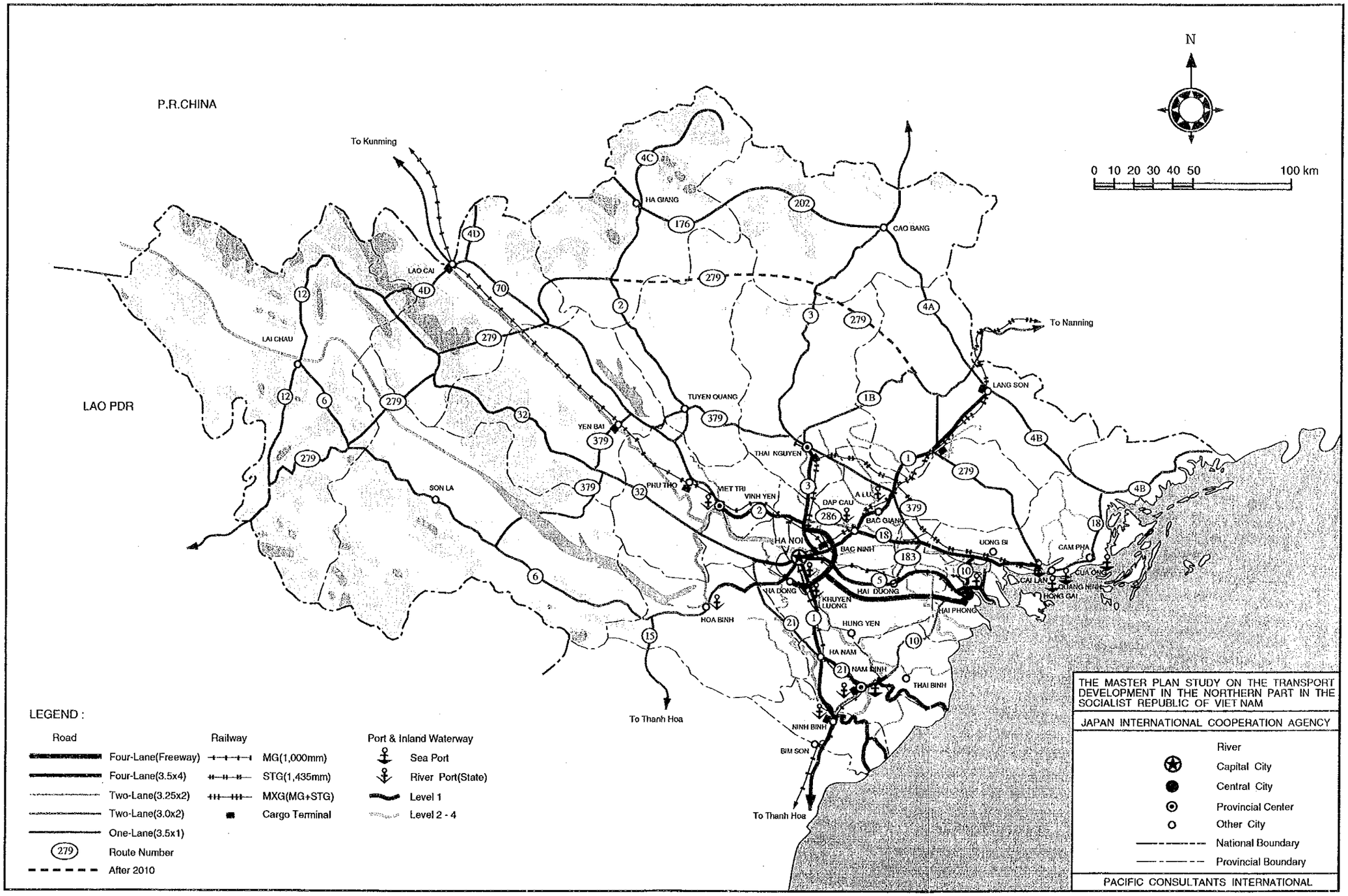


Figure 3.3.1 TRANSPORT SYSTEM IN THE NORTHERN PART OF VIETNAM YEAR 2010

The Ha Noi - Lao Cai line, among others, will carry heavy shipments of bulk cargo. The most assured and stable source of this is the cement, construction materials and coal needed for the domestic economy. The P.R. China also proposes to use the Lao Cai line for a very large volume of cross-border cargo, but only temporarily until their own port facilities are better developed, so this prospect has to be studied carefully. If a decision were taken to establish a new port at Cai Lan, the Ha Noi - Cai Lan line would also have to be prepared for heavy traffic.

As for the seaport situation, it does seem likely that the demand for general-cargo throughput would in the fairly near future exceed the existing capacity of Hai Phong port, mainly because of shallowness of the entrance channel. This is rather expensive to overcome by dredging because of the heavy siltation continually being deposited by the Red River. If a new port must be developed, Cai Lan would be one candidate site to develop it. However, the site proposed there is in Cua Luc Bay, right in the center of Ha Long Bay which is the most beautiful coastal area in the Northern part of Vietnam and perhaps the entire country, much appreciated for its scenic and recreational values and a prime source of foreign exchange earnings through tourism. Any decision to develop it for heavy shipping traffic should only be considered on the basis of in-depth environmental impact assessment and full consideration of all other possible alternatives. There are already several other ports in operation for special purposes also.

Figure 3.3.1 also shows how the rather good existing network of inland waterways could be improved. This should entail widening and deepening of selected links especially along the Quang Ninh - Pha Lai and Quang Ninh - Ninh Binh routes. By continuing and strengthening the present good use of inland waterways for transport of fuels and construction materials, overloading of railways and roads may be eased.

3.4 URBAN TRANSPORT: HA NOI AND HAI PHONG

Questions related to the status and development prospects of urban transport warrant some special consideration. It is anticipated that the population of Ha Noi and Hai Phong will increase by the year 2010 to 3.1 million and 2.3 million, respectively. Specific urban transport development studies are required for these two main urban centers in the Study area. While the results and recommendations of such studies cannot be preempted, the following major features are apparent:

(1) Ha Noi

- The only road which functions currently as a ring road, should be widened up to four lanes at least.
- In addition, one or two more ring roads will be needed.
- Proper traffic signals will have to be installed.

- The establishment of a suitable public transport system (bus, railway, and LRT) will have to be defined and determined.

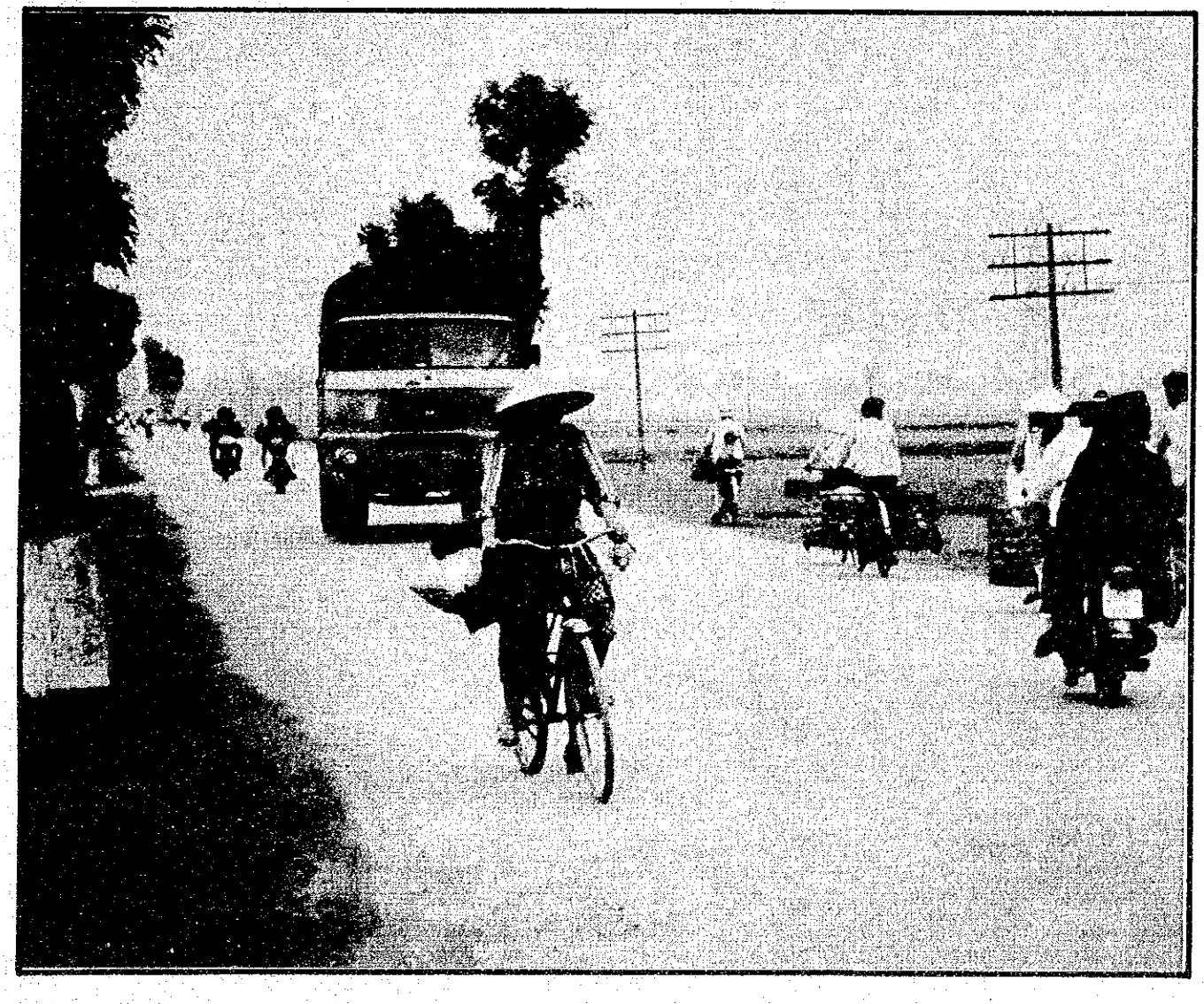
- Traffic safety facilities will have to be established.

- The general public will have to be educated about traffic rules and regulations and such regulations will have to be enforced.

(2) Hai Phong

National Road No. 5, which connects Ha Noi with Hai Phong, will create a ring road by itself and will have to be connected with the proposed Ha Noi - Hai Phong freeway within the urban area of Hai Phong.

Chapter 4 Road Transport



CHAPTER 4 ROAD TRANSPORT

4.1 INTRODUCTION

Road transport can be viewed as the most significant mode for passenger travels and general cargo transport to support socio-economic development in the Northern Part of Vietnam. This chapter first summarizes the demand forecast on road network, then presents development strategies and development plan for the road transport sector.

4.2 DEMAND FORECAST

The study team's traffic demand forecast for the years 2000 and 2010 is set out in Volume 4 and summarized in Figure 4.2.1. As discussed in Volume 4, Chapter 4, the year 2010 demand analysis confirms that the current road network can no longer cope with forecasted traffic demand, particularly in the Red River Delta. The road traffic volume will increase explosively along with economic growth, since road traffic has the advantage of frequent mobility and door-to-door accessibility.

4.3 ROAD TRANSPORT DEVELOPMENT STRATEGY

4.3.1 Role and Function of Road Transport

Road transport will be the dominant mode of transport in the Northern Part of Vietnam. Expected role and function of road transport can be summarized as follows;

- Majority of local and intra-regional travel will be made by mode of road transport, such as buses, private passenger cars, motorcycles, and bicycles.
- Most of inter-urban freight transport demand as well as passenger travel demand within the Growth Triangle would be also covered by several modes of road transport.
- Furthermore, road transport would be useful as an interface with the Mountain region for passengers and selected items of cargoes.
- Majority of goods will be transported to regional and local distribution centers.

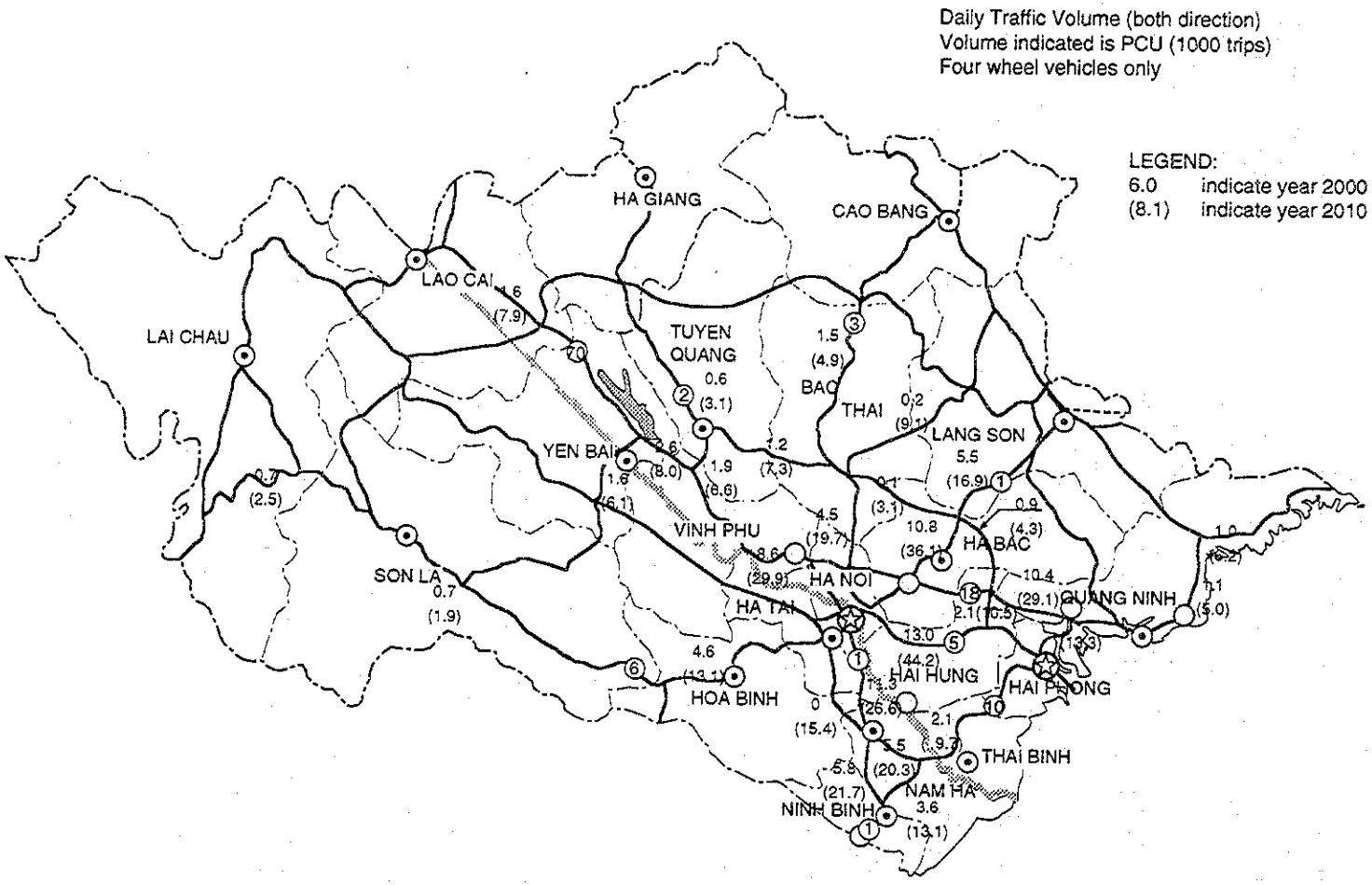


Figure 4.2.1 Road Traffic Demand Forecast in the Study Area

4.3.2 Road and Bridge Improvement and Development

(1) Road Improvement and New Construction

The total length of roads in the Study area has reached 48,986 km and present road density is 0.43 km/km^2. However, recent survey has shown that the proportion of bituminous or cement pavement on all roads in the Study Area is very low. Besides, only 35 % of the surface of the National roads is evaluated as being in good or fair condition, out of the surveyed total 3,532.6 km length in the area.

About 80 % of origin-destination trips in the Study Area are concentrated in the Red River Delta as discussed in the previous section. Therefore the assessment of roads in the study area could be summarized as follows:

- Road length and network are adequate in general, but new construction and improvement of the roads in the Red River area will be required due to the concentration and rapid increase of road traffic.

- Upgrading of road and bridge quality will be required in the North Mountain and Midland area.

Following are the recommended road improvement strategies based on the above discussion;

- Road construction and improvement in the Red River Delta should be implemented due to the traffic demand;

- Road improvement in the North Mountain and Midland area and rural road improvement should be implemented considering not only the traffic demand but also basic human needs and balanced infrastructure investment;

- Budget constraints should be considered, keeping an appropriate investment balance between transport and other sectors.

Road improvement rehabilitation should focus on increasing the pavement ratio from the present 20 %, to the range of 40 - 50 % by 2010 (excluding village and special roads).

The Study Team proposes that upgrading of road capacity should follow a series of logical and cascading steps.

- Initial efforts should seek to enhance available capacity through low-cost techniques, such as transportation system management, public education, training and, above all, consistent and honest enforcement of traffic regulations.

- Upgrading of existing road facilities implies, in most cases, widening to an acceptable two-lane standard (6.0 to 7.0 meter carriageway width) or, in higher volume cases, multilane (generally four lanes with median separation) cross-sections.

- Where upgrading of existing alignments is impractical, construction of new arterial roads should be considered within new alignments. This would include construction of urban bypasses, with cities of 100,000 to 500,000 population providing a reasonable threshold condition. As an example, the near-term widening of Route 5 between Ha Noi and Hai Phong should include a bypass at Hai Duong.

- High-order, access-controlled facilities (freeways with or without tolls) should only be considered if clearly warranted on demand grounds. This suggests that only the highest-volume corridors serving the major urban conurbations of Ha Noi and Hai Phong would qualify in the near future.

The enhancement of capacity is not, in all cases, a clearly-defined process. Parallel changes must be implemented concurrently if cost-intensive improvements (widening, new roads) are to be effective and perform to their intended standard. On urban approaches, for example, serious questions persist as to who will benefit from road improvements - vehicle traffic, two-wheeled vehicles or non-transport roadside activities which intrude into the right-of-way? It is presently common that roads, which are intended to serve longer-distance vehicle trips, must concurrently provide access to individual properties, serve as linear transport terminals or, indeed, as de-facto shopping bazaars. These functions are clearly incompatible and firm steps must be taken to regain control of roads, even if it is recognized that such actions are technically difficult and politically unpopular.

(2) Bridge Improvement and Rehabilitation

MOTC has decided that the design loads of the existing VIETNAMESE BRIDGE DESIGN CODE are as follows:

Toll Road:	H30 - XB80
National Road I - IV:	H30 - XB80
National Road V, VI:	H13 - X60 or H10 - X60
Provincial and District Road:	H13 - X60 or H10 - X60

The bridge width and loading capacity of most of the existing bridges on the National Roads are less than the values required by these standards. However, from the economical and engineering point of view, existing 2-lane bridges not less than 4.5 m wide and not less than 13 ton loading capacity should continue to be used for the time being with minor rehabilitation. Other 2-lane bridges should be improved to meet the required standards.

4.3.3 Urban Transport Development

It is expected that the urban population in the Red River Delta and in coastal areas will rapidly increase, with Ha Noi and Hai Phong as urban centers of 3.1 and 2.3 million populations, respectively. Industrialization will concentrate in these cities, resulting in a rapid growth of interurban and intraurban traffic. For instance, GDP in Ha Noi will increase by 6.5 times and its urban population by 2.1 times up to the year 2010. The development of urban transport infrastructure within the framework of a proper transport plan and management system is urgently needed to accommodate urban transport requirements.

4.3.4 Road Maintenance Enhancement

Road surfaces are generally not adequately maintained with the exception of some sections of national roads. As a result, vehicle operation costs are very high. Provision of sufficient resources for road maintenance and rehabilitation are thus mandatory. The following road maintenance targets should be set: (a) Reduction of cracking to less than 15 %, (b) reduction of rutting below 25 mm and (c) reduction of potholes to less than 5 %.

4.3.5 Transport Industry Development

MOTC or provincial DOTC are granting licenses to bus transport companies which concentrate their services on the few routes with high traffic volume. Market competition ensures an efficient bus transport management on these attractive routes; however, remote areas are neglected. Traffic safety standards for common carriers should be established and enforced.

MOTC or provincial DOTC also grant licenses to trucking companies. Fare regulations are not considered necessary, but safety regulations, including loading restrictions, need to be established and enforced.

4.3.6 Establishment of Road and Bridge Design Standard

(1) Geometric Design Standards

Vietnam has its own established geometric design standards, however, they are not always followed by engineers. There is no definition for inner shoulder and no design standard for a freeway. A four-lane national road from Ha Noi to Hai Phong is currently being planned according to modified design standards derived from the current design standards of Vietnam, Japan and the U.S.A. Geometric design standards are recommended as shown in Table 4.3.1. The class of road is defined from design speed, traffic volume and terrain (flat, rolling or mountain). Road geometry is prescribed based on design speed.

Table 4.3.1 Recommended Geometric Design Standards

	Road Class	Design Speed (km/hr)		Design Traffic Volume (Veh./day)					
				more than 30,000	30,000 ~ 10,000	10,000 ~ 6,000	6,000 ~ 1,000	1,000 ~ 300	less than 300
Freeway	1	120	100	Flat	-	-	-	-	-
(Access	2	100	80	Mountain	Flat	-	-	-	-
controlled)	3	80	60		Mountain	Flat	-	-	-
	4	100	80	Flat	Flat	-	-	-	-
Regional	5	80	60	Flat	Flat	Flat	Flat	-	-
Road	6	60	40	-	Mountain	Mountain	Flat	Flat	-
	7	40	30	-	-	Mountain	Mountain	Flat	Flat
	8	25	15	-	-	-	-	Mountain	Mountain

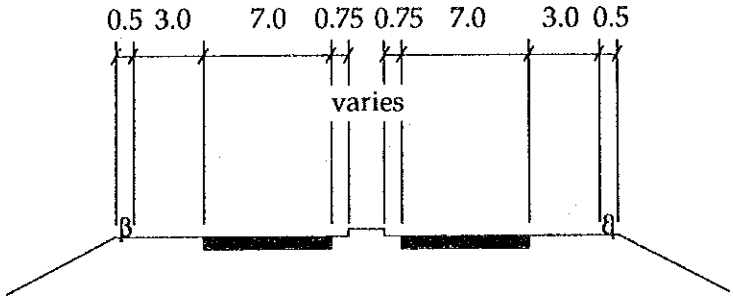
	Design Speed (km/hour)							Remarks
	120	100	80	60	40	25	15	
Width of Carriage Way (m)	3.5 (3.75)	3.5 (3.75)	3.5	3.25 ~ 3.00	3.25 ~ 3.00	2.75	2.75	per one lane
Width of Outer Shoulder (m)	3.0 ~ 2.5	3.0 ~ 2.5	2.5	1.5 ~ 0.5	1.5 ~ 0.5	1.5	1.5	
Width of Inner Shoulder (m)	0.75	0.5	0.5	0.5	0.5	-	-	
Width of Roadway (m)	-	-	-	min. 6.0	min. 5.75	min. 5.75	min. 5.75	applied to one lane road.
Min. Horizontal Radius (m)	600	400	250	130	60	25	10	
Max. Gradient (%)	4	5	6	7	8	9	10	

Notes:
(1) The lower value of design speed in each class of road will be applied in the case that terrain or other factors make lower speed travel necessary.

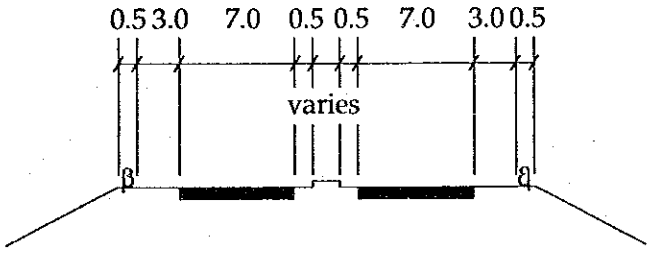
1) Road Geometry

Design speeds of 40 km/hr to 80 km/hr will be applied as standards to be met by improvements to the National Roads, depending on the terrain they traverse, and 100 km/hr to 120 km/hr will be similarly set as design-speed standards for the Freeways.

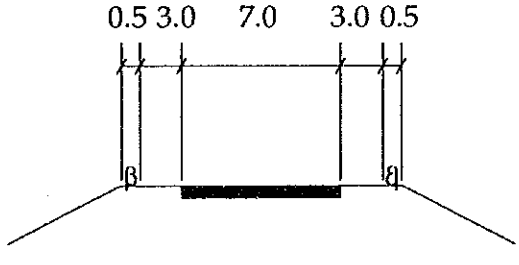
The six (6) kinds of typical cross-sections to be employed for reconstruction or improvement of the National Roads, are shown in Figure 4.3.1.



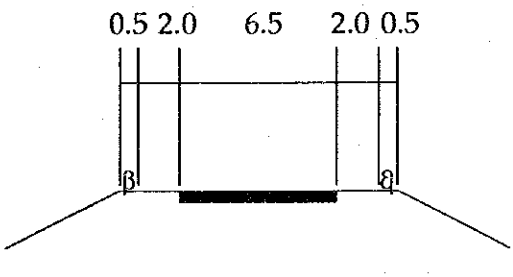
Type A Freeway (4 lane)



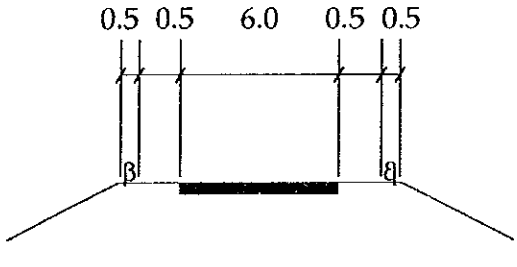
Type B National Road (4 lane)



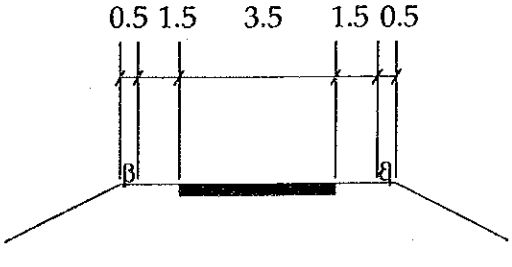
Type C National Road (2 lane)



Type D National Road (2 lane)



Type E National Road (2 lane)



Type F National Road (1 lane)

Figure 4.3.1 Typical Cross Sections

2) Pavement

The pavement components and their thickness should be determined based on the following factors governing their design:

- Traffic;
- Strength of the subgrade: and
- Construction materials applied to the pavement layers.

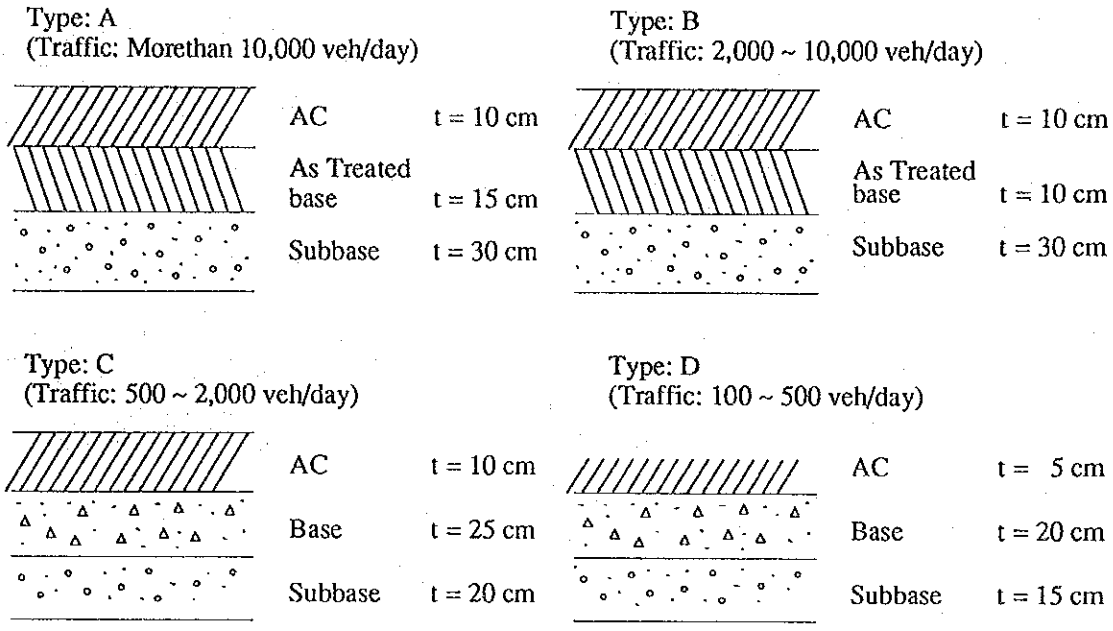
In most of the prevailing pavement design guides, traffic is expressed in terms of the cumulative number of standard axle loads of 8,200 kg, over the design lifetime of the road. The number of equivalent axles is computed from the number of commercial vehicles, in particular heavy vehicles like buses and trucks. The truck factor per one vehicle computed from the equivalent standard axle is assumed to be 1.0 up to the year 2000 since an axle load of 6.0 tons is the acceptable maximum on Vietnamese roads, and a total vehicle weight of more than 13 tons is allowable only by permission of MOTC. It is expected that these limitations will be lifted by the year 2000 due to improvement of roads and bridges. The truck factor will also increase to 3.0 by the year 2010.

The strength of subgrade will contribute to the thickness of pavement necessary. It is most commonly expressed by the California Bearing Ratio (CBR) value determined by laboratory testing. A CBR value of 2.5 to 5.0 % is adopted in this study for computation of pavement thickness.

Either of two types of material, i.e. asphalt concrete or Portland cement concrete, would be appropriate for the pavement surface of most roads. However, asphalt concrete is employed in the pavement prescriptions of this study due to its cheaper initial investment cost. Double bituminous surface treatment is only applicable as a pavement material for roads bearing less traffic, that is, those carrying less than 0.5 million equivalent standard axles over the road lifetime.

There are three types of material suitable for the base course, i.e. asphalt treated, cement treated and crushed-stone graded. River gravel is usually used for the subbase course.

Based on these considerations the four types of pavement which are recommended for new construction, as well as for rehabilitation and improvement of National Roads in the Northern Part of Vietnam, are shown in Figure 4.3.2.



Note : AC = Asphalt Concrete; As = Asphalt

Figure 4.3.2 Recommended Types of Pavement

(2) Road Traffic Capacity

The concept and methodology used for the road capacity analysis are based on the "Highway Capacity Manual of the Highway Research Board, U.S.A.". However, some adjustment was made to reflect local conditions based on the results of studies undertaken by the "Highway Research Board, Japan", since much resemblance is found in the types and sizes of vehicles and in operating conditions, between Vietnam and Japan. To calculate daily design capacity of the roads, basic capacity, possible capacity and service level were considered. The result of the traffic capacity analysis is as shown in Table 4.3.2.

1) Peak Hour Ratio (K)

The actual traffic flow on roads is not always constant, but characteristically changes by year, season, month, day and hour depending on the nature of the road. The 30th highest annual hourly traffic volume is usually applied for estimation of the capacity. The conversion factor from daily to hourly "K" is defined as the ratio of the 30th highest annual hourly traffic volume against the average annual daily traffic volume (AADT). The "K" value of 9 % is used for regional roads and freeways.

2) Heavy Direction Ratio (D)

Generally speaking, traffic volume is shown by total volume in both directions. However, the traffic volume in each direction is not usually the same, especially in the morning and evening peak hours. A "D" value of 60 % is adopted in accordance with the results of the survey.

3) Design Capacity

Design capacity per day and per one lane is therefore equal to 5,000 x Design Traffic Capacity per hour ÷ (K x D). Table 4.3.2 shows the result of the calculations following the design concept and procedure presented above for the case of Service Level I (see Note of Table 4.3.2).

(3) Bridge Design Standards

1) Design Standards and Specifications for New Bridges

MOTC has decided that the existing VIETNAMESE BRIDGE DESIGN CODE conforming to the Limit State Design Method, which was introduced from the former Union of Soviet Socialist Republics (USSR), should be utilized nationwide for the construction of new bridges. The Allowable Stress Method is generally utilized for evaluation and calculation of the bearing capacities of existing bridges.

These regulations apply for the construction of new bridges funded by the Government only. If representatives of international funding sources request an exception to the current Vietnamese design standards and specifications, the Government may accept for the particular project, alternative standards which are proposed by the funding agency, after consulting with the MOTC and TEDI. The principle to be applied is that the design loads specified by the alternative standard are equal to or higher than those specified in the Vietnamese Bridge Design Code.

However, the authors of this Master Plan study urge agencies sponsoring projects to exercise restraint in requesting such exceptions, because quality control of bridge construction may become difficult if different design standards and specifications are accepted for the each project financed by different external agencies.

Table 4.3.2 Road Traffic Capacity Analysis in the Study Area

ITEM	DESIGN SPEED (km/hr.)	LANE WIDTH (m)	LATERAL CLEAR-ANCE		HEAVY VEHICLE		COEFFICIENT OF ADJUSTMENT					BASIC CAPACITY (P.C.U./hr.)	POSSIBLE CAPACITY (Veh/hr.)	SERVICE LEVEL	ADJUSTMENT OF SERVICE LEVEL	DESIGN CAPACITY (Veh/hr.)	PEAK FACTOR (%)	RATE OF DIRECTION (%)	DESIGN DAILY CAPACITY (Veh/Day) PER LANE
			Right	Left	% of H.V.	Passr. Car Equiva.	Lane Width	Lateral Clear-ance	Heavy Veh.	Cond. of Sight	Total								
			(m)	(m)	Pt	Et	L	c	T	I		CB	C			CD	K	D	ADT
2-lane 2-way (Typical National Road)	60	7.0	0.5	0.5	25	2.56	1.00	0.75	0.71	0.80	0.426	2,500	1,605	1	0.7	745	9.0	-	8,200*
4-lane 2-way (Typical National Road)	80	3.5	3.0	0.5	25	2.56	1.0	0.9	0.71	0.80	0.51	2,500	1,275	1	0.7	892	9.0	60	8,200
4-lane 2-way (Typical Freeway)	120	3.5	3.0	0.75	25	2.56	1.0	1.0	0.71	1.0	0.71	2,500	1,775	1	0.7	1,242	9.0	60	11,500

NOTE:

(1) $T = \frac{100}{100 - Pt + Et \cdot Pt}$

$C = CB \cdot L \cdot c \cdot I \cdot T$

$ADT\ (MULTIPLE\ LANES) = \frac{5{,}000 \times CD}{K \cdot D}$

(2) The figure with asterisk indicates design daily capacity of 2 lane/2 way road.

(3)

WHERE

T: COEFFICIENT OF ADJUSTMENT FOR HEAVY VEHICLES
Pt: PERCENTAGE OF HEAVY VEHICLES
Et: PASSENGER CAR EQUIVALENT OF HEAVY VEHICLES
L: COEFFICIENT OF ADJUSTMENT FOR LANE WIDTH
C: COEFFICIENT OF ADJUSTMENT FOR LATERAL CLEARANCE
I: COEFFICIENT OF ADJUSTMENT FOR CONDITION OF SIGHT
K: PEAK FACTOR (%)
D: RATE OF DIRECTION (%)
CD: DESIGN CAPACITY (VEH/HOUR)
CB: BASIC CAPACITY (PCU/HOUR)

Service Level 1 : In the target year of design, the annual maximum peak hour traffic volume is less than the road's attainable capacity per hour. Vehicles in the 30th highest annual hourly volume can keep stable flow at certain speeds, but selection of speed is restricted.

Service Level 2 : In the target year of design, the 10th highest annual hourly traffic volume reaches the road's attainable capacity and this sometimes causes serious traffic jams during these peak ten hours. Vehicles in the 30th highest annual hourly traffic volume are unable to keep uniform speeds and the attainable speed changes at random.

Service Level 3 : In the target year of design, the 30th highest annual hourly traffic volume exceeds the road's attainable possible capacity and this causes serious traffic jams during these peak 30 hours. A vehicle in the flow of the 30th highest annual hourly traffic volume is continually forced to change speed and sometimes is forced to stop.

Taking account of these potential problems, the study team would recommend another approach to ensuring uniformity of bridge standards in Vietnam, by general adoption of the Standard Specifications for Highway Bridges adopted by the American Association of State Highway and Transportation Officials, Inc. (AASHTO) for all new bridges financed by international sources. More specifically, 125 % of the corresponding AASHTO loadings are considered to represent an appropriate international standard.

The AASHTO standard has been adopted in many other countries, and is also in use in the southern part of Vietnam. Furthermore, 125 % AASHTO loadings have already been adopted for Lai Vu bridge located at Km 59 + 164 on National Road No. 5, and Phu Luong bridge located at Km 54 + 210 on National Road No. 5.

Design loadings should be linked to the design traffic volume. The recommended design loadings in Vietnam are as follows:

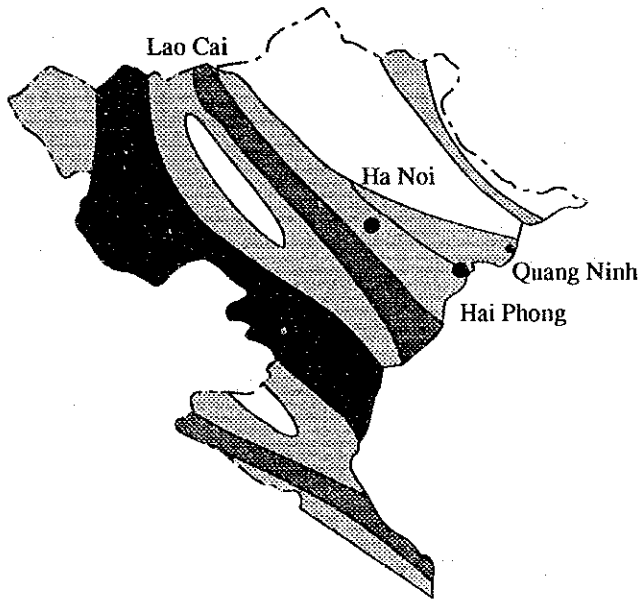
Design Traffic Volume (Veh/Day)	Design Loading
Freeway	H30 - XB80 or 125 % of AASHTO
more than 10,000	H30 - XB80 or 125 % of AASHTO
6,000 - 10,000	H30 - XB80 or 125 % of AASHTO
1,000 - 6,000	H25 or H20 - X60 or 100 % of AASHTO
300 - 1,000	H13 - X60
less than 300	H10 - X60

In the case of roads carrying between 1,000 and 6,000 vehicles per day. H25 or H20 loadings are recommended due to the large difference between H30 and H13 loadings.

In regions where earthquakes may be anticipated, structures should be designed to resist earthquake motions. In Vietnam, the seismic intensity as indicated by the Modified Mercalli scale is significant, as shown in Figure 4.3.3. However, no allowance for earthquake stresses has so far been incorporated in bridge design standards, but this should be done in the future.

Bridge width including carriageway, shoulder, strip and/or footway should be linked to the design traffic volume. The recommended bridge width is as follows:

Design Traffic Volume (Veh/Day)	Bridge Width (m)
Freeway	10.50 x 2
more than 10,000	10.50 x 2
6,000 - 10,000	10.50 or 13.00
1,000 - 6,000	7.00
300 - 1,000	5.50
less than 300	5.50



① M.M. Seismec Intensity Scale	6	7	8	9
② Acceleration Range	5-175	18-145	51-350	250
③ Mean Maximum Acceleration	40	67	172	250

Source : Preliminary Study for the Modernization and Rehabilitation of Vietnam Railway Trunk Lines, March 1992, JARTS

Figure 4.3.3 Seismic Intensity Scale

2) Criteria for Evaluation of Existing Bridges

Existing bridges should be evaluated according to their widths and loading capacities. The recommended criteria for the evaluation of existing bridges are shown in Table 4.3.3.

Table 4.3.3 Criteria for Evaluation of Existing Bridges

Design Loadings	H30 - XB80 or 125 % of AASHTO		H25 - X60 H20 - X60 or 100 % of AASHTO	H13 - X60	H10 - X60
	4-Lane	2-Lane	2-Lane	1-Lane	1-Lane
Bridge Width:					
less than 3.0 m	C	C	C	C	B
3.0 - 4.5 m	C	C	C	B	A or B
4.5 - 6.0 m	C	B	B	A	A
more than 6.0 m	A and B	A	A	A	A
Loading Capacity:					
30 ton	A	A	-	-	-
25 ton	B	A	A	-	-
13 ton	C	B	B	A	-
10 ton	C	C	C	B	A
8 ton	C	C	C	C	B

Notes:
A: To be used as it is
B: To be used for the time being with minor rehabilitation
C: To be replaced by new bridge

3) New Bridge Design Concept

In Vietnam, bridge materials such as steel plates, H-beams, steel pipes, reinforcing bards, PC cables, anchorages and high strength cement for PC structures are imported from overseas. However, high strength cement will be produced in Vietnam in the near future, as soon as new cement production facilities are put into production. Taking into consideration the bridge materials produced domestically and the domestic technology, concrete structures should be given priority for new bridge construction. Consideration of steel structures should be restricted mainly to long span bridges, bridges on soft ground or temporary bridges.

The present type of rail-cum-road bridge of steel truss construction, with central track for railway and two side tracks for vehicles, such as Ham Rong bridge located Km 320 + 240 on National Road No. 1 and 170K478 m on Ha Noi - Ho Chi Minh rail line, is not recommended for new bridges on the National Roads. The precast reinforced concrete slabs for carriageways are supported by the brackets and stringers which are located on both sides of the main truss of the bridge. Because of the lack of rigidity of floor systems, deflection and vibration of the carriageways are rather severe and the carriageways

have been heavily damaged. Furthermore, because the road is separated on the bridge, one lane of traffic has to cross the railway twice. To avoid level crossings, two bridges are necessary at the crossing points of road and railway, and the road alignment in this segment is worsened. A bridge of the same type is under construction on National Road No. 2, but it would be preferable to construct separate bridges for the road and railway.

It is recommended that new standards be established for prestressed concrete beams are to:

- Span Length 10 - 20 m: Pre-tension Hollow Core Beam
- Span Length 20 - 40 m: Post-tension T Beam

As the Final Report of the National Transportation Sector Review of 1992 pointed out in Volume III, the current fabrication method of prestressed concrete beams produced by the Union of Enterprises Thang Long is doubtful from the engineering point of view. The following features of their PC beams should be changed:

- No sheathing
- Up-turned PC cables without curbed section
- Insufficient reinforcement, in terms of both diameter and arrangement of bars

An established jacking system such as the Freyssinet system, VSL system, etc. should be adopted. In case of the Post-tension T Beams, rigid cross beams should be used at the center of the span and at both ends of the main beams. Lateral pre-stressing is recommended for both cross beams and deck slabs. The details of bearing shoe, expansion joint, drainage, etc. should be reviewed.

Prestressed box girders erected by the center-hinged cantilever system are recommended for the new bridge construction to replace existing ferry services. In general at these sites presently served by ferries, the bridge length is more than 500 m and the distance between pier to pier is 70 m to 150 m, because of the river width and the requirement for navigation clearance.

Cast-in-situ concrete piles of 1.0 m to 1.5 m diameter constructed by the reverse circulation drilling method are generally recommended for the foundations of the long span bridges, to get a high bearing capacity from materials available in the domestic market.

4.4 ROAD TRANSPORT DEVELOPMENT PLAN

4.4.1 Regional Road Network Development Plan

Proposed upgrading includes provision of freeways (year 2010 or beyond), four-lane arterials (median-separated roads with shoulders and, if possible, facilities for two-wheeled vehicles); high-order two-lane roads (6.5 - 7.0 meter carriageway with shoulders and facilities for two-wheeled vehicles) and two-lane roads (6-meter carriageway with narrow shoulders). The latter improvement would typically apply in mountainous areas. The recommended road improvement plan contains a year 2000 short-term phase and a long-term year 2010 phase as follows (Table 4.4.1, Figures 4.4.1 and 4.4.2):

(1) Sufficiency Analysis

1) General Analysis

The performance of the future networks was tested via the assignment of year 2000 demand onto the year 2000 network, and year 2010 demand onto years 2000 and 2010 networks.

- More importantly, high-order roads (freeways, multilane arterials, two-lane arterials wider than 6.5 meters) comprise 13 % of the 1993 network, but high order roads make up 20 and 30 % of the 2000 and 2010 networks, respectively.

- PCU kilometers of travel will grow from 8.2 million in 2000 to some 32 million in 2010. PCU hours will grow from 144,000 in 2000 to almost one million (2010 trips on 2000 network). However, assignment of 2010 trips onto the 2010 network totals only 660,000 PCU hours, thus clearly reinforcing the benefits inherent in the 2010 network.

- This benefit is further reinforced by the composite Volume/ Capacity (V/C) ratio which totals 0.13 in the year 2000, 0.50 for 2010 demand on the 2000 network and 0.36 for the 2010 demand on 2010 network.

The relative advantages of the network demand testing combinations can also be measured in terms of speed performance (lower speed implies higher congestion) and PCU kilometers expended. Higher PCU kilometers for identical demand implies circuitous travel due to overloaded roads (Figure 4.4.3).

Table 4.4.1 Future Link Improvements of the Study Area Road Network

Improvement (1)	Year 2000			Year 2010		
	Route	Length (km)	Limits	Route	Length (km)	Limits
Four-lane Freeway (2)				M1	40	Ha Noi Outer Ring Road East (Route 3 - Route 6)
				M2	100	Ha Noi Outer Ring Road Hai Phong
Four-lane (3)	1	109	Bac Giang - Ha Noi - Ha Nam	1	103	Lang Son - Bac Giang
	2	57	Route 3 - Viet Tri		54	Ha Nam - Bim Son
	5	99	Ha Noi - Hai Phong	3	72	Route 1 - Thai Nguyen
	18	85	Chi Linh - Hong Gai	6	77	Ha Noi - Hoa Binh
				10	25	Hai Phong - Uong Bi
					18	Nam Dinh - Thai Binh
				18	38	Route 1 - Chi Linh
				21	30	Ha Nam - Nam Dinh
				32	42	Ha Noi - Son Tay
Two-lane (4)	183	20	Route 5 - Route 18	10	72	Hai Phong - Thai Binh
					31	Ninh Binh - Nam Dinh
				21	30	Route 6 - Son Tay
				286	25	Route 1 - Route 3
Two-lane (5)	2	81	Viet Tri - Tuyen Quang	1B	145	Thai Nguyen - Dong Dang
	70	193	Route 2 - Lao Cai	2	180	Tuyen Quang - Ha Giang
	379	170	Route 32 - Route 3	3	245	Thai Nguyen - Cao Bang
				4B	173	Lang Son - Mong Cai
				6	342	Hoa Binh - Route 279
				18	83	Hong Gai - Tien Yen
				279	105	Dien Bien - Route 6
				379	105	Chi Linh - Thai Nguyen
Total		814			2,135	

Note:

(1) Parameters of affected links, such as speed and capacity, are to be upgraded from 1993 conditions in line with indicated improvements.
(2) Median-separated, access controlled facility. Operation can be with or without toll.
(3) Median-separated, rural highway; four 3.5 meter lanes with shoulders; preferably with separate facilities for two-wheeled vehicles.
(4) Two-lane, rural highway; 6.5 meter carriageway with shoulders; preferably with separate facilities for two-wheeled vehicles.
(5) Two-lane, rural highway; 6.0 meter carriageway with or without shoulders, depending on terrain conditions.

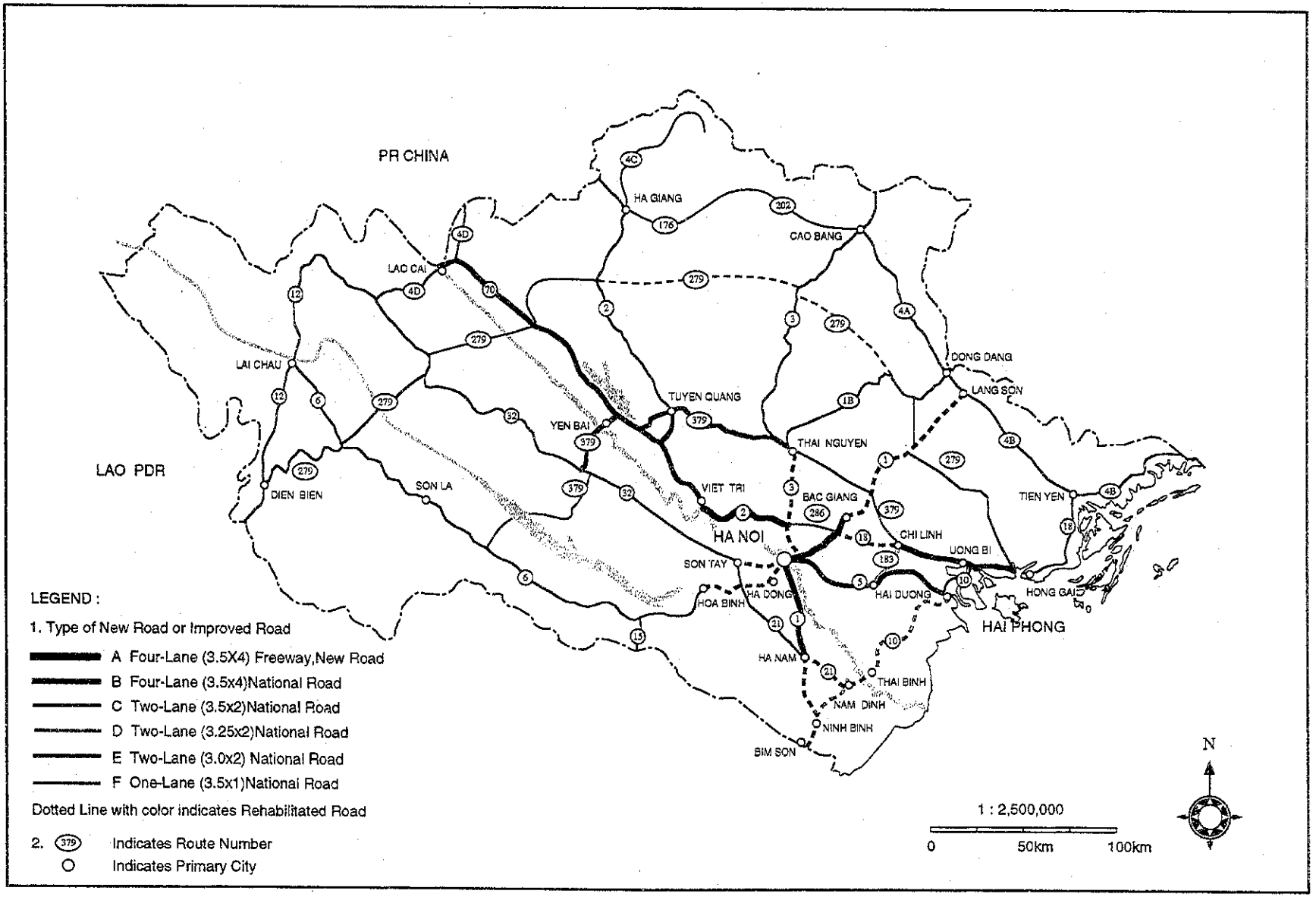


Figure 4.4.1 Recommended Improvement Plan for Roadway Network in the Northern Part of Vietnam by 2000

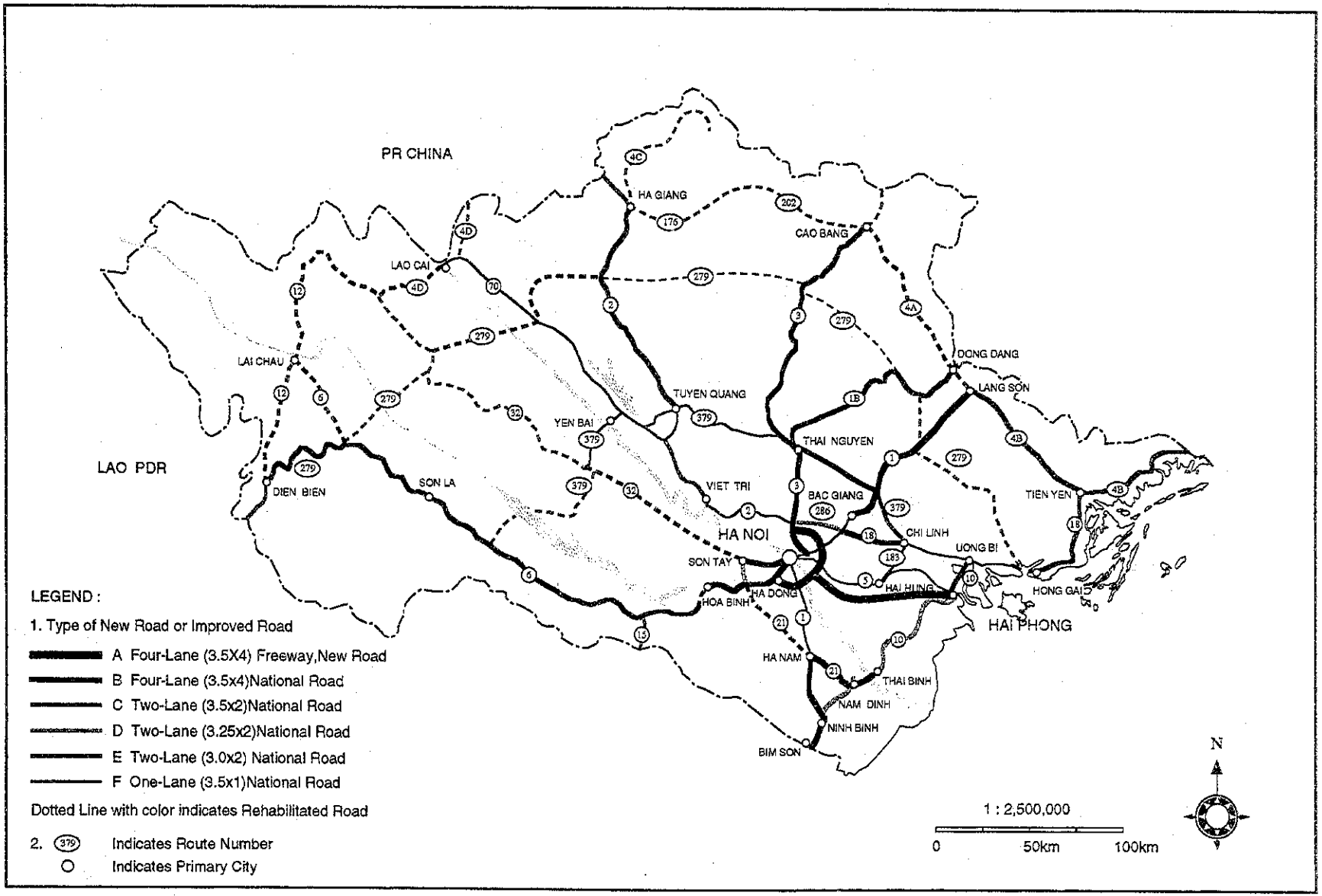


Figure 4.4.2 Recommended Improvement Plan for Roadway Network in the Northern Part of vietnam from 2001 to 2010

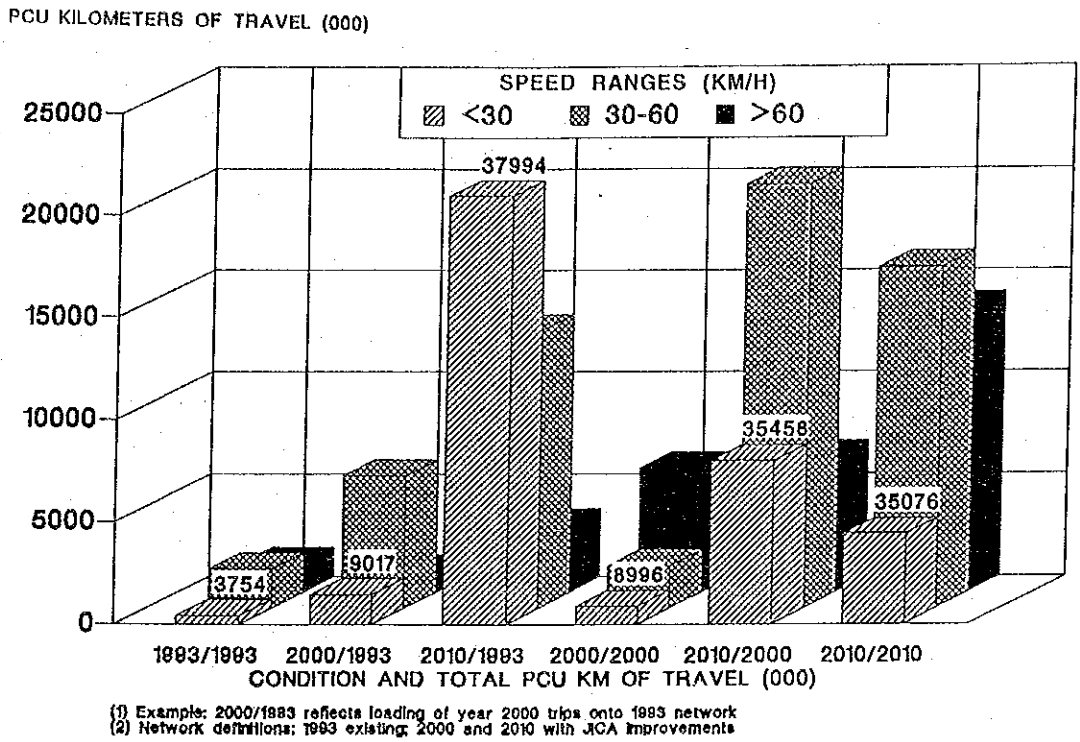


Figure 4.4.3 Years 1993, 2000 and 2010 Speed Ranges on the Road Network in the Study Area: with and without Improvements

- For 1993 network/1993 demand, PCU kilometers total some 3.75 million with the total almost equally split between "30 to 60" and "above 60 km/h" speed ranges. Loading of 2000 demand on the network increases PCU kilometers to 9.02 million, 72 % of which fall the "30 to 60 km/h" speed range. Imposition of 2010 demand increases PCU kilometers to almost 38 million, over half of which fall into the "below 30 km/h" speed range. This supports the contention that the existing network cannot adequately support future levels of demand.

- The 2000 network/2000 demand condition gives rise to less than 9 million PCU kilometers, over two thirds of which fall into the "above 60 km/h" speed range. This is a marked improvement compared to the 1993 network/2000 demand condition.

- The 2010 network/2010 demand scenario results in 35.08 million PCU kilometers, which fall almost equally into the "30 to 60" and "above 60 km/h" speed ranges. However, for 2000 network/2010 demand, PCU kilometers increase to 35.5 million, some 60 % of which fall into the "30 to 60 km/h" speed range.

The important role assumed by high-order facilities (freeway, multilane arterial, two-lane arterial wider than 6.5 meters) is undeniable. In 1993, such roads represented 13 % of the network, yet absorbed 55 % of PCU kilometers. By 2010, the proportion of high-order roads in the network is shown as growing to 30 %, and their PCU kilometer share to 78 %. Freeways alone comprise only 4 % of the 2010 network, but carry 20 % of expended PCU kilometers.

- No major V/C ratio problems are apparent with assignment of 2000 network/2000 trips.

- The 2000 network/2010 demand scenario clearly identifies several capacity shortfalls : Route 1 over its entire extent; Route 18 from Route 1 to Route 183, segments of Route 3 in Bac Thai Province, Route 10 in Ninh Binh Province and Routes 2 and 3 corridor to Vinh Phu Province.

- The 2010 network/2010 demand assignment indicates good overall performance, but several concerns exist.

These concerns relate to the Route 1 corridor between Bac Giang and Lang Son, where forecast volumes are near design daily capacity for a high-grade, two-lane section. However, rather than recommending upgrading to four lanes, it is suggested that actual traffic be monitored on an ongoing basis to determine when four-laning is required on this relatively isolated road. Capacity shortfalls are also evident in the vicinity of Ha Noi.

Traffic volume is commensurate with cross-sections provided in the year 2010. The heaviest freeway use is the Ha Noi - Hai Phong freeway (M2) with 40,000 to 50,000 PCU per day. This volume, which can be considered borderline in terms of freeway justification, suggests that careful consideration be given to timing of freeway construction. Volumes along four-lane and two-lane arterials remain within acceptable bounds.

2) Particular Analysis

The section along National Road No. 5 from Ha Noi to Hai Phong is recommended to have a four-lane national road until year 2000 and to have an additional four-lane freeway until 2010. The traffic analysis and the required number of lanes are shown in Figure 4.4.4 based on traffic forecast and road capacity as discussed above.

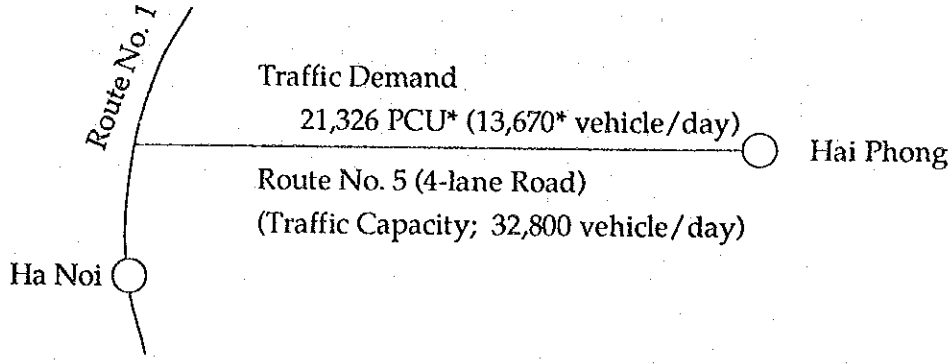
The degree of congestion based on the V/C ratio will be 1.67 (13,670 ÷ 8,200) in the year 2000, in the case that the widening from 2 to 4 lanes is not implemented. The congestion degree will be 1.23 (40,200 ÷ 32,800), if the additional four-lane freeway is not completed before the year 2010.

(2) Short-Term and Long-Term Road Development Plan

1) Short-Term Projects until the Year 2000

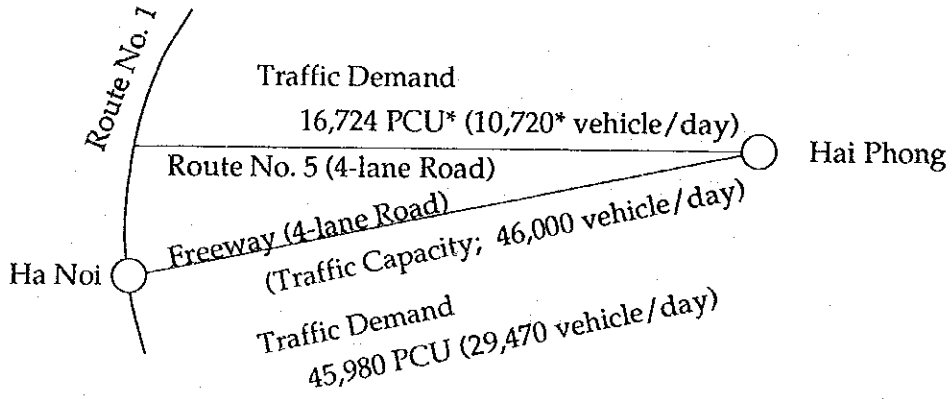
- Construction of four-lane sections along Route 5, parts of Routes 1, 2 and 18.
- High-order two-lane sections are to be rehabilitated in strategic corridors throughout the Red River Delta.
- Rehabilitation of currently deteriorated sections of Routes 2, 70 and 379 in strategic corridors throughout the North Mountain and Midland Region.
- Efforts should also begin throughout the North Mountain and Midland region, as well as the Red River Delta Area, for removal of major bottlenecks posed by bridges and other capacity constraints, particularly along Routes 1, 2, 3 and 70.

- Traffic Demand in Year 2000

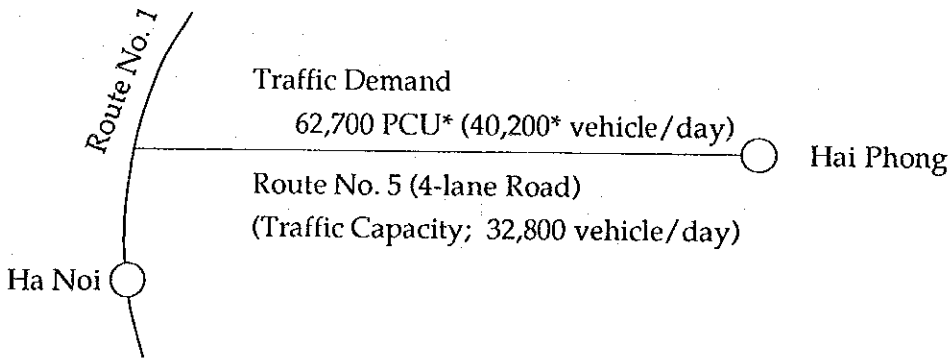


- Traffic Demand in Year 2010

With Freeway



Without Freeway



Note : Figure with asterisk includes the intra-province traffic demand.

Figure 4.4.4 Traffic Analysis of the Roadway Section from Ha Noi to Hai Phong

2) Long-Term Projects until Year 2010

- Construction of four-lane roads for parts of Route No. 1, 3, 6, 10, 18, 21 and 32.
- Expanded upgrading to high-order two-lane status, of routes No. 10, 21 and 286 in the Red River Delta.
- Broadscale rehabilitation and improvement of roads in the North Mountain and Midland Region.
- Provision of freeways in the heavily-traveled Ha Noi - Hai Phong as well as around Ha Noi's Eastern Flank (Outer Ring Road).
- Provision of freeway-class roads in the Ha Nam and Bac Giang corridors would depend upon (a) findings of subsequent preliminary engineering reviews as to whether identified Route 1 sections can be upgraded to a four-lane section within existing rights-of-way, or whether construction within a new alignment is required and (b) monitoring of actual developments, possibly via updates of the Study at five-year intervals, to ensure that forecast demand coincides with observed conditions.

The commitment to build a freeway system should be based not only on regional demands, but also on a broader philosophy of national unity. Thus, a North-South freeway spine with Ha Noi and Ho Chi Minh City as "anchors" carries many benefits, although the full implementation of such a system would extend far beyond the Study's planning horizon. The following freeway strategy appears plausible for the Northern Part of Vietnam:

- Committed by year 2010 : Partial Ha Noi Outer Ring Road (eastern crescent linking Routes 3 and 6) and Ha Noi - Hai Phong freeway. The importance of the latter corridor is confirmed via modeling tests which indicate that the corridor carries, under all scenarios, some 20 to 25 % of total PCU kilometers expended in the entire Study area.
- Committed beyond 2010 : Completion of Freeway from Ha Noi to Bim Son.

(3) Improvement of Pavement

Improvement and rehabilitation are required on the remaining national, provincial and district roads since some roads have not sufficient strength of pavement, because the pavement thickness is too shallow. Gravel and earth roads with sufficient traffic demand require new bituminous pavement. A pavement ratio target of 40 to 50 % is recommended for 2010, based on rehabilitation and improvement as shown in Table 4.4.2.

Table 4.4.2 Improvement of National, Provincial and District Roads in the Study Area

Road Classification	Road Length (km)	Present Paved Road		Improvement	Paved Road in 2010	
		Length (km)	Ratio (%)	Length (km)	Length (km)	Ratio (%)
National	5,461	2,886	52.8	1,747	4,633	85
Provincial	6,136	1,423	23.2	1,753	3,176	50
District	11,116	138	1.2	2,046	2,184	20
Total	22,713	4,447	19.6	5,546	9,993	44

4.4.2 Bridge Development Plan

(1) Urgent Bridge Improvement Projects

Table 4.4.3 shows the existing bridges on the main National Roads which are recommended to be improved as soon as possible.

Table 4.4.3 Urgent Project

National Road No.	Bridge Name	Location	Length (m)	Proposed Width (m)
1	Lang Nac	49 + 500	30	10.5
1	Met	86 + 900	106	10.5
1	Bac Giang	121 + 800	132	10.5 x 2
1	Dap Cau	136 + 600	173	10.5 x 2
2	Xuan Phuong	13 + 400	47	10.5 x 2
2	Ngoi He	191 + 100	53	7.0
3	Gian Tien 1	83 + 300	27	7.0
10	Nguyen	89 + 500	103	10.5

The above bridges have been selected because of one of the existing bridge conditions mentioned below:

- Poor loading capacity
- Narrow bridge width
- Rail-cum-road bridge with one lane carriageway
- Wooden slab

(2) Project for Construction of Long-Span Bridges

Among the 16 existing river crossings served by ferries, the 6 ferry services listed in Table 4.4.4 are recommended for replacement by bridges because of the transport demands forecast for these crossings.

Table 4.4.4 Long-Span Bridges Project

National Road No.	Name	River Width (m)	Clearance (m x m)	Bridge Length (m)	Bridge Width (m)
10	Dun	500	50 x 9	550	10.5 x 2
10	Kien	500	70 x 25	1,276	10.5 x 2
10	Tien Cuu	250	70 x 12	502	10.5
10	Quy Cao	560	50 x 9	616	10.5
10	Tan De	500	70 x 11	550	10.5 x 2
18	Lai	350	50 x 8	436	10.5 x 2

The existing route of National Road No. 10 between Hai Phong and National Road No. 18 should be diverted to the west in view of the best locations for river crossing by new bridges. Dun and Kien bridges are intended as substitutes for the existing ferry services at Rung and Binh respectively.

(3) Bridge Improvement and Rehabilitation

Table 4.4.5 shows bridges not less than 25 m long on the National Roads which are to be improved and rehabilitated, in addition to those designated for improvement in the urgent projects list

Table 4.4.5 Additional Bridges to be Improved and Rehabilitated

National Road No.	Improvement		Rehabilitation	
	No. of Bridge	Area (m^2)	No. of Bridge	Area (m^2)
1	11	13,494	3	3,683
1B	7	2,912	0	0
2	18	9,428	10	5,481
3	13	7,676	5	2,233
4A	7	1,666	1	833
4B	16	9,436	1	1,113
4C	1	242	3	541
4D	2	314	0	0
5	-	-	-	-
6	13	6,321	1	426
10	4	3,360	4	2,701
12	6	1,827	3	1,680
15	0	0	0	0
18	8	6,122	11	5,290
21	2	427	0	0
32	8	10,415	9	2,260
70	11	2,891	2	518
176/202	4	748	1	120
183	-	-	-	-
279	5	1,469	0	0
286	2	630	0	0
379	18	6,210	1	336